



# Colorado Scientific Society

*The objective of the Society is to promote  
the knowledge and understanding of Earth Science,  
and its application to human needs*

## *Student Night*

### **The Importance and Characterization of Pseudotachylytes from the Outer Hebrides Fault Zone**

*Trista Thornberry, Colorado State University*

### **Fault Slip Rates, Structural Style, Seismic Moment And Magnitudes Of The Last 2.3 Ka – Lake County Uplift, New Madrid**

*Jocasta Champion, University of Colorado*

### **Variations in the Au-Bearing L<sub>1</sub> and L<sub>2</sub> Liese Quartz Zones, Pogo Deposit, East Central Alaska**

*Keri Moore, Colorado School of Mines*

**Wednesday, November 3, 1999**

**American Mountaineering Center**

**710 Tenth Street (NE corner with Washington, just north of Clear Creek)  
Golden, Colorado**

**Social Half-hour: 7:00 p.m.**

**Meeting Time: 7:30 p.m.**



## **P x 4** (President Pierce's Purple Prose)

Our dinner meeting in October was truly a Family Nite with a bunch of kids and lots of spouses attending. About 60 sipped and dined amongst the exhibits at the Colorado School of Mines Museum. We then moved down the hall to hear an informative and truly engaging presentation on the "Dig a hole in your backyard: new discoveries in Denver's geology". by Kirk Johnson of the Denver Museum of Natural History. The recent growth of the metro area has produced excavations that have turned up a lot of fossils. Newly discovered *Tyrannosaurus Rex* fossils now have street addresses in the metro area. A true tropical rain forest grew here with "drip tips" on the leaves not long after the K-T boundary!

For Student Night this Wednesday, Nov. 3, we are working with the new, improved format. Competitions have already been held at CU, CSM, and CSU. The three winners will present their talks at the next Colorado Scientific Society Meeting at our new meeting place at the Alpine Club Auditorium (old Golden High School) in Golden.

We have a strong slate of future officers lined up for CSS positions. Thanks to Mark Hudson for chairing the committee that has nominated the candidates. Look elsewhere in this newsletter for the slate of candidates.

We are delighted that Steve Sonnenberg has agreed to serve on the CSS council, filling a recently vacated position. Steve has a long record of commitment and involvement in the Society, including President in 1992.

## **Email newsletter option – preliminary poll**

We are considering making available the option of electing to receive the CSS newsletter via email, perhaps as a PDF attachment, readable by shareware like Acrobat. The traditional mailed paper copy will remain available to those who do not elect email distribution. A main advantage of email, if there is sufficient interest to implement this option, would be the savings of postage costs and labor that would be available for other CSS operations. Another advantage is that members could get their copies a couple of days sooner than "snail mail". (There will be no dues restructuring for this option.) If we selected a PDF option, members could easily print out the fully-formatted newsletter on their own printers should they so desire. If you think you would elect this option if available, please send email to this effect, with *css-news* in the subject line, to [sclundst@usgs.gov](mailto:sclundst@usgs.gov) by November 15. At this point, you would not be electing an email option, but would only be indicating interest. We will not go to the effort to make this option available unless there is sufficient interest.



# Student Abstracts

## **The Importance and Characterization of Pseudotachylytes from the Outer Hebrides Fault Zone**

**Trista Thornberry,**

**Department of Earth Resources , Colorado State University**

Pseudotachylytes from the Outer Hebrides Isles, Scotland have been characterized on the basis of mineralogy, texture and chemical compositions. This was done using a petrographic microscope, back-scattered electron image and microprobe analysis. Every method indicates an entirely crystalline matrix, with no glass yet seen. Intermediate (sodic oligoclase to labradorite) plagioclase microlites are arranged in a crude spherulitic fashion and can reach lengths as long as 300 microns. Intergrown with the plagioclase lathes are slightly aluminous amphibole/clinopyroxene microlites and magnetite dendrites. Partially melted quartz clasts are the most common host rock remnants of these pseudotachylytes. Sparse apatite, zircon, and rutile clasts also persist in the matrix. Altered veins are scarce and easy to identify by their different textural and mineral components. Commonly altered veins show replacement minerals such as epidote, adularia, and chlorite, and a lack of microlites. Chemically, the pseudotachylyte groundmass shows SiO<sub>2</sub> percentages as low as 48.06. This is in marked contrast with the rather felsic Lewisian gneiss host rocks and could indicate incomplete melting and a low viscosity melt. Also important for dating, is the fact that volatiles are low and the K<sub>2</sub>O percentage is moderately high. In conclusion, the microlitic matrix indicates only a moderately high cooling rate. This, in conjunction with high temperature microlites, could point to a mid-crustal, high ambient temperature source. The large microlites could be useful in applying a quartz-plagioclase-hornblende thermobarometer. Lastly, the unaltered pseudotachylyte with ample K<sub>2</sub>O concentrations provides a likely candidate for <sup>40</sup>Ar/<sup>39</sup>Ar dating.

