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Welcome and Acknowledgements
Daily Schedule
Program at a Glance
Hotel Floor Plan
Technical Session Schedule
Conference Abstracts

Congratulations!!!
AIPG 2015 National Awardees

Ben H. Parker Memorial Medal
David M. Abbott, Jr., CPG 4570
Denver, Colorado

Martin Van Couvering Memorial Award
James J. Jacobs, CPG 7760
Mill Valley, California

Award of Honorary Membership
Dennis Pennington, CPG 4401
Ambler, Pennsylvania

Outstanding Achievement Award
Karl E. Karlstrom
Albuquerque, New Mexico

Outstanding Achievement Award
Laura J. Crossey
Albuquerque, New Mexico
Welcome!

The Alaska Section welcomes you to the 52nd Annual AIPG National Meeting! This year’s meeting theme Fire and Ice embodies the powerful and juxtaposed forces that have shaped much of the Alaskan landscape. With majestic glaciers and volatile volcanoes, Alaska is the perfect backdrop for a gathering of geologists to learn, connect, and enjoy the beauty of the Last Frontier. To enrich your stay and participation, the Alaska Section has developed a fantastic field trip line up and technical session program to include some of the most experienced geologists and scenic destinations.

We hope that you will attend one of the many field trips that have been planned, but will also take advantage of your time in the Alaska to take in additional sights and activities on your own. And when you do, please stay safe; have a plan, communicate it, follow it.

On behalf of the Alaska Section, I would like to thank all of those with AIPG National that have made this meeting possible; Cathy Duran, Wendy Davidson, Dorothy Combs, Cristie Valero, Vickie Hill, and Interim Executive Director Bill Siok. To those with the Alaska Section that have been instrumental in the planning process over the last year, I want to extend my most heartfelt THANK YOU; without your dedication and hard work, this meeting would not be the same. Eric Cannon, Holly Weiss-Racine, Nick Van Wyck, Paul Pribyl, Keith Torrence, Anna Stanczyk, and Mark Lockwood – you’re all fantastic! So many others have also given their time and energy, especially our fearless field trip leaders; thank you for your time and dedication and for sharing your knowledge with others.

I would also like to offer a welcome to our guests from AIPG’s partner societies from Geoscientists Canada, AGI, and GSA, plus members from our wonderful local professional organizations. I am looking forward to meeting and greeting with as many of you as possible. Please enjoy your time here in Anchorage and wherever your Alaskan travels take you. Welcome!

Keri A. Nutter, CPG
2015 AIPG Annual Meeting Planning Committee Chair
AIPG Alaska Vice President
2015 AIPG National Advisory Board Representative
2015-2016 AIPG National Secretary-Elect
<table>
<thead>
<tr>
<th>Event</th>
<th>Thursday September 17</th>
<th>Friday September 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Conference Field Trip</td>
<td>Field Trip — Fairbanks, AK - Fort Knox Gold Mine and Permafrost Tunnel Tours (begin and end in Fairbanks) 8:00 am-6:00 pm</td>
<td></td>
</tr>
<tr>
<td>Breakfast (open to all registrants)</td>
<td>Top of the World (15th Floor) 7:00 am-8:30 am</td>
<td>Chart Room (15th Floor) 8:00 am-12:00 noon</td>
</tr>
<tr>
<td>AIPG Executive Committee Meeting (open to all registrants)</td>
<td></td>
<td>AIPG Awards Luncheon (open to all registrants)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AIPG Advisory Board Meeting (open to all registrants)</td>
</tr>
<tr>
<td>AIPG 2015-2016 Joint Executive Committee Meeting &amp; Business Meeting (open to all registrants)</td>
<td></td>
<td>AIPG 2015-2016 Joint Executive Committee Meeting &amp; Business Meeting (open to all registrants)</td>
</tr>
<tr>
<td>Foundation of the AIPG Meeting (open to all registrants)</td>
<td></td>
<td>Foundation of the AIPG Meeting (open to all registrants)</td>
</tr>
</tbody>
</table>

**Front Cover Photos**

#1-Byron Glacier Peak-Keri Nutter
#2-Denali National Park & Preserve-National Park Service
#3-Glacier-Nicole Geils and Visit Anchorage
<table>
<thead>
<tr>
<th>Event</th>
<th>Saturday September 19</th>
<th>Sunday September 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>2:00 pm-6:00 pm (2nd Floor)</td>
<td>7:30 am-5:00 pm (2nd Floor)</td>
</tr>
<tr>
<td>Exhibitor Set-Up</td>
<td></td>
<td>10:00 am-4:00 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Poster Set-Up</td>
<td></td>
<td>10:00 am-4:00 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>University of Alaska Anchorage (UAA) Geology Club Student Networking Event (open to all)</td>
<td></td>
<td>5:30 pm-6:30 pm Aspen (1st Floor)</td>
</tr>
<tr>
<td>Welcome Reception (open to all registrants)</td>
<td></td>
<td>6:30 pm-8:00 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Purchased Field Trips</td>
<td>See page 6 for Details</td>
<td>See page 6 for Details</td>
</tr>
</tbody>
</table>

Glacier-Photo Courtesy of Nicole Geils and Visit Anchorage
<table>
<thead>
<tr>
<th>Event</th>
<th>Monday September 21</th>
<th>Tuesday September 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>7:30 am-5:00 pm (2nd Floor)</td>
<td>7:30 am-3:00 pm (2nd Floor)</td>
</tr>
<tr>
<td>Breakfast (open to all registrants)</td>
<td>7:00 am-8:30 am Aleutian/Alaska (2nd Floor)</td>
<td>7:00 am-8:30 am Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Technical Sessions (open to all registrants)</td>
<td>8:00 am-5:00 pm (see pg 10 for the detailed schedule)</td>
<td>8:00 am-5:00 pm (see pg 16 for the detailed schedule)</td>
</tr>
<tr>
<td>Exhibits Open (to all registrants)</td>
<td>8:00 am-5:00 pm Aleutian/Alaska (2nd Floor)</td>
<td>8:00 am-3:30 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Morning Break (open to all registrants)</td>
<td>10:00-10:30 am Aleutian/Alaska (2nd Floor)</td>
<td>10:00-10:30 am Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Lunch (open to all registrants)</td>
<td>12:00-1:30 pm Aleutian/Alaska (2nd Floor)</td>
<td>12:00-1:30 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>Afternoon Break (open to all registrants)</td>
<td>2:45 pm-3:15 pm Aleutian/Alaska (2nd Floor)</td>
<td>2:45 pm-3:15 pm Aleutian/Alaska (2nd Floor)</td>
</tr>
<tr>
<td>AIPG Awards and Dinner (all welcome w/ additional fee)</td>
<td>6:30 pm-8:30 pm Top of the World (15th Floor)</td>
<td></td>
</tr>
<tr>
<td>Rockslide Rendezvous! (open to all registrants)</td>
<td>8:30 pm-10:00 pm Top of the World (15th Floor)</td>
<td></td>
</tr>
<tr>
<td>Purchased Field Trips</td>
<td>See page 7 for Details</td>
<td>See page 7 for Details</td>
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<tr>
<td>Saturday</td>
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<tr>
<td><strong>September 19</strong></td>
<td><strong>September 20</strong></td>
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<tr>
<td><strong>Registration</strong></td>
<td><strong>Registration</strong></td>
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<td>(2nd Floor)</td>
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<tr>
<td>2:00 pm-6:00 pm</td>
<td>7:30 am-5:00 pm</td>
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<tr>
<td><strong>2-Day Field Trip —</strong></td>
<td><strong>Field Trip — Matanuska</strong></td>
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<tr>
<td>Denali National Park</td>
<td>Glacier</td>
<td></td>
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<tr>
<td>and Usibelli Coal Mine</td>
<td>8:00 am-5:00 pm</td>
<td></td>
</tr>
<tr>
<td>6:00 am Saturday-8:30 pm Sunday</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Field Trip — Wishbone Hill, Palmer, Alaska</strong></td>
<td>University of Alaska Anchorage (UAA) Geology Club Student Networking Event (open to all)</td>
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<tr>
<td>8:00 am-6:00 pm</td>
<td>Aspen</td>
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<td>(1st Floor)</td>
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<tr>
<td></td>
<td>5:30 pm-6:30 pm</td>
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<tr>
<td><strong>Welcome Reception</strong></td>
<td>Exhibit Area Open (open to all registrants)</td>
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<tr>
<td></td>
<td>Aleutian/Alaska (2nd Floor)</td>
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<tr>
<td></td>
<td>6:30 pm-8:00 pm</td>
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</tbody>
</table>

* All trips will depart and return to the Hilton Anchorage Hotel. Transportation will be out the front lobby doors to the left on 3rd Avenue.

Turnagain Arm-Photo Courtesy of Nicole Geils and Visit Anchorage
| **Monday**  
| **September 21** | **Tuesday**  
| **September 22** |
| Registration  
(2<sup>nd</sup> Floor)  
7:30 am-5:00 pm | Registration  
(2<sup>nd</sup> Floor)  
7:30 am-3:00 pm |
| *Field Trip — Transect of the Mesozoic Subduction Complex, Southcentral Alaska*  
7:30 am-5:30 pm | *Field Trip — Turnagain Arm Geology Tour*  
8:00 am-5:00 pm |
| Technical Sessions  
(see Technical Session Schedule page 10)  
8:30 am-5:00 pm | *Field Trip — 1964 Great Alaska Earthquake: Geologic Causes and Effects*  
(begins in the King Salmon room - 2<sup>nd</sup> Floor)  
8:00 am-12:00 noon |
| Exhibits Open  
Aleutian/Alaska (2<sup>nd</sup> Floor)  
8:00 am-5:00 pm | Technical Sessions  
(see Technical Session Schedule page 16)  
8:00 am-5:00 pm |
| AIPG Awards and Dinner  
(all welcome with additional fee) - Top of the World (15<sup>th</sup> Floor)  
6:30 pm-8:30 pm  
Cash bar opens at 6:00 pm | Exhibits Open  
Aleutian/Alaska (2<sup>nd</sup> Floor)  
8:00 am-3:30 pm |
| Rockslide Rendezvous!  
Come and Share Your Musical Talents!  
Top of the World (15<sup>th</sup> Floor)  
8:30 pm-10:00 pm |  |

**Flattop**—Photo Courtesy of Roy Neese and Visit Anchorage
# Technical Sessions

### Plenary Session

- **Welcome**
  - Keri Nutter, CPG - AIPG Conference Chairman, AK Section Vice President

- **Christopher F. Waythomas, Ph.D., Alaska Volcano Observatory, U.S. Geological Survey, Anchorage, AK**
  - Fire and Ice in the Aleutian Arc: The Science of Volcano-Ice Interactions During Eruptive Activity in Alaska

### Poster Session Presentations - Aleutian/Alaska

**Monday, September 21, 2015**  
**10:00 am-10:30 am**

**Errors in Seismic Hazard Assessment are Creating Huge Human Losses**  
James Bela  
International Seismic Safety Organization, Portland, OR

**Assessment of Remaining Oil and Gas Potential Within the Desert Creek Formation of Papoose Canyon Field, Paradox Basin, Western Colorado**  
Jessica Davey, SA  
Metropolitan State University of Denver, Denver, CO

**Numerical Modeling of the Hydrothermal System at East Pacific Rise 9°50’N Including Anhydrite Precipitation**  
Kannikha Parameswari Kolandaivelu, SA  
Virginia Polytechnic Institute and State University, Blacksburg, VA

**Identifying, Characterizing and Cataloging of Surface Features of Ice Shelves in Dronning Maud Land, Antarctica**  
Ian Lee, SA  
University of Washington, Seattle, Seattle, WA
<table>
<thead>
<tr>
<th><strong>Poster Session Presentations - Aleutian/Alaska</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Geologic Highway Guides Across Eastern Alaska</strong></td>
</tr>
<tr>
<td>Warren J. Nokleberg</td>
</tr>
<tr>
<td>U.S. Geological Survey, Menlo Park, CA</td>
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<tr>
<td><strong>Using Specific Gravity to Determine the Solid Solution Variation of K⁺, or Na⁺ and Ca²⁺ in Feldspar Hand Samples</strong></td>
</tr>
<tr>
<td>Timothy Olson, SA</td>
</tr>
<tr>
<td>Metropolitan State University of Denver, Denver, CO</td>
</tr>
<tr>
<td><strong>Crude Oil Transportation Hazards</strong></td>
</tr>
<tr>
<td>Allison Richards, SA</td>
</tr>
<tr>
<td>Metropolitan State University of Denver, Denver, CO</td>
</tr>
<tr>
<td><strong>Identifying Chloride Sources to Austin-Area Stream Waters Using Stable Chlorine Isotopes</strong></td>
</tr>
<tr>
<td>Collin Roland, SA</td>
</tr>
<tr>
<td>Department of Geological Sciences, The University of Texas at Austin, Austin, TX</td>
</tr>
<tr>
<td><strong>Satellite and Ground-Based Geophysics for Monitoring Ice Conditions and Related Permafrost Beneath Shallow-Water Environments</strong></td>
</tr>
<tr>
<td>Christopher Stevens</td>
</tr>
<tr>
<td>SRK Consulting, Anchorage, AK</td>
</tr>
<tr>
<td><strong>Remote Aerial Photogrammetry to Map, Model and Document Rock Outcrops</strong></td>
</tr>
<tr>
<td>James R. Taylor, P.G., MEM</td>
</tr>
<tr>
<td>Taylor GeoServices, Newtown Square, PA</td>
</tr>
</tbody>
</table>