## **Fault Slip Rates, Structural Style, Seismic Moment and Magnitudes of the Last 2.3 Ka – Lake County Uplift, New Madrid Region**

**Jocasta Champion**

**Department of Geological Sciences, University of Colorado**

Trenching, geomorphology and structural analysis of subtle, fault-related folds in the Lake County uplift (LCU) suggest uplift is accommodated mostly by fault-bend folding above the blind Reelfoot thrust. Trench exposures indicate the Reelfoot scarp is comprised of 2-3 east-facing kink bands that dip 5-16°. These form above bends in the underlying blind thrust, collectively accommodating ~ 20-25° flattening of the thrust at the top of a ramp dipping 55° west. Seismic profiles image the scarp as a monocline comprised of overlapping kink-bands (multibend fold). Additional shortening is defined in trench excavations and seismic data as a ~4 km wide fold that forms above a fault tip (i.e. a fault-propagation fold). Fault-related fold theory and radiocarbon dates on folded sediments allow slip rates on the thrust to be determined. The average width of kink bands in the trenches is ~ 14.0 m. Limb width is equivalent to fault slip; this and the age of folded sediments (~2.3 ± 0.1 ka) yields a slip rate of 5.8 ± 0.7 mm/yr. Another method uses the 9.1 m of total structural relief across the Reelfoot scarp, the age of folded sediments and uplift on a 55° thrust to yield a slip



rate of  $4.8 \pm 0.2$  mm/yr. Vector transformation of these rates onto the strike slip Cottonwood Grove fault (CGF) indicates slip on the CGF of  $1.8 \pm 2.2$  mm/yr. This is in conflict with recent assertions based on GPS that New Madrid is now inactive. Seismic moment and moment magnitude calculations for faults in New Madrid used fault geometry from our model, slip inferred by fold geometry and published recurrence intervals. For a period of 500 years, seismic moment for the thrust is  $8.37 \times 10^{26}$  dyne-cm ( $M_w = 7.25$ ); for the strike slip CGF, moment is  $4.93 \times 10^{26}$  ( $M_w = 7.10$ ). This is consistent with historical records from the 1811/12 sequence where greater shaking was felt over the LCU.

## Variations in the Au-Bearing L<sub>1</sub> and L<sub>2</sub> Liese Quartz Zones, Pogo Deposit, East Central Alaska

**Keri Moore**

**Department of Geology and Geological Engineering, Colorado School of Mines**

Gold at the Pogo deposit (estimated 10 million tons, average grade 0.52 opt) is hosted in the subhorizontal, subparallel L<sub>1</sub> and L<sub>2</sub> Liese quartz zones. These zones crosscut Proterozoic (?) to Paleozoic amphibolite-grade gneisses and Cretaceous granitoids of the Yukon-Tanana terrane. The quartz can be divided into three types based on color, texture, and mineralogy. The quartz types are correlatable across the deposit and appear to be closely related in time. Type 1 is massive, milky white quartz with sulfides dominated by pyrrhotite and pyrite; biotite alteration occurs locally along wallrock contacts. Type 2 is massive, gray, and commonly mottled. Locally, however, this type is dark gray and highly strained. Sulfides are dominated by arsenopyrite and pyrite, and feldspars and micas in wallrocks have been altered to ferroan dolomite and sericite. Type 3 is pale gray to white with a distinctive "granular" texture consisting of subrounded to subangular quartz grains with intergranular potassium feldspar. It is not clear whether this texture is primary or secondary. Pyrrhotite, arsenopyrite, and pyrite are all present in type 4. Gold, with or without various associated Au-Bi-Pb-Te±S-Ag minerals, is found in all quartz types, though visible gold is preferentially concentrated in type 2.

### 1999 Colorado Scientific Society Student Night Semi-Finals

The council of the Colorado Scientific Society decided to maintain the format for Student Night that we revised last year. We held semi-finals at the Colorado School of Mines, Colorado State University, and the University of Colorado.

At each semifinal, 5 students, ranging from undergraduates to Ph.D. students, gave presentations. Their names are listed below. The top presenter received \$50 from the Colorado Scientific Society. The second and third place presenters received \$25. The top presenter from each school will give their papers at the November 10th C.S.S. meeting where they will receive either \$125 (first place) or \$75 (runner ups).