**Poster Presenters will be Available at their Posters Monday During the Morning Break**

**Student Poster Contestants will be Available at their Posters Monday During the Morning Break and also Monday Afternoon from 1:30 pm - 3:30 pm to Answer Judges’ Questions**
Monday, September 21, 2015 10:30 am-11:45 am

Session 1A - Denali Room

Mining

- Moderator - Doug Bartlett, CPG, AZ
10:30-10:55
Mining Works for Alaska: An Overview of Alaska’s Metal Mining Industry and Its Economic Impact
Karen Matthias - Council of Alaska Producers, Anchorage, AK

10:55-11:20
Lost River - A Major Fluorspar/Tin/Tungsten Project in Alaska
Steven Borell, P.E. - Borell Consulting Services LLC, Anchorage, AK

11:20-11:45
Rare Earth Element Mineralization in an Early Jurassic Peralkaline Intrusive Complex at Dora Bay, Southeast Alaska
Steve Buckley, CPG - Sealaska, Juneau, AK

Session 1B - Dillingham/Katmai Room

Hydrology/Groundwater/Surface Water

- Moderator - Christine Lilek, CPG, WI
10:30-10:55
Geologists’ Role in Evaluating Vocs from Illegal Drug Labs, Industrial Wastes and Household Cleaners in Sewer Air
James Jacobs, CPG - Clearwater Group, Point Richmond, CA

10:55-11:20
Generalized Responses of Fractured Rock Aquifers to Anthropogenic and Climatic Perturbations
Donald M. Reeves - University of Alaska Anchorage, Department of Geological Sciences, Anchorage, AK

11:20-11:45
Development and Feasibility of an Automated Percolation Tester for Infiltration and Waste Water Disposal System Assessments
Uwe Kackstaetter, MEM - Metro State University of Denver, Denver, CO
**Monday, September 21, 2015**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 2A - Denali Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30-1:55</td>
<td><strong>Earthquake and Tsunami Hazards</strong> • Moderator - Eric Cannon, CPG, AK</td>
</tr>
<tr>
<td></td>
<td><em>Anticipating the Next Big Earthquake in Alaska</em> Michael West - University of Alaska Fairbanks, Fairbanks, AK</td>
</tr>
<tr>
<td>1:55-2:20</td>
<td><em>Tsunami Modeling and Inundation Mapping in Alaska</em> Dmitry Nicsolky - Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK</td>
</tr>
<tr>
<td>2:20-2:45</td>
<td><strong>Destructive Potential of Breaking Solitary Waves</strong> Roberto Marivela Colmenarejo, SA - Virginia Tech, Roanoke, VA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 2B - Dillingham/Katmai Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30-1:55</td>
<td><strong>Professional/Legal/Environmental</strong> • Moderator - Jean Neubeck, CPG, NY</td>
</tr>
<tr>
<td></td>
<td><em>Removal of Hydraulic Fracturing Fluids From Petroleum Wastewater Using Sorption Techniques</em> Damy Alalade - Ball State University Graduate Student, Muncie, IN</td>
</tr>
<tr>
<td>1:55-2:20</td>
<td><strong>Successful Environmental Liability Risk Transfer Deals? The Environmental Consultants Perspective</strong> David Heidlauf, CPG - Ramboll Environ, Chicago, IL</td>
</tr>
</tbody>
</table>

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**Luncheon Keynote Speaker**

Dr. David Applegate, MEM, Associate Director for Natural Hazards, U.S. Geological Survey, Reston, VA

**Making Hazards Real: How Science Enables Action Before and After Disaster Strikes**

Aleutian/Alaska Room 12:00 noon-1:15 pm
### Technical Sessions

**Session 3A - Denali Room**

**Monday, September 21, 2015**  
3:15 pm - 4:55 pm

#### Geology and Topography-Alaska and Western North America

- **Moderator - David Pyles**, CPG, IL

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Description</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:40-4:05</td>
<td>Transgressions on Alaska’s North Slope</td>
<td>Susan Wilson, MEM - Golder Associates Inc., Anchorage, AK</td>
</tr>
<tr>
<td>4:05-4:30</td>
<td>Quaternary Geology of Anchorage, Alaska</td>
<td>Eric Cannon, CPG - Golder Associates Inc., Anchorage, AK</td>
</tr>
<tr>
<td>4:30-4:55</td>
<td>Managing and Distributing Large Elevation Datasets in Alaska</td>
<td>Mike Hendricks - Alaska Division of Geological &amp; Geophysical Surveys, Fairbanks, AK</td>
</tr>
</tbody>
</table>

*Byron Glacier Peak-Photo Courtesy of Keri Nutter*
Technical Sessions

Session 3B - Dillingham/Katmai Room

Monday, September 21, 2015  3:15 pm-4:55 pm

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:15-3:40</td>
<td>Comparison of Some CPD Programs</td>
<td>David Abbott, CPG - Consulting Geologist, Denver, CO</td>
</tr>
<tr>
<td>3:40-4:05</td>
<td>Canada's Competency Profile for the Profession of Geoscience - Outcome at the End of a Long Journey</td>
<td>Oliver Bonham - Geoscientists Canada, Burnaby, BC, Canada</td>
</tr>
<tr>
<td>4:05-4:30</td>
<td>Educational and Professional Standards for a Global Profession: Information Developed as Part of the IUGS Task Group on Global Geoscience Professionalism (TG-GGP)</td>
<td>Barbara Murphy, CPG - Clear Creek Associates, Scottsdale, AZ</td>
</tr>
<tr>
<td>4:30-4:55</td>
<td>Global Geoscience Professionalism - Building a More Connected Professional Community, the Role of Professional Geoscience Organizations and the Emerging Study of Geoethics - “Some Points of Focus at TG-GGP”</td>
<td>Oliver Bonham - Geoscientists Canada, Burnaby, BC, Canada</td>
</tr>
</tbody>
</table>

Anchorage City Skyline - Photo Courtesy of Jody Overstreet and Visit Anchorage
<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
<th>Institution/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-8:25</td>
<td>Frozen In Time - A Paleochannel Gold Placer Deposit on an Alaskan Mountain Top is Discovered and Explored</td>
<td>Dennis Stacey</td>
<td>ALMINCO LLC, Anchorage, AK</td>
</tr>
<tr>
<td>8:25-8:50</td>
<td>Coal Resource and Development Potential for the Raton Mesa, Denver, Cañon City and South Park Coal Regions in Colorado</td>
<td>Laurie Brandt</td>
<td>DOWL, Montrose, CO</td>
</tr>
<tr>
<td>8:50-9:15</td>
<td>Directional Drilling for Mine Water Supply Development</td>
<td>Rick Smith</td>
<td>AECOM, Tucson, AZ</td>
</tr>
<tr>
<td>9:15-9:40</td>
<td>Open Pit Mine Scheduling with Variants on Inventory Considerations</td>
<td>Mojtaba Rezakhah</td>
<td>Golden, CO</td>
</tr>
<tr>
<td>9:40-10:05</td>
<td>Geotechnical Instrumentation: Monitoring Longitudinal Stress of a High Pressure Pipeline During Longwall Mining Operations - A Case Study in West Virginia</td>
<td>Martin Derby</td>
<td>Applus RTD, Buffalo, NY</td>
</tr>
</tbody>
</table>

*Student Poster Contest Results will be Announced Tuesday at the Morning Break in the Aleutian/Alaska Room*
### Session 5A - Denali Room

**Tuesday, September 22, 2015 10:30 am-11:45 am**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30-10:55</td>
<td>Development of a Competitive Undergraduate Geoscience Degree Program by a Teaching Institution of Higher Education with Limited Resources</td>
<td>Uwe Kackstaetter, MEM - Metro State University of Denver, Denver, CO</td>
</tr>
<tr>
<td>11:20-11:45</td>
<td>Value of International Geologic Field Experience for Emerging Undergraduate Geoscientists</td>
<td>Uwe Kackstaetter, MEM - Metro State University of Denver, Denver, CO</td>
</tr>
</tbody>
</table>

#### Luncheon Keynote Speaker

**Greg Wilson**, Director of Arctic Exploration and Services, ConocoPhillips, Anchorage, AK  
**Inspiration in Times of Challenge: Retracing the Steps of Pioneers in North Alaska Geology**  
Aleutian/Alaska Room 12:00 noon-1:15 pm
### Session 6A - Denali Room

#### Permafrost/Cold Regions/Arctic

**Moderator - Keri Nutter, CPG, AK**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenter</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30-1:55</td>
<td>Challenges of Contaminated Site Remediation in the Arctic; Twenty Five Years of Studies at the Former Naval Arctic Research Laboratory in Barrow, Alaska</td>
<td>Keith Torrance, CPG - UMIAQ, LLC, Anchorage, AK</td>
<td></td>
</tr>
<tr>
<td>2:20-2:45</td>
<td>Geotechnical Aspects of Saline Permafrost and Cryopegs</td>
<td>Nikolay Volkov - Fugro Consultants, Inc., Houston, TX</td>
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</tr>
</tbody>
</table>

### Session 6B - Dillingham/Katmai Room

#### Engineering and Field Geology

**Moderator - David Crotsley, MEM, AK**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenter</th>
<th>Institution</th>
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<tbody>
<tr>
<td>1:30-1:55</td>
<td>Geotechnical Recon, Drilling, and Runway Construction in Western Alaska</td>
<td>Craig Boeckman, CPG - Alaska Department of Transportation, Anchorage, AK</td>
<td></td>
</tr>
<tr>
<td>1:55-2:20</td>
<td>Site Characterization Requirements for Segmental Retaining Wall Design</td>
<td>Kevin Earley, CPG - Anchor Wall Systems, Collegeville, PA</td>
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### Technical Sessions

**Tuesday, September 22, 2015**

**Session 7A - Denali Room**

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<td>Michelle Ozarowski, YP - South Dakota School of Mines &amp; Technology, Rapid City, SD</td>
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<td>Subsurface Interpretation of the Great Plains Oil and Natural Gas Field in Lincoln County, Colorado</td>
<td>Allison Richards, SA - Metropolitan State University of Denver, Denver, CO</td>
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**Thank You for Attending!**

**Safe Travels Home!**

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*Moose-Photo Courtesy of Wayde Carroll and Visit Anchorage*
Conference Abstracts

(Alphabetical According to Lead Presenter)

2015 Fire & Ice

Conference Presented by
American Institute of Professional Geologists
(AIPG)
AIPG Alaska Section
COMPARISON OF SOME CPD PROGRAMS

David Abbott, CPG, Consulting Geologist, Denver, CO, damageol@msn.com

Most geoscience professional ethics codes encourage geoscientists to engage in continuing professional development (CPD). Some geoscience professional organizations require members to engage in a minimum amount of CPD to maintain a particular membership status and others are considering whether to do so. Eight of the 30 Association of State Boards of Geology require some amount of CPD in order to maintain a professional or registered geologist’s license. This paper reviews the CPD requirements of several required CPD programs identifying common requirements and reporting systems and can serve as a model for a required CPD program. Generally contact hours are the basic reporting unit and CPD programs provide 6 to 8 activity areas for reporting hours. Some activity areas are weighted providing an increase or decrease from reported contact hours to reportable CPD hours. Maximum or minimum amounts of reportable CPD hours in particular activities are required. For example, a minimum amount of professional ethics may be required. Some CPD programs require reporting of professional practice hours in addition to continuing education hours (generally on a weighted basis). Some CPD programs require annual CPD minimums while others require that the required minimum be met over a 3-year period or on a 3-year rolling average basis. Some CPD hours acquired in excess of a year’s minimum requirement can be carried forward to the succeeding year. A proposed model CPD system and associated Xcel™ reporting form requires that an average of 50 CPD hours per year be reported within a 3-year period and does not include reporting of professional practice hours. Use of this model form provides a record that should be accepted by most professional organizations requiring CPD reporting with little or no additional reporting (generally professional practice hours) being required.

REMOVAL OF HYDRAULIC FRACTURING FLUIDS FROM PETROLEUM WASTEWATER USING SORPTION TECHNIQUES

Damy Alalade, Ball State University Graduate Student, Muncie, IN, alaladeoludamilola@gmail.com

Hydraulic fracturing is a drilling method that uses large volumes of high-pressure, chemically treated water to free oil and natural gas trapped deep in underground strata. The chemical-enriched water and some groundwater are recovered from the well along with oil and gas. Major disadvantag-
es of hydraulic fracturing are that it requires millions of gallons of relatively clean water, and the process may impart significant impacts on local ecosystems (e.g., water loss and pollution). Additionally, a common disposal method of petroleum-related wastewater is deep well injection, which is a costly and ineffective solution. Alternatively, petroleum-related wastewater is evaporated in open pits. Water recycling is not a mainstream practice among oil and gas companies because the procedure is expensive and, until recently, most oil and gas companies ‘disposed’ of all wastewater, i.e., it was treated as a waste. Presently, some companies are treating the wastewater to use again for drilling. Recycling of hydraulic fracturing water is an engineering best practice and the proposed research project focuses on water recycling/cleaning techniques using sorption processes. Specifically, this research will test different sorbent materials for their effectiveness in removing synthetic fracturing fluids from water. Different fracturing fluid formulations will be prepared and reacted with selected sorbent materials (both natural and synthetic). The resultant fracturing fluid leachate will be tested for both toxicity and chemical properties. The proposed study may be of significant practical value to oil and gas production industries.

ERRORS IN SEISMIC HAZARD ASSESSMENT ARE CREATING HUGE HUMAN LOSSES

James Bela, International Seismic Safety Organization, sasquake@gmail.com

The current practice of representing earthquake hazards to the public based upon their perceived likelihood or probability of occurrence is proven now by the global record of actual earthquakes to be not only erroneous and unreliable but also too deadly!

More than 700,000 people have now lost their lives (2000-2011), wherein 11 of the World’s Deadliest Earthquakes have occurred in locations where probability-based seismic hazard assessments had predicted only low seismic hazard.

Unless seismic hazard assessment and the setting of minimum earthquake design safety standards for buildings and bridges are based on a more realistic deterministic recognition of “what can happen” rather than on what mathematical models suggest is “most likely to happen,” such future huge human losses can only be expected to continue!

The actual earthquake events that did occur were at or near the maximum potential-size event (MCE) that either already had occurred in the past; or were geologically known to be possible.
Haiti’s M 7 earthquake, 2010 (with > 222,000 fatalities) meant the dead could not even be buried with dignity. Japan’s catastrophic Tohoku earthquake, 2011; a M 9 Megathrust earthquake, unleashed a tsunami that not only obliterated coastal communities along the northern Japanese coast, but also claimed more than 20,000 lives. This tsunami flooded nuclear reactors at Fukushima, causing 4 explosions and 3 reactors to melt down.

But while this history of huge human losses due to erroneous and misleading seismic hazard estimates, despite its wrenching pain, cannot be unlived; if faced with courage and a more realistic deterministic estimate of “what is possible”, it “need not be lived again.”

An objective testing of the results of the GSHAP global probability-based seismic hazard maps, against real earthquake occurrences, has never been done by GSHAP team participants; even though the obvious inadequacy of the GSHAP maps could have been established in the course of a simple check beforehand.

**GEOTECHNICAL RECON, DRILLING, AND RUNWAY CONSTRUCTION IN WESTERN ALASKA**

**Craig Boeckman, CPG, Alaska Department of Transportation, Anchorage, AK, craig.boeckman@alaska.gov**

Alaska Department of Transportation & Public Facilities (ADOT&PF) constructed a new runway in Chefornak, Alaska. Chefornak is a small village in western Alaska that is only accessible by small plane or by boat. The village is located on the south bank of the Kinia River that drains Dall Lake into Etolin Strait. The village is within the Clarence Rhode National Wildlife Refuge that was established for migratory waterfowl protection. ADOT&PF performed reconnaissance for a local rock source in this area to use as surfacing on a recently constructed runway embankment. No rock source had previously been identified in the area. Reconnaissance identified a potential rock source near the project. Follow-on drilling proved the source to contain usable and good quality rock. This presentation will review the reconnaissance, drilling, and construction associated with this rock source.
CANADA’S COMPETENCY PROFILE FOR THE PROFESSION OF GEO SCIENCE - OUTCOME AT THE END OF A LONG JOURNEY

Oliver Bonham, Geoscientists Canada, Burnaby, BC, Canada, obonham@geoscientistscanada.ca

In September 2012, Geoscientists Canada received funding from the Government of Canada’s Foreign Credentials Recognition Program for a 30 month project to carry out four interrelated initiatives in the area of admissions support for its members - the provincial/territorial professional bodies that regulate geoscience practice in Canada. The central and largest initiative involved the development of a competency profile for the geoscience profession. The project concluded in March 2015.

Competencies are defined by the Canadian Information Centre for International Credentials as "a set of knowledge, skills and abilities obtained through formal or non-formal education, work experience or other means, required to perform an occupation at the point of entry to a profession".

A key rationale for development of a competency profile is the move by professions both in Canada and around the world, away from traditional credentials-based admissions assessments towards systems based on a combination of academic outcomes and practice skills.

Work on the resulting profile was completed in 2014 with the release of the document “Competency Profile for the Professional Geoscientists at Entry to Practice” in June 2014.

This talk will describe the approach taken to develop the profile, including: 1) input from Subject Matter Experts - practicing geoscientists representing a diverse sampling of the profession; 2) extensive consultation and refinement, and 3) a validation procedure. It will also summarize the profile’s structure and its key components.

Subsequent work will determine specific indicators of proficiency related to each competency that an individual is expected to demonstrate in order to become a P.Geo. and suggest appropriate methodologies to assess competencies.

Oliver Bonham, Geoscientists Canada, 200-4010 Regent St., Burnaby, BC, Canada, V5C 6N2, obonham@geoscientistscanada.ca; Ruth Allington, European Federation of Geologists, Brussels, Belgium

In 2012, the International Union of Geological Sciences (IUGS) formed the Task Group on Global Geoscience Professionalism (“TG-GGP”) to bring together the expanding network of organizations around the world whose primary purpose is self-regulation of geoscience practice. TG-GGP was also formed to foster a new “connecting up” of geoscience globally, around the concerns common to academia, industry, and government service: competence, ethics and professional accountability.

This talk will expand on some of the key points of focus of TG-GGP at present. It will summarize the status of self-regulation of geoscience around the World, and the role of the professional geoscience organizations in fostering professionalism, handling complaints and imposing professional discipline. It will also explore how the emerging academic study of geoethics might best inform, and be informed by, the promotion and support of competent, professionally accountable and ethical geoscience practice.

Codes of Ethics, to which all registered professionals are bound, incorporate such traditional tenets as: safeguarding the health and safety of the public, scientific integrity, and fairness. Codes also increasingly include obligations concerning welfare of the environment and sustainability.

While legal regimes for the oversight of professions differ around the world, principles of peer-based self-regulation universally apply. This makes professional organizations ideal settings for geoscientists to openly consider what Society should expect of us in the range of roles we fulfill. They also provide the structures needed to best determine what expectations, in the public interest, are appropriate for us to collectively impose on each other as fellow professionals.

This talk will draw from an earlier presentation by the authors given at the American Geophysical Union Joint Assembly, in...
After more than three decades in bankruptcy, the Lost River Fluorspar/Tin/Tungsten project located 120 km northwest of Nome, Alaska is again available for development.

Lost River contains a pre-NI43-101 reserve of 30 million proven tonnes grading 17% CaF₂ (Fluorspar), 0.19% Sn (Tin), and 0.03% WO₃ (Tungsten). Contained within these reserves is a zone of 6 million tonnes grading 21% CaF₂, 0.22% Sn, and 0.03% WO₃.

Lost River was extensively evaluated from 1969 to 1976 with $9 million spent [over $60 million in 2015 dollars] but due to protracted bankruptcy proceedings of the previous owner, no recent work or current NI43-101 report has been completed. Although gold is known to be present in the underlying pluton, historic drill core was not analyzed for gold due to the then price of $35/oz. A few samples were analyzed for Indium which was identified but not quantified.

The previous feasibility study determined that with a strip ratio of 1:1, the deposits were ideally suited for low cost open pit mining for 20 years at a mill process rate of 4,000 tonnes per day. Pilot scale testing showed recoveries of 85% CaF₂, with 75% of that acid grade and 25% metallurgical grade. Very little work was focused on recoveries of Tin and Tungsten. The project area has significant potential for additional reserves, including potential for gold and silver.

Lost River is located 10 km from tidewater, 20 km west of Port Clarence, and extensive bathometric and port studies have been completed throughout the coastal area. The Alaska Industrial Development and Export Authority (AIDEA) has expressed interest in issuing bonds for the port and road infrastructure. The private owner of this project, Greatland Exploration Ltd, is looking to sell the project and estimates the total cost of acquisition and construction of a 4,000 t/d mine, mill, road, expanded airfield and port would be in the range of $200 million.
Abstracts

COAL RESOURCE AND DEVELOPMENT POTENTIAL FOR THE RATON MESA, DENVER, CAÑON CITY AND SOUTH PARK COAL REGIONS IN COLORADO

Laurie Brandt, CPG, DOWL, 222 South Park Ave., Montrose, CO, lbrandt@dowl.com

The BLM’s Royal Gorge Field Office (RGFO) in Cañon City, Colorado has a Planning Area that includes the eastern two-thirds of the state and they manage 3.9 million acres of Federal mineral estate within that area. As part of the BLM’s Resource Management Plan, their coal resource and development potential was studied. Within the RGFO Planning Area there are four coal regions: Raton Mesa, Denver, Cañon City and South Park. These four regions are all located along or near the Front Range and are post-Laramide structural basins with late Cretaceous to Paleocene coal and lignite. The Denver Region (including the Denver and Cheyenne Basins) and the small South Park Region to the southwest, contain Laramie Formation subbituminous coal and the Denver Basin also contains a significant amount of Denver Formation lignite. The Cañon City and Raton Mesa Coal Regions contain Vermejo Formation bituminous coal and the Raton Basin also contains Raton Formation bituminous coal. Of the four regions, Raton Mesa, which has over 140 years of coal mining history, has a large and desirable coking coal resource in the Trinidad Coal Field due to the Tertiary Spanish Peaks intrusions which increased the rank of the coal to coking quality.

Despite most of the coal being high energy (BTU) and compliant to super-compliant, low sulfur coal or coking coal, there are a number of factors that limit the development of the resource. Although longwall mining methods have successfully been used in portions of the Raton Basin, which also extends into northern New Mexico, most coal beds are relatively thin and lenticular and would require room and pillar methods, providing less recovery. Some other factors limiting development include coalbed methane and conventional natural gas production, urban development, conversion of many coal-powered steam plants to natural gas, reduced demand for steam and coking coal, competition with other Colorado coal with thicker and more continuous coal beds, and lack of transportation and processing infrastructure. Because the Raton Basin produces the highest quality coking coal in the west, this resource has the greatest development potential for metallurgical coal used primarily for non-domestic steel production.
RARE EARTH ELEMENT MINERALIZATION IN AN EARLY JURASSIC PERALKALINE INTRUSIVE COMPLEX AT DORA BAY, SOUTHEAST ALASKA

Steve Buckley, CPG, Sealaska, One Juneau Plaza, Juneau, AK 99801, steve.buckley@sealaska.com; Cliff D. Taylor, United States Geological Survey, Denver, CO; Leonid A. Neymark, United States Geological Survey, Denver, CO; Christopher S. Holm-Denoma, United States Geological Survey, Denver, CO; Sarah A. Bala, Department of Earth and Atmospheric Sciences Metro State University of Denver, Colorado

Southeast Alaska could be an important domestic source of critical Heavy Rare Earth Elements (HREE). The mineralization is associated with Early Jurassic peralkaline intrusive rocks of the Alexander Terrane on southern Prince of Wales Island. The Alexander Terrane is an island arc sequence of Late Proterozoic to Jurassic rocks that were accreted to the western margin of North America during the Jurassic to Early Cretaceous. Two main peralkaline intrusive complexes are found on southern Prince of Wales Island. The Bokan Mountain deposit is undergoing active exploration drilling by Ucore Rare Metals and is entering feasibility stage. The Dora Bay intrusive complex (DBIC), located 30 km to the north, has had little exploration work over the years mainly due to limited access and land status uncertainty in the area. The DBIC area contains a mix of USFS, Alaska Native Village Corporation surface ownership, underlain by the subsurface mineral estate of Sealaska, the Alaska Native Regional Corporation for southeast Alaska.