October 18<sup>th</sup> Semi-final at Colorado State University:

Winner: Trista Thornberry - The Importance and Characterization of Pseudotachylytes from the Outer Hebrides Fault Zone



Runner Ups:

Laura Lapey - Hydrogeologic Parameters of the Denver Basin Bedrock Aquifers From Core Analyses

Maureen Newcomb - Acequia (Ditch): the centuries-old communal water management system in Northern New Mexico

October 20 Semi-Final at University of Colorado

First Place:

Jocasta Champion - Fault slip rates, structural style, seismic moment and magnitude for the Lake County uplift, New Madrid, during the last 2.3 Ka.

Runner Ups:

Alex Iriondo - Overlap in magmatic age distributions among the early Proterozoic crustal provinces and blocks in SW North America

Hersh Gilbert - Receiver function imaging of the upper-mantle discontinuity structure below the Lau basin spreading center and Tonga subduction zone.

Honorable Mentions:

Dan Miggins - Geochronology and geochemistry of sills within the Cretaceous Pierre shale near the Spanish Peaks, south-central Colorado

Jesse Starr - Fluid inclusion study of a Cu-rich breccia pipe, El Teninete copper deposit, Chilean Andes.

Eric James - Analysis of ocean sediment cores from the Reyjafjardarall trough, northern Iceland.

October 20<sup>th</sup> Semi-final at Colorado School of Mines

First place: Keri Moore - Variations in the Au-Bearing L<sub>1</sub> and L<sub>2</sub> Liese Quartz Zones, Pogo Deposit, East Central Alaska

Runner up: Chris Zahm - Effects of Tear Faulting on Permeability

Runner up: Sandin Phillipson - Emplacement and Mineralization of the San Cristobal Ag-Pb-Zn Deposit, Southern Bolivia

## Museums

**Friends of Dinosaur Ridge** For information call 697-DINO. Visitors' Center is located at 16831 West Alameda Parkway (north side of Alameda, just west of the C-470 overpass). Open 9 a.m. to 4 p.m. weekdays and weekends. Fireside chats are held at the Red Rocks Elementary School Cafe, in Morrison starting at 7 p.m.



# Earth Science Meetings and Talks

**Colorado Scientific Society's** regular meetings are held the 1st Wednesday of the month (unless otherwise advertised). Social time begins at 7:00 p.m. and presentations start at 7:30 p.m. For information, contact Ken Pierce at (303) 236-1244 or kpierce@usgs.gov

**Denver International Petroleum Society (DIPS)** meets the 2<sup>nd</sup> Friday of each month at the Wynkoop Brewing Co., 18<sup>th</sup> and Wynkoop Streets. Reception begins at 11:30 a.m., luncheon at 12 p.m., program at 12:30 p.m. Make reservations (required) by leaving message at (303) 623-5396. Reservations accepted after 8 a.m. on Friday until 10:30 a.m. on Wednesday prior to the meeting. Cancellations accepted until 11:00 am Wednesday prior to the meeting. Cost: \$15 for lunches; talk only is available for \$2 (make checks payable to "D.I.P.S."). Contact Keith Murray at (303) 986-8554 for information.

**Denver Region Exploration Geologists' Society (DREGS)** meets in the Mutual Consolidated Water Building, 12700 West 27th Avenue, Lakewood. Social hour 6:00-7:00 p.m. Technical presentation at 7:00 p.m. Meetings are normally scheduled for the first Monday of each month. For information contact Don Bryant, (303) 733-2358, or the website <http://www.qadas.com/dregs>

**Colorado School of Mines Lectures** For Heiland Lectures at 4:00 p.m. on Fridays, contact Michelle Szobody (303) 273-3451. For information on Van Tuyl Lectures, call the Dept. of Geology at (303) 273-3800

**Colorado State University Geology Lectures** Mondays, 4:10 p.m. in room 109 or 316 of the Natural Resources Building. Call the Dept. of Earth Resources at (970) 491-5661 for further details.

**University of Colorado at Boulder, Geological Sciences Colloquium**  
Wednesdays, 4:00-5:30 p.m., Rm. 180. For schedule, contact Kathy Madsen 303-492-8141

## Election Ballot

### Candidates for upcoming CSS election

The Society will elect its officers for 2000 at the December 1 business meeting. If you cannot attend the business meeting, please clip the election ballot below and return it by November 26 to : The Colorado Scientific Society, P.O. Box 150495, Lakewood, CO 80215-0495

President-Elect  Michelle Tuttle  
 \_\_\_\_\_ (write-in)

Councilors 2000-2002 (vote for two)  Paul Weimer  
 Scott Lundstrom  
 \_\_\_\_\_ (write-in)  
 \_\_\_\_\_ (write-in)



# Invitation to Join the Colorado Scientific Society

The Society is dedicated to the advancement of science through open forums and activities. We sponsor lectures, field trips, student scholarship grants, and discussions of scientific matters of public concern. Please help us enlist new members.