Recent work has shown that magmatism at Bokan Mountain and DBIC is broadly coeval (~177 and ~184 Ma, respectively, within error) and possibly co-genetic, and consists of A-type, within plate alkaline granites and syenites, which may be the result of strike-slip pull-apart basin rifting. Isotopic and geochemical characteristics suggest a primitive or juvenile magma source. At the DBIC, HREE mineralization occurs in late-stage, coarse grained pegmatites and dikes (dated at ~179 Ma) within a complex suite of over 20 associated REE-bearing zirconosilicate, phosphate, and carbonate minerals. A joint program will be conducted in 2015 between Sealaska and the USGS, designed to better define the extent of the mineralization at Dora Bay and more fully understand the process of HREE enrichment in peralkaline granites.
QUATERNARY GEOLOGY OF ANCHORAGE, ALASKA

Eric Cannon, CPG, Golder Associates Inc., 2121 Abbott Road, Suite 100, Anchorage, AK, ecannon@golder.com

The largest city in the State of Alaska, Anchorage is surrounded by dramatic examples of Quaternary geology. In this presentation, I will provide an introduction to the geology of the Anchorage area, focusing on the Quaternary Period, based on key findings from researchers, plus observations from my own experiences in the area as an Engineering Geologist. The geologic framework of the Anchorage area is a function of the active plate margin setting, Quaternary glacial activity, and sedimentary deposits. Active deformation across much of Alaska is influenced by the northwestward subduction of the Pacific oceanic plate beneath continental North America, along with the collision and partial subduction of the Yakutat microplate along the southern coast. The 1964 moment magnitude (M_w) 9.2 Great Alaska Earthquake resulted from slip on the Alaska-Aleutian megathrust in the subduction zone. The Anchorage area is located within an area of active transpression, with crustal fault sources consisting of strike-slip and reverse faults, and fault-related folds. In addition, earthquakes are generated along the subduction zone interface, and as intraslab events within the subducting plate. Extensive Quaternary glaciations have modified the active Alaskan plate margin. Several glacial episodes have occurred in the Quaternary, with the final late Quaternary glacial episode represented by the Elmendorf moraine, located to the north of downtown Anchorage. The Quaternary glacial advances and retreats have left a complex series of sedimentary deposits throughout the Cook Inlet region. Surficial deposits in the Anchorage area include glacial drift, glacial outwash, glaciomarine and glaciodeltaic, alluvial, colluvial, and modern tidal flat deposits. One of the most significant sedimentary deposits is the Bootlegger Cove Formation, composed primarily of silts and clays deposited in glaciomarine and glaciodeltaic environments prior to the Elmendorf glaciation. Deformation within the Bootlegger Cove Formation was largely responsible for many of the landslide failures in the 1964 M_w 9.2 Great Alaska earthquake.
EFFECTS OF THE BOULDER COUNTY COLORADO 2013 FLOOD ON GEOLOGIC FEATURES

Jessica Davey, SA, Metropolitan State University of Denver, 4585 Zuni Street, Denver, CO, fester@msudenver.edu; Barbara EchoHawk, PhD, Metropolitan State University of Denver, Denver, CO

Boulder County was the focus of the 2013 Flood of northern Colorado. As a result of record-setting stream flooding, a wide variety of geologic features were altered or created. Channel scouring and migration exposed new bedrock outcrops, and deposits from multiple previous floods were exposed by incision into stream banks and floodplains. Stream channels were deepened, widened, and in many locations permanently rerouted. Within the channels and on floodplains previous bedforms and deposits were altered or destroyed and new bedforms were deposited. The full stratigraphic section of Boulder County is exposed on various properties of Boulder County Parks and Open Space (BCPOS) that were extensively impacted by the 2013 Flood. Although BCPOS is actively working to mitigate flood damage, a great deal of the original destruction is still visible in the parks along the foothills and plains of Boulder County. The summer of 2014 was spent cataloging, measuring, photographing, and obtaining GPS coordinates for mapping of some of these features in BCPOS. One finding of this research is that geologically significant features, such as Permian stromatolites newly exposed by the flooding, are subject to rapid alteration or destruction by normal stream processes and sub aerial exposure. A second key finding is that the area has been affected by multiple prehistoric floods and debris flows, as evidenced by stacked flood deposits exposed by new stream cutting. Estimates of maximum flow in cubic feet per second (cfs) for the 2013 Flood event as well as prehistoric flood events have been calculated from types and sizes of flood-transported clasts and drainage cross-sectional measurements at one location within BCPOS. This study will provide BCPOS with a catalog of change in geologic features resulting from the 2013 Flood, with data on how quickly newly created or exposed features are being degraded and with evidence for repeated significant flood events along Boulder County foothills.
ASSESSMENT OF REMAINING OIL AND GAS POTENTIAL WITHIN THE DESERT CREEK FORMATION OF PAPOOSE CANYON FIELD, PARADOX BASIN, WESTERN COLORADO

Jessica Davey, SA, Metropolitan State University of Denver, 4585 Zuni Street, Denver, CO, fester@msudenver.edu; Barbara EchoHawk, PhD, Metropolitan State University of Denver, Denver, CO

Since 1970, oil and gas have been produced from Papoose Canyon Field, located in Dolores County, Colorado. A 2005 government study concluded that the field is nearly exhausted of oil and gas resources. However, new technologies, such as directional drilling paired with hydraulic fracturing, have led to the rejuvenation of numerous long-established oil and gas fields. In light of this trend of renewed production in older fields, this undergraduate research investigation was undertaken in order to identify and characterize the potential for future oil and gas production from the Desert Creek Formation within Papoose Canyon Field. As a result of Pennsylvanian sea transgression, algal mounds formed as shallow water coastal deposits within the lower portion of the Desert Creek Formation. The algal mounds were subsequently encased by shale layers, which were the source rocks for these oil and gas stratigraphic traps. Commercial production of oil and gas began in Papoose Canyon Field in 1970 with the discovery of the Desert Creek pay zone at a depth of 6,194 feet below ground level at the #1 Pribble-Govt well, located at NENE Section 31-T39N-R19W, Dolores County, Colorado. Based on the well logs from this field, the pay zone within the Desert Creek Formation was occasionally missed, as the geologist and/or drill team apparently misjudged the depth of the target zone while drilling. Subsequently, drillstem tests at these locations were not performed in the known pay zone. The porosity and resistivity logs of these well bores indicate the presence of hydrocarbons within the pay zone. This study of Papoose Canyon Field includes: subsurface structural maps of the Pennsylvanian Gothic Shale, Desert Creek Formation, and Chimney Rock Shale; an isopach of the Desert Creek pay zone; and two cross-sections depicting lateral and vertical variation within the Desert Creek pay zone. These maps and cross-sections have aided in a better understanding of the relationship between pay zone thickness, structure, and productivity. This research project has identified wells with potential bypassed production and a number of infill locations for future drilling.
GEOTECHNICAL INSTRUMENTATION: MONITORING LONGITUDINAL STRESS OF A HIGH PRESSURE PIPELINE DURING LONGWALL MINING OPERATIONS – A CASE STUDY IN WEST VIRGINIA

Martin P. Derby, P.G., CPG, Applus RTD, Buffalo, NY, martin.derby@applusrtd.com

Longwall mining operations could compromise the integrity of high pressure pipelines by the way of surface subsidence and soil strains. Prior to implementing field programs for monitoring subsidence, a preliminary mitigation/stress analysis study should be designed to determine the possible effects of the longwall mining operations on the pipeline(s). If the mitigation plan/stress analysis plan indicates possible pipeline integrity issues, then a strain monitoring program should be implemented.

The purpose of this presentation is to discuss the design of a pipeline strain monitoring program, which includes the installation of strain gages at critical locations along two adjacent pipelines. The study area includes a 12 inch diameter steel pipeline (for oil/gas transport) and a 12 inch HDPE pipeline for water transport. The study area is located in a mountainous region of West Virginia.

Prior to the field program, a laboratory pilot study was performed with strain gages on a test section of HDPE pipe to determine the best mounting procedures. The field implementation program included the installation of strain gages on the gas and water pipelines. Multiplexers, data loggers, a solar array and a satellite modem for 24/7 data transfer were installed and monitored throughout the study. During the field implementation program several meteorological and geologic events occurred which caused some design changes in the field program.

The presentation will include the following topics: the preliminary stress analysis for mitigating effects of subsidence on high-pressure pipeline; design of a field monitoring program; laboratory research; field implementation; data retrieval/acquisition; and data analysis.
SITE CHARACTERIZATION REQUIREMENTS FOR SEGMENTAL RETAINING WALL DESIGN

Kevin Earley, CPG, Anchor Wall Systems, 3025 Fairhill Dr., Collegeville, PA, kearley@anchorwall.com

Use of mechanically stabilized earth (MSE) retaining structures, particularly segmental retaining walls (SRW), is one of the best options on the market today to address grade changes for land development due to their affordability and aesthetic value. SRW concrete blocks come in a variety of textures, sizes and colors and can be used for small and large retaining wall applications. Because they are “mortar-less”, light weight, and easy to stack and install, they have become very popular in commercial development and provide engineered solutions for walls, sometimes in excess of fifty feet in height. Industry design and construction guidelines established by the National Concrete Masonry Association (NCMA) provide recommendations for SRW designers and include criteria for a geotechnical investigation to characterize site conditions and soil properties. Catastrophic SRW failures are rare, and are generally related to improper design and construction. Failure factors such as improper site drainage and excessive hydrostatic pressures can be mitigated if a proper site characterization is conducted. Geotechnical professionals should be versed in the basics of SRW construction and the site specific parameters obtained through proper characterization so that reinforced earth walls perform as designed.

Collecting representative site soil samples for laboratory analysis should be part of any geotechnical investigation when earth retaining structures are proposed. The minimum information to be provided within the geotechnical report include: soil description and classification, particle size gradation, moisture content, Atterberg limits, strength (friction angle), and density (unit weight). Understanding the on-site material to be used as foundation and backfill material is critical to the SRW designer. Unfortunately, these soil properties are often assumed even when laboratory methods are readily available and inexpensive.

Existing and proposed site drainage features should also be evaluated in the context of the SRW locations to prevent wall failures. Sources of groundwater should also be investigated. In cut wall situations there may be seams that could be flow channels for groundwater to interfere with the MSE structure requiring a chimney drain. Shallow groundwater in the foundation soil may also require additional drainage elements. Information about the site hydrology is critical to the SRW designer. Finally, a complete geotechnical report should address existing and proposed site slope conditions, global stability recommendations, bearing capacity, settlement potential and
Abstracts

Developers have traditionally deferred the expense associated with a complete SRW design until the low bid installer is identified. This design/build process often challenges the project team when the site geotechnical investigation may not provide accurate soil characteristic properties specific to the SRW locations. This paper reviews the basic components of SRW design and construction and describes the required soil and site characterization needed to properly design a SRW.
SUCCESSFUL ENVIRONMENTAL LIABILITY RISK TRANSFER DEALS - THE ENVIRONMENTAL CONSULTANTS PERSPECTIVE

David Heidlauf, CPG, Ramboll Environ, 333 West Wacker, Suite 2700, Chicago, IL, dheidlauf@environcorp.com; Wahid Khan, Ramboll Environ, Princeton, NJ; Paul Lambert, DeNovo Constructors, Chicago, IL

Environmental liability risk transfer deals and guaranteed fixed price remediation projects were once in vogue in the environmental industry. These types of projects have an allure of a silver bullet rescue to those in need and a ripe opportunity for companies willing to assume risk and provide guarantees. However, the intransigent nature of historical remediation requirements and the “go-it-alone” approach adapted by past practitioners lead to numerous unsuccessful outcomes.

Environmental liability risk transfer paradigm is making a slow, but sure comeback. The growing acceptance and codification of risk based remediation requirements across state and federal regulatory programs help remove some of the inherent danger associated with these projects. Furthermore, the previous “go-it-alone” approach is being supplanted by a multi-party collaborative approach whereby companies with different expertise niches, working together, have a greater prospect for success. Elements of multi-party environmental liability risk transfer teams can include a risk transfer buyer, an environmental consultant, a yellow-iron remediation firm, a local developer, legal counsel, and sometimes an insurance indemnification product.

Environmental consultants engaged in these projects provide key services both in the upfront prospect identification, assessment, and cost estimation phase as well as the actual project execution phase. Cost valuation due diligence of an environmental liability risk transfer prospect entails review of data and reports, identification of media of concern, understanding the governing regulatory program, developing a feasible conceptual environmental action plan, identifying uncertainty to gage risks, and developing Monte Carlo cost estimates. As many environmental liability risk transfer projects entail real estate plays, completing required environmental response actions in a timely manner is often critical to the overall project success. Hence, project execution entails focusing on regulatory coordination, work pace, budget, and exit schedule.

Ramboll Environ US Corporation (Ramboll Environ) and the DeNovo Group (DeNovo) have teamed together on a half dozen environmental liability risk transfer projects. On one
such project, DeNovo acquired a 30-acre former automotive battery production facility. DeNovo assembled a project team consisting of DeNovo Constructors (DeNovo’s remediation construction division), Ramboll Environ (environmental consultant), and Wicks (a local developer). A Ramboll Environ staff member assumed the Licensed Site Remediation Professional (LSRP) role for this New Jersey Industrial Site Recovery Act (ISRA) site.

During year one of the project, DeNovo Constructors decontaminated the interior of the 340,000 ft² former manufacturing facility, Ramboll Environ characterized the Site, and Wicks identified a potential future tenant and use for the site. The team collaboratively prepared a site redevelopment plan which was used to implement a cost effective site remedy and site repurposing. Ramboll Environ negotiated a favorable site specific hot spot removal standard and the ability to obtain two media specific Response Action Outcomes (RAOs; formerly No Further Action). During year two of the project, the most environmentally impacted portion of the facility was demolished, contaminant soil hot spots were removed, a new parking lot was installed as direct contact barrier, and a new rail spur was installed. The remediated and repurposed facility is set for occupancy by a new tenant this fall.