I hereby apply for \_\_\_\_\_ membership in the Colorado Scientific Society.  
 (Regular, Corresponding, Student)

\_\_\_\_\_  
 (Last Name) (First Name) (Middle)

\_\_\_\_\_  
 (Address) (Telephone, with area code) (e-mail)

\_\_\_\_\_  
 (City) (State) (Zip)

\_\_\_\_\_  
 (Company/Agency/University)

\_\_\_\_\_  
 (Mailing address if different than above)

\_\_\_\_\_  
 School Degree Year Major

**Main Scientific Interests**

**DUES**—Your dues are for the calendar year and help support the newsletter, monthly meetings, two field trips each year, family night, and the Emmons Lecture.

Regular Member (\$15) \_\_\_\_\_  
 Corresponding (outside Denver metro area) Member (\$10) \_\_\_\_\_  
 Student Member (\$5) \_\_\_\_\_

Please make your dues payable to Colorado Scientific Society. Thank you!!

**T**he success of certain Colorado Scientific activities depend on your volunteer help. Please circle those activities for which you can provide assistance. We will pass your name on to the appropriate Committee Chairperson.

- |                         |                     |                   |                      |
|-------------------------|---------------------|-------------------|----------------------|
| <i>Arrangements</i>     | <i>Fund Raising</i> | <i>Newsletter</i> | <i>Publicity</i>     |
| <i>Best Paper Award</i> | <i>History</i>      | <i>Outreach</i>   | <i>Science Fairs</i> |
| <i>Field Trips</i>      | <i>Membership</i>   | <i>Program</i>    | <i>Web Site</i>      |

I certify that all statements in this application are correct and, I agree to promote the objectives of the Society and to abide by its Constitution, Bylaws, and Rules.

\_\_\_\_\_  
**Applicant's signature**

\_\_\_\_\_  
**Date**

**Colorado Scientific Society, P.O. Box 150495, Lakewood, CO 80215-0495**



Visit CSS at <http://home.rmi.net/~css/>

## Colorado Scientific Society Officers, Councilors, and Chairpersons

### OFFICERS

**President:** Ken Pierce, USGS, 236-1244  
**President-Elect:** Mark Hudson, USGS, 236-7446  
**Treasurer:** Michael N. Machette, USGS, 273-8612  
**Secretary:** Stephen F. Personius, USGS, 273-8611  
**Past President:** Eric Erslev, CSU, (970) 491-6375

### COUNCILORS

**1997-1999:** Michelle L. Tuttle, USGS, 273-8626  
**1997-1999:** William D. Nesse, UNC, (970) 351-2830  
**1998-2000:** Eric Nelson, CSM, 273-3811  
**1998-2000:** Vacant  
**1999-2001:** Emmett Evanoff, CU, 492-8069  
**1999-2001:** Steve Sonnenberg, 236-6447

### COMMITTEE CHAIRPERSONS

<b>Database Manager:</b>	<b>Robert C. Bucknam, USGS, 273-8566</b>
<b>Best Paper Award:</b>	<b>Bruce Bryant, USGS-retired, 236-1234</b>
<b>Field Trips:</b>	<b>Sherm Marsh, (303) 986-0939</b>
<b>History:</b>	<b>Marjorie E. MacLachlan, USGS-retired, 986-7192</b>
<b>Membership:</b>	<b>Dean Kleinkopf, USGS, 236-1412</b>
<b>Memorial Funds:</b>	<b>Eric Erslev, CSU, (970) 491-6375</b>
<b>Memorial Funds Treasurer:</b>	<b>Michael N. Machette, USGS, 273-8612</b>
<b>Newsletter Editor:</b>	<b>Scott Lundstrom, USGS, 236-7944</b>
<b>Outreach (signs):</b>	<b>Peter J. Modreski, USGS, 236-5639</b>
<b>Program:</b>	<b>Eric Nelson, CSM, 273-3811</b>
<b>Publicity:</b>	<b>David Moore, USGS, 236-1271</b>
<b>Webmaster</b>	<b>Randy Schumann, USGS, 236-1525</b>

**\*\* NOTE: Please help us with publicity by posting copies of the Newsletter on bulletin boards.**