CORRELATION OF SEDIMENTARY STRUCTURES IN DAVENPORT, CA

Lauren Henderson, SA, Metropolitan State University, Denver, P.O. Box 173362, CB 22, Denver, CO, lhende28@msudenver.edu

This project presents a novel new technique for sampling sedimentary structures, on the beaches of Northern California. The area of interest is Davenport Landing, in Davenport, CA, roughly 11 miles north of Santa Cruz, CA. The main beach is a cove, where the outer edges of the beach are much less sheltered from storm events; specifically the turbulent waves of the Pacific Ocean. Samples will be taken from each area and compared. This beach is of interest because of the cove environment, tectonic activity, structural geology and steep incline shelf. Also the high energy environment, demonstrated by the wave breaks on the beach, which would result in an area of higher deposition during storm events. Due to the steady high energy of this beach, it may be possible that mud drapes would not develop, as they need a low energy environment. The research will investigate the variations in sedimentary structures with the same beach. Correlation of direct wave impact vs. cove environment in regards to sedimentary structures is also investigated.
MANAGING AND DISTRIBUTING LARGE ELEVATION DATASETS IN ALASKA

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Elevation data and its derived products are critical datasets for geologists, as well as for many other scientific and general users. In light of this critical need, the Alaska Division of Geological & Geophysical Surveys (DGGS) manages and hosts an “Elevation Datasets in Alaska” web application. The web app allows users to view and download all known, publicly available LiDAR and IfSAR elevation-based datasets covering Alaska. As of summer 2015 the web app hosts 2.5 Tb of elevation data. The “Elevation Datasets in Alaska” web app operates within the Division’s larger online geologic publication infrastructure, which includes geologic maps, GIS datasets, other web maps, reports, and raw data files. This presentation focuses on the technical aspects of managing, processing, visualizing, and distributing large volumes of elevation-based data.

The two primary categories of publicly available elevation data currently managed in DGGS’s web application are LiDAR and IfSAR. The web application contains LiDAR point-cloud data and its derived products, when available, such as hillshade, digital terrain models (DTM), digital surface models (DSM), and intensity images. In addition, IfSAR data is available in three categories: DTM, DSM, and orthorectified radar image (ORI).

The first step in the process to create the application is finding and obtaining publicly available elevation datasets that cover Alaska. The elevation datasets are then organized, processed, and served using Esri’s ArcGIS, along with Blue Marble Geographic’s Global Mapper to make hillshades. LiDAR data is available from many different organizations and, as a result, each dataset is unique and requires considerable effort to organize and process. Each dataset’s point-cloud files and metadata must be inspected to determine extent footprints, point spacing, projections, and attributing. Raster surfaces (DTM and/or DSM), along with their associated hillshades, are generated at spatial resolutions ranging from 1 to 5 meters. In addition, the point-cloud and raster files are compressed for delivery. IfSAR data, on the other hand, is delivered by the USGS in a relatively standard format—as 5-meter-resolution DTM and DSM elevation surface rasters together with ORI rasters at either 0.625-meter or 2.5-meter resolution.

Once a dataset’s point-cloud files and derived products are generated, web services are built using Esri’s ArcServer. A vector-based index service identifies the footprints of all the elevation files, and raster hillshade services provide visualiza-
tions of the data. Though these individual services can be viewed independently by users, their primary role is to drive DGGS’s custom “Elevation Datasets in Alaska” web app built with OpenLayers JavaScript library.

DGGS plans to continue to populate their “Elevation Datasets in Alaska” web application as more elevation data becomes available in the future. In addition, we will continue to add functionality and new categories of elevation data such as bathymetric data and “Structure from Motion” derived elevation data.

GEOLOGISTS ROLE IN EVALUATING VOCS FROM ILLEGAL DRUG LABS, INDUSTRIAL WASTES AND HOUSEHOLD CLEANERS IN SEWER AIR

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Geologists are commonly sought out for cost-allocations and forensic evaluations of the release timing, original volumes and source of chemicals deposited into the subsurface. Some contaminant release cases feature the sewer-plumbing system as a preferred flow pathway in the conveyance of liquid wastes from a release location (source). In these cases, exfiltration of contaminated sewer liquids from leaky pipes into adjacent soil and groundwater serves as a secondary release location. Sewer pipe exfiltration of volatile organic compound (VOC)-laden sewer waste provided secondary release points for the Lodi, California groundwater plumes.

Inversely, the infiltration of VOCs from subsurface VOC contamination into leaky sewer pipes has been confirmed, only in the past decade, to be a pathway for VOCs to migrate into sewer air. This migration can occur when legacy sewer systems intersect VOC-laden groundwater plumes. To date, VOC contaminant presence or loads in sewer-air have yet to be comprehensively studied.

Sewer-plumbing systems, designed for conveying human and permitted wastes, are degraded by earth movement and biogeochemical reactions in soils and groundwater and are further damaged by VOCs, including chemicals or byproducts of illegal drug manufacturing, industrial processes, and medicine or household waste disposal.

Sewer-plumbing systems are not designed to be liquid and vapor tight. Several decades after the installation of sewer
collection systems underground and after the construction of plumbing venting in and through buildings, many components of sewer venting systems leak and some vapor seals, designed to protect against sewer air intrusion into structures, become compromised (pipes crack, fittings loosen, wax seals degrade and crack and P-traps dry out). Outdoor air studies in Denmark and Massachusetts, in areas with nearby PCE-containing groundwater plumes, have linked unhealthy levels of tetrachloroethylene (PCE) vapors in indoor air to sewer-plumbing systems with failed vapor seals (p-traps, wax toilet rings, etc.). Sewer agencies test for pipe leaks by forcing smoke into the sewer pipe lines; the pressurized smoke appears above ground generally above the pipe failures. Sewer agencies use pressurized smoke testing to locate leaks. In 6 smoke testing projects in northern California, about 10% of sewer laterals produced visible smoke (about 120 houses out of 1250 total). Of those, about one-third of these leaking laterals (35) produced visible smoke within 5 feet of the structure. Of these, 5 sewer laterals out of 1,250 (0.4%) leaked either within 2-feet of the building, under the building or in the building vents.

The talk covers (1) design elements and vulnerabilities of the materials used in pipes and fittings in the sewer-plumbing system, (2) the geologic hazards and biogeochemical reactions that impact sewer-pipe system longevity, (3) the types and associations of compounds disposed as wastes from illegal drug manufacturing, industrial processing and household cleaning activities, (4) the likely VOCs produced from these wastes, (5) the potential impacts to sewer air, (6) modes of possible human exposures to VOC-laden sewer air, and (7) testing methods to identify exposure.

DEVELOPMENT AND FEASIBILITY OF AN AUTOMATED PERCOLATION TESTER FOR INFILTRATION AND WASTE WATER DISPOSAL SYSTEM ASSESSMENTS

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Field testing soil for groundwater percolation is a common requirement when engineering a private, onsite waste disposal system. The principal test consists of three test holes dug into the soil at representative locations to a prescribed depth which are filled with water. The water level drop rate through soil percolation is then attained by measuring the depth to the water in each hole at certain intervals over an extended time period. In order to keep the test consistent, percolation holes may need to be refilled with water as needed. A percola-
tion test therefore requires the deployment of a field technician to execute the proper test, which is both costly and time consuming. Automated systems were sporadically developed but have fallen into disfavor because of very high pricing, limited data translation, and lack of extended deployment when percolation hole refills were required. However, new inexpensive, advanced electronics with an extensive array of programmable data logging and acquisition modes can be employed to develop a versatile, light weight, robust, multitasking field instrument. The Automated Percolation Analyzer (APA) prototype was developed as an undergraduate engineering project and showcases many advantages not found in previous instruments, such as: continuous data logging, automated refill and test hole pre soak capabilities, error detection, GPS, USB data interfacing and multiple instrument networking. The complete project cost for all components was below $200. Field testing of the APA prototype shows promising results with high data densities, continual automated percolation rate calculations, and possible seepage velocity applications for related projects.

**VALUE OF INTERNATIONAL GEOLOGIC FIELD EXPERIENCE FOR EMERGING UNDERGRADUATE GEOSCIENTISTS**

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Geologists resoundingly agree that field experiences are of immense benefit to the profession. In 2001 the American Geoscience Institute affirmed this position during their Associates Conference in declaring “the value and necessity of field experience and training is an essential element of the proper preparation for practicing geology”. While national field training exists in form of field camps, field trips, and internships, not many schools provide international equivalents on a regular basis. Cost and very involved logistics appear to be the main drawbacks. However, international field trips greatly enhance a students training and professional development in multiple ways. One of the main benefits reported by students concerning their international field exposure is a connection of cultural experiences in conjunction with their academic and professional endeavors. Working in an environment with language barriers and minimally exposed outcrops has honed skills and injected real problem solving into the learning repertoire. In addition, professional networking on an international level can be an extended benefit. The presentation will give examples of successfully utilized international geoscience field experiences currently offered by Metropolitan State University of Denver (MSU Denver) as part of the newly developed Applied Geology Degree Program. Participants will gain work-
able ideas of implementing their own international excursions which include cost effectiveness and workable logistics.

DEVELOPMENT OF A COMPETITIVE UNDERGRADUATE GEOSCIENCE DEGREE PROGRAM BY A TEACHING INSTITUTION OF HIGHER EDUCATION WITH LIMITED RESOURCES

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Metropolitan State University of Denver (MSU Denver) is predominantly a liberal arts teaching institution of higher education, serving a diverse student base in an urban setting. While interest in geoscience degrees is high among our students, their geology-related degree options until now have been limited to geology concentrations within two programs – a more heavily science-and-math-based Environmental Science program and a more planning-based Land Use program. However, despite being in the geographic shadow of major research institutions with strong geology degree offerings and resources, MSU Denver has recently implemented a successful new incubator program which is slated to become a full-fledged geology degree within a few semesters. The challenge was to develop a course of study that would be unique from existing programs at neighboring R1 institutions in ways that would attract and retain talented students. The MSU Denver geology incubator is designed to maintain a strong disciplinary core while also providing students with a strong set of specific, marketable skills and experiences that make them competitive entrants to either the workforce or graduate school. Thus a degree in “Applied Geology” was developed in which a core of geology courses is augmented by coursework from other departments, and where acquisition and application of new knowledge occurs in field, laboratory, and research settings, as well as in the classroom. Among the factors that set this program apart are the experience students gain in undergraduate research and field- and lab-based skills that are applicable to “doing geology” in the workplace and in graduate school. Our program offers ample opportunities for national and international field work, meaningful undergraduate research projects, and industry-related internships, all leading to a Bachelor of Science (B.S.) degree in Applied Geology. The mission of the applied geology program is to prepare students for active entry into geoscience careers or graduate programs by providing access to critical content knowledge, applicable skills, and modes of thought. Our goal is for our students to gain a strong geologic background and
then to develop abilities and habits in thinking critically, interpreting data rigorously, applying knowledge to work done in the laboratory and field, and designing and completing undergraduate research projects.

While examples of unique strategies will be given, this presentation will be interactive with the audience to discuss needs, wants, and desires by industry and academia for a new and emerging geoscience program. Since the degree is still under development, input and discussion by attendees as well as feedback given on a questionnaire will be considered for incorporation. MSU Denver hopes that this program will become a successful model for other institutions of higher education wanting to offer geology degrees in strong alignment with the expectations of industry and academia.

NUMERICAL MODELING OF THE HYDROTHERMAL SYSTEM AT EAST PACIFIC RISE 9°50’N INCLUDING ANHYDRITE PRECIPITATION

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To better understand the effects of anhydrite precipitation on mid-ocean ridge hydrothermal systems, we conducted 2-D numerical simulations of two-phase hydrothermal circulation in a NaCl-H2O fluid at the East Pacific Rise 9°50’N. The simulations were constrained by key observational thermal data and seismicity that suggests the fluid flow is primarily along axis with recharge focused into a small zone near a 4th order discontinuity. The simulations considered an open-top square box with a fixed seafloor pressure of 25 MPa, and nominal seafloor temperature of 10 °C. The sides of the box were assumed to be impermeable and insulated. We considered two models: a homogeneous model with a permeability of $10^{-13}$ m$^2$ and a heterogeneous model in which layer 2A extrusives were given a higher permeability. Both models had a fixed bottom temperature distribution and initial porosity of 0.1. Assuming that anhydrite precipitation resulted from the decrease in solubility with increasing temperature as downwelling fluid gets heated, we calculated the rate of porosity decrease and sealing times in each cell at certain time snapshots in the simulations. The results showed that sealing would occur most rapidly in limited regions near the base of the high-temperature plumes, where complete sealing could occur on decadal time scales. Though more detailed analysis is needed, it appeared that the areas of rapid sealing would likely have negligible impact on
the overall circulation pattern and hydrothermal vent temperatures. The simulations also indicated that sealing due to anhydrite precipitation would occur more slowly at the margins of the ascending plumes. The sealing times in the deep recharge zone determined in these simulations were considerably greater than estimated from 1D analytical calculations, suggesting that with a 2D model, focused recharge at the EPR 9°50’N site may occur, at least on a decadal time scale.

IDENTIFYING, CHARACTERIZING AND CATALOGING OF SURFACE FEATURES OF ICE SHELVES IN DRONNING MAUD LAND, ANTARCTICA

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The Antarctic Ice Sheet has been undergoing rapid changes in the past few decades, triggered by rapid thinning of its ice shelves. This thinning is caused primarily by enhanced basal melting by warm ocean water. However, recent studies have found that melting rates are not spatially uniform, but rather are strongly controlled by the topography of the base of the ice shelf. The topography of the ice-shelf base can often be inferred from the ice-shelf surface, because the ice is floating close to hydrostatic equilibrium. I identified, characterized and categorized surface morphological features of the ice shelves in Dronning Maud Land (DML) using RADARSAT-2 satellite imagery. DML has many loosely connected small ice shelves. Due to their sizes and complicated shapes, simple glaciological algorithms that are widely used in continent-wide work cannot be applied to these ice shelves. I have processed these new RADARASAT-2 images using speckle filtering and multi-looking methods to enhance image-brightness contrast associated with surface features. The surface features are highly variable between ice shelves, and related to ice-flow fields. These features are digitized and incorporated into the QGIS-operated program Quantarctica 2.0, which is a collection of Antarctic geographical datasets. This project was conducted in winter quarter 2015 as part of larger efforts led by the Norwegian Polar Institute to determine the current status of the DML coast (Ice Shelves, Ice Rises, Outlet Glaciers etc.) in greater detail.
DESTRUCTIVE POTENTIAL OF BREAKING SOLITARY WAVES

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For a better understanding of the tsunamis destructive potential, their breaking hydrodynamics need to be carefully studied when they approach to coast. Numerous studies have been developed previously for identifying the tsunamis hazard, mostly based on their maximum runup. However, for a quantitative analysis of their destructive capacity it is necessary to analyze their three-dimensional breaking phenomena. Their destruction potential is highly related to the velocity and momentum distribution due to and during the breaking process. We present a simple law that provides not only the maximum tsunami destructive potential, but also when and where it occurs during their shoreline wave approaching.

MINING WORKS FOR ALASKA: AN OVERVIEW OF ALASKA’S METAL MINING INDUSTRY AND ITS ECONOMIC IMPACT

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This presentation will give an overview of the modern metal mining industry in Alaska, calculate its economic and social impact, and examine the industry’s challenges and opportunities.

Alaska has world-class potential and relatively untapped deposits, yet there are only five large producing metal mines. The industry provides thousands of high paying jobs, local procurement of goods and services, municipal and state government revenue, and payments to Alaska Native Corporations. These factors have a profound regional impact, particularly in rural Alaska where there are often few economic opportunities. So with such rich potential, why aren’t there more producing mines?

The four year decline in commodity prices and the challenging financial environment mean tighter budgets and greater competition for fewer global exploration dollars. While these issues have affected the industry worldwide, Alaska has seen a disproportionate drop in exploration spending since 2011.
Is this entirely a result of the investment climate or are there other factors at work?

Alaska has challenges: from remote locations and lack of infrastructure to public perception and the paradox of high energy costs in a state rich in oil and gas. These factors will be examined along with Alaska’s unique opportunities, particularly the role of Alaska Native Corporations which own the surface and subsurface rights to 12.5% of the state.

Alaska can’t control commodity prices or the remote location of deposits, but other things can be changed to attract or discourage investment: 1) regulatory certainty and efficiency; 2) investment in infrastructure; and 3) support for an industry that is so important to Alaska’s economic diversity and prosperity.

GASTROPODS, CEPHALOPODS, AND TRILOBITES OH MY! EXPLORATION IN THE EARTH SCIENCES AT CAESAR CREEK LAKE

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In today’s world Science, Technology, Engineering and Mathematics or STEM programs are more important than ever. According to the 2014 report from the National Center on Education Statistics about 28 percent of bachelor’s degree students enter a STEM field; however, 48 percent of these students left the STEM fields between 2003 and 2009. There are two issues to examine: 1) How do we encourage students to pursue careers in the STEM fields? and 2) How do we retain students once they are pursuing a STEM career? A successful learning experience can garner children’s interest and set them on a path that leads them to pursue careers in the STEM disciplines. This presentation will address the issue of increasing students’ interest in the STEM fields. In an effort to stimulate interest in children and encourage them to enter these areas of study, the U.S. Army Corps of Engineers at Caesar Creek in Waynesville, Ohio, has created geology education programs designed for school field trips, scout troops, and ranger guided tours. Lesson plans, survey analysis, and student/teacher feedback will be discussed.
EDUCATIONAL AND PROFESSIONAL STANDARDS FOR A GLOBAL PROFESSION: INFORMATION DEVELOPED AS PART OF THE IUGS TASK GROUP ON GLOBAL GEOSCIENCE PROFESSIONALISM (TG-GGP)

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The successful 4th International Professional Geology Conference (4IPGC) that was held in Vancouver, British Columbia, Canada in January 2012 was a collaborative effort by representatives from several national professional geology organizations. The conference featured speakers from many countries addressing various topics under the theme of Earth Science – Global Practice. It illustrated that geoscientists worldwide face many of the same concerns and issues regarding professional and educational standards and ethics. Professional geology organizations are increasingly being relied on by governments and society to assist with determining standards and to communicate the importance of geoscience professionalism including codes of conduct and ethics. Globally consistent professional geologist standards are of rising importance as society increases its demands on Earth resources (minerals, extractable energy sources, water, rocks and soil) while also developing a common understandings on the use, and management of Earth resources for a sustainable future. Professional standards are also key for geologists when conveying to the public their understandings on environmental conditions and geohazards.

Following the 4IPGC, members of the planning committee worked together with the International Union of Geological Sciences (IUGS) to form the Task Group on Global Geosciences Professionalism (TG-GGP). The TG-GGP was officially formed.
The purpose of the TG-GGP is to ensure that geoscientists are fully engaged in the transformation of their global profession by providing information that will result in a greater worldwide understanding of geoscience professionalism by all geoscience stakeholders. The TG-GGP website (www.tg-ggp.org) provides information for both Society and the global geoscience community; it also serves as a forum for collaboration on professional matters in geoscience at the local, national, and international level. The overall aim is greater protection to the public and the environment through increased communication and understanding of professionalism in the geosciences. Expanding the membership in the TG-GGP and the addition of further collaborating organizations continues as awareness rises through presentations about the Task Group at meetings and conferences.

This presentation will provide general information about TG-GGP, and will summarize recent and planned activities.

TSUNAMI MODELING AND INUNDATION MAPPING IN ALASKA

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The Alaska Earthquake Center (AEC) participates in the National Tsunami Hazard Mitigation Program by evaluating and mapping potential tsunami inundation of coastal communities along the Alaska-Aleutian megathrust. A critical component in the tsunami modeling is accurate identification and characterization of hypothetical tsunami sources. As it was demonstrated by the 2011 Tohoku tsunami, the maximum considered event for a segment of the subduction zone might be underestimated. This emphasizes the importance of the detailed knowledge of the region-specific subduction processes, and using the most up-to-date geophysical data and research models that define the magnitude range of possible future tsunami events.

Our study area extends from the eastern half of the 1957 rupture zone to Prince William Sound, covering the 1946 and 1938 rupture areas, the Shumagin gap, and the 1964 rupture area. We present a technique to develop maximum credible tsunami scenarios for locations that have short or nonexistent paleoseismic/paleotsunami record. We conduct a set of sen-
sitivity model runs to identify coseismic deformation patterns resulting in highest runup at a given community. In addition, we consider tsunami scenarios that model a repeat of the tsunami triggered by the 1964 Great Alaska Earthquake, as well as hypothetical tsunamis generated by 1964-type ruptures, a Cascadia megathrust earthquake, and a hypothetical Tohoku-type rupture.

Results of numerical modeling are compiled on inundation maps and used for site-specific tsunami hazard assessment by local emergency planners.

VIRTUAL GEOLOGIC HIGHWAY GUIDES ACROSS EASTERN ALASKA

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Exciting virtual geologic highway guides are designed for Eastern Interior and South-Central Alaska in order to clearly describe, explain, and illustrate the nature, origin, and geological evolution of a complicated part of the North American Continental Margin. The guides provide an understanding of the major geologic units and their tectonic origins along three sets of major highways – the Pipeline Highway Road Guide (for 111 sites proceeding northward along Highways 4, 2, and 11), the Alaska Highway 1 Road Guide (for 65 sites proceeding northwest to northeast), and the Parks Highway Road Guide (for 51 sites proceeding northward). Each site can be viewed independently from Hot Links (hyperlinks) on an interactive Eastern Alaska Geologic Map. For site descriptions the major features are: (1) GPS latitude and longitude; (2) an oblique aerial overview of the region, adapted from Google Earth with overlaid geology; (3) color photos with explanations; and (4) descriptions of major geologic features. To acquaint users with regional geography and geomorphology, also included are annotated Google Earth Tours that are analogous to flying a small plane along the highways. You are invited to stop by the Poster Display and sample sites along the Pipeline Highway Road Guide and view the associated tour.

In addition to the virtual guides and tours, the geologic highway guides can also be used for a physical trip, either in paper format, tablet or laptop computers, however, without features obtained by Internet (Web) access.
The virtual geologic guides are part of the forthcoming E-Book on the Dynamic Geology of the Northern Cordillera (Alaska and Western Canada). This E-Book, that contains major new syntheses and interpretations of the geology and tectonics of the Northern Cordillera, should be quite useful for college and university earth science teachers, earth science majors, and professional earth scientists. The E-Book will be published on DVD and on the Internet. The publication, that will not be copyrighted, will be available for free downloading, and free DVD’s will be available for the cost of postage. To receive an announcement about the release the E-Book, kindly send an E-Mail to the first author.

E-BOOK PUBLICATION ON DYNAMIC GEOLOGY OF THE NORTHERN CORDILLERA - ALASKA AND WESTERN CANADA

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An exciting new E-Book is designed to clearly describe, explain, and illustrate the nature, origin, and geological evolution of the amazing mountain system that extends through the Northern Cordillera (Alaska and Western Canada). Major sections of the E-Book cover Regional Geology and Tectonics, Neotectonics and Natural Hazards, Sculpting the Earth, Slicing the Earth, Geologic Sources of Minerals and Energy, How the Solid Earth Works, A Tectonic Model for the Northern Cordillera, Virtual Geologic Highway Guides for Eastern Alaska and the Southern Canada Cordillera, and a Digital Atlas (with large-format, color geologic, tectonic, natural hazard, and geomorphic maps). For this presentation, selected interactive displays of these sections, with numerous Hot Links (Hyperlinks), will be demonstrated.

The publication of the E-Book, in digital format, provides several advantageous features: (1) the availability of Hot Links to definitions and concepts as explained on various Web sites; (2) the availability of Hot Links to other parts of the E-Book, including color figures, photos, tables, and Highlights (related interesting articles); and (3) the availability of Hot Links to re-
regional maps in the E-Book that containing multiple layers that can be displayed in different combinations in order to portray major earth science relationships between or among the various layers.

The E-Book is primarily designed for persons with a strong interest in earth science. The E-Book is aimed at readers who understand science at the level of Scientific American, and/or have taken a first- or second-year earth science course. The E-Book, that contains major new syntheses and interpretations of the dynamic geology of the region, should also be quite useful for college and university earth science teachers, earth science majors, and professional earth scientists.

The E-Book will be published on DVD and on the Internet. The publication will not be copyrighted; it will be available for free downloading. Free DVD’s will be available for the cost of postage. To receive an announcement about the release of the E-Book, kindly send an E-Mail to the lead author.

**USING SPECIFIC GRAVITY TO DETERMINE THE SOLID SOLUTION VARIATION OF K⁺, OR NA⁺ AND CA²⁺ IN FELDSPAR HAND SAMPLES**

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Plagioclase and alkali feldspar minerals have slightly varying specific gravities, due to changing chemical compositions within their respective solid solution and exsolution series. While quantitative chemical analysis in investigating compositions is desirable, it is either confined to the laboratory or requires expensive field instruments. However, advances in inexpensive load cell scale technology has led to the development of pocket scales that can be used to make rapid, precise field measurements of specific gravity (SG) on rock and mineral samples using a single pan hydrostatic method (Kackstaetter, patent pending). Accuracies such attained show enough resolution to enable differentiation in chemical compositions of feldspar samples. Specific gravity measurements were performed on known feldspar species and data was scrutinized through regression analysis. Additionally, geochemical data of each sample was obtained through acid digestion and Flame Atomic Absorption Spectroscopy to determine the exact proportions of K⁺, or Na⁺ and Ca²⁺. Trend line regression for solid solution plagioclase samples as well as alkali feldspar exsolution series can now be developed to relate the specific gravity to the chemical composition of each sample. Densities can now be assigned to exact chemical compositions within feld-
spars. By using the field portable single pan hydrostatic method for SG determination, an accurate and rapid identification of specific feldspar species is now possible.


STRUCTURAL DEVELOPMENT OF THE SOUTHERN WILLISTON BASIN: PRECAMBRIAN TO EARLY MISSISSIPPIAN

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An evaluation of Precambrian to Early Mississippian sediments, to determine basin structure, was performed in the Williston Basin of South Dakota using wells logs from the South Dakota Geological Survey. Basin analysis included identification of upper and lower formation boundaries, extent, and subsurface structure. Formation of the Williston Basin initiated in the Middle to Late Cambrian on the western shelf of Laurentia and later, the North American Craton. Pre-Devonian physiography was dominated by collisional tectonics to the west, resulting in a north-south trending geosyncline extending from Alaska and Northern Canada to Arizona. This tectonic activity provided structural control over the development of the Williston Basin, influenced its sediment supply, and induced transgressions and regressions of the seas. The Black Hills Uplift, Transcontinental Arch, and Cedar Creek Anticline provided structural limits to the southern extent of the basin and supplied sediments for deposition. These and other Precambrian structures were intermittently reactivated through the earliest Mississippian as a result of the tectonic activity to the west. Well log analysis revealed three previously unidentified potential subsurface structures in the Williston Basin of South Dakota. In addition, data have supported proposed southeastern extensions of the Cedar Creek Anticline and Sheep Mountain Syncline.
GENERALIZED RESPONSES OF FRACTURED ROCK AQUIFERS TO ANTHROPOGENIC AND CLIMATIC PERTURBATIONS

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Fractured rock aquifers are pervasive worldwide with many communities relying on fractured rock aquifers as their primary source of potable water. Exploitation of fractured rock aquifers is expected to increase in the future due to depletion of current water supplies and shifts in housing development from urbanized areas to less-developed mountainous regions. Understanding the dynamics of ground water in fractured rocks is vital to improving the sustainability of these complex aquifer systems. A combination of saturated discrete fracture network and variably-saturated dual-permeability flow simulators are used to investigate generalized responses of both unconsolidated porous and fractured rock aquifers to anthropogenic and climatic perturbations. Unlike porous media aquifers which produce circular to elliptical cones of depression, exploitation of fractured aquifers tends to produce irregularly-shaped patterns of drawdown due to multi-scale heterogeneity within the fracture networks. This multi-scale heterogeneity arises from the geometric configuration of interconnected, discontinuous fractures of varying length scales, orientation, transmissivity and local density. Storage within fracture networks is nearly non-existent due to very low fracture porosity, with only nominal volumes of water released from storage from surrounding low-porosity matrix blocks. The combination of high transmissivity and low storativity translates to pronounced differences in responses for fractured rock and porous media aquifers to anthropogenic and climatic perturbations, with fractured rock systems being significantly more susceptible to external forcings than porous media aquifers. Of particular importance is the role of the unsaturated zone in propagating time series of precipitation to the saturated zone. Unsaturated, low-porosity fractured rock tends to quickly transmit recharge to the saturated zone with dramatic swings in water table elevation, whereas porous media provides significantly more unsaturated zone storage and greater capillarity which effectively modulates recharge to the water table over longer time scales and buffers the aquifer from external forcings.
OPEN PIT MINE SCHEDULING WITH VARIANTS ON INVENTORY CONSIDERATIONS

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We present several ways of modeling stockpiling (with and without considering degradation) in open pit mine production scheduling, including (i) individual stockpiles for each block and (ii) binned stockpiles with pessimistic grade estimates. These models are formulated for a currently operational mine and compared to results without stockpiling in order to assess the benefits of stockpiling and to analyze the relationship between milling capacity and stockpiling value.

CRUDE OIL TRANSPORTATION HAZARDS

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This study focuses on the benefits and hazards of both transportation of crude by rail and by pipeline. The population surrounding major pipelines and railroad lines that regularly transport crude oil will be examined and mapped. Native American lands along routes of pipelines, including the proposed Keystone Pipeline, will be studied to determine possible impact spills have on watersheds in the area.

While the railroad network in America is extensive, the hazards are also extreme. Crude transported by rail only takes 5 to 7 days to reach its destination, while pipeline transport can take up to 40 days. While crude by rail is faster, it does cause major delays and congestion on rail routes preventing efficient transport of grains, agricultural and industry products, and passenger cars. The trains can also be largely affected by changes in weather including extreme heat and cold that cause expansion and contraction of tracks, floods, wildfires and tornadoes. All of which can cause derailment, leaks, and explosion. Currently, the tank car used to transport crude oil on rail is the DOT-111, which was originally designed in the 1960s for transport of non-flammable liquids. Crude oil from the Bakken Fields in North Dakota is light oil with a high percentage of natural gas liquids. Along the expansive journey, the gases begin to separate from the liquid, creating a blanket of highly flammable natural gas above the liquid oil in the tanker.
SUBSURFACE INTERPRETATION OF THE GREAT PLAINS OIL AND NATURAL GAS FIELD IN LINCOLN COUNTY, COLORADO

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The Great Plains oil and natural gas field is located in Lincoln County, Colorado. Drilling in the field reaches depths of over 7,000 feet below ground surface and produces out of Pennsylvanian strata. The production zones in the area are concentrated primarily in the Marmaton Group, Cherokee Group, and Morrow Formation. This study focuses on mapping and interpretation of limestone production zones throughout the layers. There are very few sandstone deposits within the production zones in Colorado, as the area was covered in a vast inland sea during deposition. The Cherokee Group in Colorado is composed of multiple allocyclic sequences of shallow marine shale and deeper marine limestone deposited in the Middle Pennsylvanian Desmoinesian Stage during recurring episodes of rapid sea level change. The cycles of transgression and regression in the area were likely caused by regional crustal disturbances or by glacial and interglacial conditions in the Southern Hemisphere at that time. Black shales mark the boundaries between informal limestone units within the Marmaton Group, Cherokee Group and Morrow Formation in Colorado. In many areas the strata is not divisible into formations in the subsurface. Siliciclastic material comprising shale layers within the groups may have been transported from the Uncompahgre Mountains to the west, the finest particles of which would have settled in the deep marine anoxic environments present in the vast inland sea covering the craton.

The discovery well within the area is the Aloha Mula 1. Wells within the Great Plains were vertically drilled and the Cherokee A payzone was subjected to limited area acid fracing, also known as fracture acidizing. Fracture acidizing is a process in which carbonate reservoir rock is dissolved to increase permeability within the rock to create new flow paths by which oil and gas may reach the wellbore.

Vertical wells reach depths well below sea level to access oil and gas reservoirs trapped within calcareous formations, likely by faults along the margins of the field, as suggested by structural maps created for this study. Lateral distribution of the carbonate payzone is dispersed and erratic, likely due to deposition as bioherm deposits in shallow marine environments, bounded above and below by black shale layers from allocyclic sequences resulting from sea level changes during the Pennsylvanian. Hydrocarbons present in the reservoir seem to have migrated up dip and been trapped by a series of faults along the eastern margin of the field.
IDENTIFYING CHLORIDE SOURCES TO AUSTIN-AREA STREAM WATERS USING STABLE CHLORINE ISOTOPES

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The addition of pollutants to waterways via non-point sources has been shown to dramatically impact water quality and ecosystem health, but is inherently difficult to identify and quantify due its distributed nature. Non-point source pollutants are especially important in a karst terrain, such as that of central Texas, where surface runoff flows into and through aquifers via conduit systems that may have little amelioration effect on pollutant concentrations. Constituent concentrations in waterways may be used to characterize relative source contributions, but isotopic variations often yield more powerful tracing capabilities, because the waters may possess a source-dependent distinct isotopic signature. Analysis of nitrogen and strontium isotope compositions in Austin waterways has illuminated the magnitude of contribution of these elements from natural and anthropogenic sources. However, the application of these isotopic systems may be limited due to the non-conservative nature of nitrogen (it is actively cycled through chemical and biological processes) and some sources of Sr that have overlapping ranges of isotopic composition.

This project investigates the feasibility of using Cl isotope compositions to determine sources of chloride to Austin area waterways. Chloride is likely to serve as a reliable tracer of anthropogenic inputs as chloride concentrations have increased in conjunction with increased development in Austin watersheds, and urban waterways exhibit highly elevated chloride concentrations in comparison to rural waterways (where the primary source of Cl is hypothesized to be limestone mineral-solution reactions and soil leaching). Furthermore, chloride concentrations in some Austin waterways exceed regulatory limits, and a method of quantifying the sources of this chloride would prove useful in maintaining and remediating urban water quality.

Thirty samples, including anthropogenic waters (i.e., untreated wastewater, municipal water, septic water, pool water, and treated wastewater), natural waters (i.e., groundwater, cave drip water, and stream water), and anthropogenic raw materials (i.e., pool chlorinators, fertilizers), were analyzed on a
ThermoElectron MAT 253 isotope ratio mass spectrometer. All δ^{37}Cl values range from -1.8‰ to +0.7 ‰ vs. SMOC (Standard Mean Ocean Chloride), with the exception of a bleach sample with a δ^{37}Cl value of 12.7‰.

Type categories (anthropogenic surface water, non-anthropogenic ground and surface water, and chlorinated raw materials) overlap significantly in their δ^{37}Cl values, indicating that individual sources do not possess sufficiently distinct isotopic compositions to allow delineation of Cl sourcing. The relative homogeneity of δ^{37}Cl values is hypothesized to be partially due to sourcing of Cl in foods, drinks, and industrial products from evaporitic halite deposits, which possess δ^{37}Cl values near SMOC. However, the fractionation of Cl in biological and industrial processes is not fully understood. Additionally, the large variation between the δ^{37}Cl values of bleach and water samples indicates that bleach is not a significant contributor of Cl to Austin waterways. Further research in alternative methods for determining the source of water to Austin’s urban streams includes principal components analysis of major cations and anions to determine characteristic constituents of major sources.

DIRECTIONAL DRILLING FOR MINE WATER SUPPLY DEVELOPMENT

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AECOM conducted an exploration drilling and well construction program for a confidential mining client in the southwestern United States to develop water supply wells to replace existing wells that are being displaced by expansion of mine facilities. Initial efforts to construct standard vertical production wells had limited success in the fractured basin-fill conglomerate aquifer. Field mapping indicated that fractures were near-vertical and made for difficult drilling targets using conventional methods. Directional drilling methods using mud motors and downhole survey methods were employed to construct two, 16-inch diameter production wells at angles of approximately 35 degrees from horizontal, extending 1,300 and 1,500 linear feet. The borehole alignments were designed to target the production intervals of successful existing wells that were being displaced by the mine expansion project. The two new angle wells are capable of pumping at rates of approximately 1,500 gallons per minute, which is comparable to the wells they were designed to replace. The wells serve as part of a network to capture and contain potentially impacted groundwater from migrating offsite.
FROZEN IN TIME - A PALEOCHANNEL GOLD PLACER DEPOSIT ON AN ALASKAN MOUNTAIN TOP IS DISCOVERED AND EXPLORED

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Alaskan gold placers have been studied and mined since the 1890’s gold rush. A warming climate in modern geologic history has played a major role that is sometimes under-appreciated in the geo-morphology and evolution of arctic alluvial gold placers. This paper discusses the genesis of an obscure and enigmatic type of arctic gold placer deposit, the elevated, abandoned, frozen “paleochannel” preserved in permafrost high on a mountainside above the actively eroding auriferous Hammond River drainage. The geo-morphology of the arctic region on the south slope of the Brooks Range will be discussed and how this was affected by the latest ice age and the Quaternary erosional history of this unique deposit. The subject deposit, known as The Slisco Bench, had been lightly mined in its shallower northern portion exposing high-grade gold values dipping under a thick mantle of frozen overburden. The deposit was subsequently explored by drilling its deeper areas. Some of those drill holes penetrated to surprising depths before reaching bedrock and confirming the presence of a well-incised paleochannel containing exciting gold grades. Evidence for this deposit’s age and evolution will be presented. Some of the implications for the economic geology, exploration, and development of this fascinating type of alluvial gold placer deposit will be discussed, as well as evidence of nearby lode gold sources.

SATELLITE AND GROUND-BASED GEOPHYSICS FOR MONITORING ICE CONDITIONS AND RELATED PERMAFROST BENEATH SHALLOW-WATER ENVIRONMENTS

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Discontinuous permafrost beneath shallow-water presents a significant challenge to the engineering of nearshore infrastructure due to the lack of well-established techniques for characterizing and monitoring the physical and thermal condition of the ground. As part of an ongoing study, multi-frequency ground penetrating radar (GPR) and satellite syn-
thetic aperture radar (SAR) have been used to improve the understanding of ice conditions and permafrost within the nearshore zone of the Mackenzie Delta, Canada. Interpretation of these indirect methods has been validated with drill and ground temperature measurements. Multi-year ground temperatures acquired throughout the period of open water and ice cover indicate the timing and spatial distribution of bottom-fast ice is a key control of winter heat loss from the underlying sediment. GRP surveys conducted over a five-year period were effective for mapping bottom-fast and floating ice, seasonal frost thickness, and ice-bonded permafrost. Isolated unfrozen taliks were also identified over distances which may not be resolved by traditional geotechnical programs. Wide-area mapping from a time-series of satellite SAR images provides evidence for recent changes to the extent and thermal condition of permafrost caused by interannual variability in ice conditions and sediment deposition and erosion. The findings indicate spaceborne and ground-based geophysics can be used to characterize seasonal frost and ice-bonded permafrost along proposed infrastructure routes and monitor existing infrastructure, such as buried nearshore pipelines.

REMOTE AERIAL PHOTOGRAMMETRY TO MAP, MODEL AND DOCUMENT ROCK OUTCROPS

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Mapping rock outcrops has been the long standing privilege of the field geologist or aspiring geology student. From regional mapping projects to supplementing local site characterizations, valuable knowledge is garnered from observing the local road cut or quarry wall. However, there are times when outcrops are difficult to access and observe. Other times, they are large and require days to cover. Regardless of accessibility, in many cases, it is just helpful to photo-document the outcrop for further desktop analysis or inclusion in later presentations. The popularity of unmanned aircrafts (UAs) or drones has added a new tool for the field geologist. Aerial flights have long been used for ortho-photographs. Now, with the use of UAs, close range, low altitude aerial flights can be used to collect high resolution photographs and video of rock outcrops. Photogrammetry can then be applied to analyze outcrops directly or prepare 3D models. Deliverables can range from basic photo-documentation, to detailed mapping
of lithology and structural features. This paper presents an overview of the use of UAs and photogrammetry to observe rock outcrops. Various photographic resolutions and post processing techniques are considered as possible means to measure basic field geology structures such as strike, dip, bed thickness, and joint patterns. Case studies and photographic examples of several outcrop sites are presented.

CHALLENGES OF CONTAMINATED SITE REMEDIATION IN THE ARCTIC; TWENTY FIVE YEARS OF STUDIES AT THE FORMER NAVAL ARCTIC RESEARCH LABORATORY IN BARROW, ALASKA

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The Naval Arctic Research Laboratory (NARL) was operational from 1947 until 1980 occupying a 350 acre site north of the city of Barrow. At a latitude of 71 degrees north Barrow is the most northerly city in North America and is located at the strategic junction of the Chukchi and Beaufort Seas. Most of the original structures at NARL are still intact and have been put to other uses. However, complete utilization of the facility is limited by soil contamination dating back to its former use. Most of the contamination relates to fuel spills, but metals, PCBs and chlorinated solvents are also present at some locations above action levels. Characterization and remediation efforts have been ongoing since the Navy left NARL and are expected to continue for another decade or more.

Sub-surface movement of contaminants is complicated by the presence of permafrost which limits vertical migration of contaminants and restricts lateral migration to the unfrozen zone, which is active during the summer months. As extreme low temperatures in Barrow during the Arctic winter greatly reduce the effectiveness of natural degradation contaminant concentrations can remain elevated for an extended period. Other remediation options are limited by the high cost of transporting contaminated soil by barge during the short window when ocean transportation is possible; there are no road connections to Barrow.

This presentation provides an overview of efforts to characterize sub-surface contamination at the former NARL site and the effectiveness of previous attempts to remediate specific sites. Observations on the future direction of clean-up activities will be presented in light of the growing importance of the Arctic as an economic and strategic resource and the environmental concerns of local inhabitants.
GEOTECHNICAL ASPECTS OF SALINE PERMAFROST AND CRYOPEGGS

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Saline permafrost and cryopegs have wide distribution in coastal and offshore permafrost along the Arctic coast including Alaska. Cryopeg is a layer of unfrozen ground that is perennially cryotic (forming part of the permafrost) in which freezing is prevented by freezing-point depression due to the dissolved-solids content of the pore water. Cryopegs are lenses of “cryosaline water” located in saline permafrost. A cryopeg located inside permafrost is sealed. It has no direct air or/and hydraulic connection to the current environment.

The majority of structures in the Arctic/permafrost region, including Alaska, are built on pile foundation. Permafrost soil is a complicated subject compared to nonfrozen soil due to temperature, which contributes additional uncertainty. Unlike non permafrost areas, mechanical properties of permafrost soil and pile bearing capacity are dependent on temperature. For instance, a temperature rise in 1°C may cause loss of up to 20% in pile bearing capacity.

Saline permafrost is a complicated subject compared to non-saline permafrost due to salinity, which contributes an additional degree of uncertainty. Mechanical properties of saline permafrost soil are heavily dependent on both temperature and salinity. 1°C temperature rise of saline permafrost soil may cause loss in pile bearing capacity up to 40%. All other conditions being equal, including temperature, if soil salinity increases from 0.45% to 0.9%, then pile bearing capacity may lose up to 50%.

Permafrost soil temperature varies within 10 meters below ground surface, where structure foundations are usually located. Cryopegs are able to migrate, which may cause to change in soil salinity. Thus, even small change in temperature and/or salinity of saline permafrost may cause significant reduction in soil mechanical properties, such as deformation modulus, soil strength (equivalent cohesion), adfreeze stress, etc. with the following structure failure. To detect reduction in soil mechanical properties, common practice relies on temperature monitoring. In case of saline permafrost, temperature monitoring is not sufficient. Salinity and pile bearing capacity must be monitored in addition to temperature.
THAWING PERMAFROST IN THE TANANA BASIN NEAR FAIRBANKS, ALASKA

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Permafrost can restrict the availability of groundwater in arctic regions in otherwise favorable hydrogeologic settings, but temperature profiles in the Tanana Basin show that some of this permafrost is on the verge of melting. Land development, presumably aided by climate change, is thawing deep permafrost in portions of the Tanana Basin and may result in the appearance of exploitable groundwater in currently frozen areas.

The Tanana Basin runs along the northern flank of the Alaska Range in central Alaska and is a prolific source of groundwater for Fairbanks, North Pole, Eielson Air Force Base (AFB), and smaller communities. Fluvial sands and gravels of the Tanana River predominate along the basin axis and supply the community wells, while silty overbank sediments fill the margins and are generally frozen to depths of 40 m or more.

The thermal state of the aquifer is the primary factor affecting the potential for off-axis groundwater extraction. To assess the availability of groundwater in the northeastern portion of Eielson AFB, the transition from axial to marginal hydrostratigraphy was probed in 2009 and 2010 by 17 borings to depths ranging from 8 to 82 m. Profiling pipes (1-inch PVC), installed in the four deepest borings were capped on the bottom to exclude groundwater and were filled with a non-toxic antifreeze solution. An outer casing of 2-inch PVC pipe extended to 9 m below ground surface (bgs), and, to resist frost jacking, the annulus between the two pipes was filled with vegetable oil. A 30 m cable with thermistors at 0.6-m intervals and 42 m of lead wire was equilibrated for an hour at various depths to span the full length of each profiling pipe.

Along the 4-km transect, the borings revealed a laterally extensive zone of sand and gravel with an axial thickness of 30 m and an inferred distal thickness of 8 m or less. Distal borings encountered permafrost to their maximum depth of 31 m, and the temperature profiles of the deep borings showed that permafrost extended to nearly 50 m bgs. At the axial edge of the transect, permafrost persisted at depth, but the upper 15 m of the aquifer was thawed, likely reflecting the thermal effects of nearby gravel pits that probably date from the 1950s. In this area, the frozen zone was isothermal at 0°C, indicating that it is in the process of thawing. Only 300 m toward the basin margin, however, conditions beneath black spruce wetlands were significantly different and indicative of stable permafrost. There, temperatures were supercooled to -0.4°C at the base of the active zone (6 m bgs) and gradually increased to 0°C at
the bottom of the permafrost layer (47 m bgs). At 2 km toward the basin margin, the permafrost was again isothermal at 0°C and presumably thawing. At this location, the native mossy soil had been removed from the local area (in the 1950s?) and replaced with gravelly silty sand to support vehicle traffic.

**FIRE AND ICE IN THE ALEUTIAN ARC: THE SCIENCE OF VOLCANO-ICE INTERACTIONS DURING Eruptive ACTIVITY IN ALASKA**

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The purpose of this talk is to provide a review of the science of how active volcanoes in Alaska interact with their associated ice and snow cover. The presentation will be focused primarily on historical eruptions at ice and snow clad volcanoes in Alaska, and will emphasize the effects of eruptive activity on glacier ice and snow and the generation of melt water and ensuing hazards. Nearly every volcano in the Aleutian arc has some amount of permanent ice and snow cover, and many volcanic edifices support ice volumes in excess of 5 km$^3$. External water exerts a significant role in the dynamics of explosive eruptions and is an important factor in the resulting eruption magnitude. Because eruptions that involve water are among the most violent eruptions known, it is important to have a thorough understanding of the range of conditions and settings associated with such eruptions, especially at volcanoes mantled by snow and ice. An improved understanding of the role of external water during eruptions serves as a potentially useful framework for evaluating unrest likely to culminate in eruption, the interpretation of eruptive products, and the forecasting hazards associated with excess water on volcanoes.

**ANTICIPATING THE NEXT BIG EARTHQUAKE IN ALASKA**

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Earthquakes are an integral part of Alaska’s landscape. The Alaska Range, the Aleutian Islands, and even the glaciers of the panhandle owe their existence to seismic motions. These examples show the breadth of earthquakes across the state. Their variety and extent make it challenging to anticipate the consequences of the next big one. The very notion of the “the big one”—a singular well-defined earthquake catastrophe—
does not apply in Alaska. There are many widely different scenarios that can, and will eventually, play out.

This talk will focus on why some earthquake scenarios are catastrophic and others are not. We will examine the specific vulnerabilities in Alaska and the potential for otherwise modest earthquakes to have major consequences. By looking objectively at the actual risks we can better shape the processes we use to plan at the community level.

INSPIRATION IN TIMES OF CHALLENGE: RETRACING THE STEPS OF PIONEERS IN NORTH ALASKA GEOLOGY

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In 1901 Frank Schrader and a USGS party set off on a geologic reconnaissance of then unmapped north Alaska. The party planned to traverse the Brooks Range and descend the Colville River to the sea, but the return plan before freeze-up was somewhat sketchy. In 1906 Ernest Leffingwell traveled by sea to the north coast of Alaska in search of a rumored land mass in the Arctic Ocean, only to remain there in near isolation in a cabin built from the vessel that brought him there, as his party departed. He lived nine summers and six winters in the cabin while mapping the geography and geology of northeast Alaska, documented in a manuscript that reads not only as a geologic reference but a “how-to manual” on surviving in the Arctic. The work of these intrepid geologists provided the basis for the first geologic map of the North Slope by Alfred Brooks. Their dedication to science and vocation in the face of personal risk, adversity, and sacrifice is a source of inspiration to geologists.

Modern geologic successors to these early explorers, whether pursuing oil and gas, minerals, coal, or simply funding for government projects, all face professional adversity and uncertainty in 2015. In an attempt at inspiration, this presentation centers on the aforementioned and other examples of passion for vocation at great personal sacrifice. The examples provide a blend of Alaska geology and entertaining accounts by geologists. Over the course of multiple field programs on the North Slope and Brooks Range I have had the opportunity to retrace the steps of some of these early geologic expeditions, albeit by modern means. Geology and photos from my experiences are blended with historical maps, photos, and quotations for a comparison of what’s changed or not changed with the physiography as well as geologic interpretation.

TRANSGRESSIONS ON ALASKA’S NORTH SLOPE

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Sea level fluctuation has played a vital role in the shaping of the North Slope of Alaska. Several wave-cut escarpments that represent periods of relatively static sea level are identifiable using the National Elevation Dataset, as evidenced by wave-cut escarpments. These escarpments relate to post-Miocene transgressions. Previous authors (Black, 1944; Hopkins, 1973; Williams, 1993; Brigham, 1985; and Brigham-Grette and Hopkins, 1995) have correlated the escarpments to differing transgressions including the Pelukian, Simpsonian, Wainwrightian, Kotzebuan, and Einahnuhtan. The escarpments are primarily eroded into the Gubik Formation, which lies unconformably on top of a folded and faulted sequence of Cretaceous to Tertiary Bedrock. The Gubik Formation was emplaced during a period of fluctuating sea levels in response to alternating glacial and inter-glacial periods, as described by Black, 1944. Marine terraces adjacent to the Colville River delta, described by Rawlinson in 1993, provide collaborating evidence of static sea stands. In addition to wave-cut escarpments and terraces, features such as beaches, barrier islands, and deltas are also evident. Additional study is needed to fully correlate the elevations of the apparent sea stands with transgressive sequences. This would aid in the understanding of the depositional history of the Gubik formation, which is important for engineering considerations regarding anticipated engineering properties of landforms and the presence and character of ice-rich deposits. The soil properties are also an important consideration when speculating how a warming climate and rising sea levels may affect the landscape of the future.
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