



# Colorado Scientific Society

*In pursuit of the promotion of knowledge,  
understanding of science,  
and its application to human needs.*

## *Student Night*

### **Secondary Hematite: Evidence for Molybdenum Transport under Oxidizing Conditions, Bergslagen District, Sweden**

*Nick K. Starkey, Colorado State University*

### **Integrated Approach to Three-phase Fluid Flow Modeling: Application to Northern Walker Ridge/Southern Green Canyon, Northern Gulf of Mexico Basin**

*S. Chereé Stover, University of Colorado*

### **Geology, Alteration, and Mineralization of the Cerro San Pedro Gold-Silver Deposit, San Luis Potosi, Mexico**

*David Winterbourn, Colorado School of Mines*

**Tuesday, November 10, 1998**

**Union Square Theatre in the Sheraton Hotel**

**360 Union Boulevard**

**Lakewood, Colorado**

**Social Hour: 7:00 p.m.**

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

These 3 talks of 15-20 minutes should allow us to finish the meeting by 9:00 including time for discussion.



# Student Abstracts

## Secondary Hematite: Evidence for Molybdenum Transport under Oxidizing Conditions, Bergslagen District, Sweden

Nick K. Starkey  
Colorado State University

Petrographic evidence shows that widespread oxidation of early pyrite to hematite may record the introduction of oxidizing molybdenum-rich fluids in granite systems at Bispbergs klack in the Bergslagen district, central Sweden.

Two ore hosts, distinguished by their deep red and pale gray colors, were investigated. Both are homogeneous, hypidiomorphic, slightly porphyritic, A-type granites. The red ore host differs from the gray ore host by aggrandized alteration of early pyrite to hematite, a higher degree of sericitization and chloritization, and dramatically higher molybdenite grades (locally up to 5% MoS<sub>2</sub>). Chemical analyses of the two ore hosts exhibit notable differences. The red ore host is enriched in Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, Mo, Ba, and Zr, and depleted in SiO<sub>2</sub> and Na<sub>2</sub>O compared to the gray ore host. Most of the red ore has been removed by centuries of mining; some lower grade gray ore remains in outcrop.

A model for the Bispbergs klack deposit is as follows: (1) crystallization of abundant magmatic pyrite (plus minor chalcopyrite and sphalerite) in an early granite phase; (2a) oxidation of early pyrite (related to intrusion of gray granite?) producing widespread hematization and imparting a pervasive red color to the early granite; and (2b) simultaneous precipitation of molybdenite resulting from reduction of oxidized Mo-bearing fluids by reaction with early pyrite.

The bulk mineralogy and chemistry of the Proterozoic Bispbergs klack granites are similar in many respects to Tertiary Climax-type granites (e.g., Colorado Mineral Belt) where the significance of an oxidizing system for the transport of molybdenum has been demonstrated (e.g.,  $\delta^{34}\text{S} > 4.0$  permil). We propose that Bispbergs klack may be a deeper crustal analog to shallow Climax-type granite porphyries. High confining pressure at Bispbergs klack may have precluded exsolution of sufficient quantities of magmatic fluid to produce the stockwork veining characteristic of shallow Climax-type Mo-porphyry systems. As a result, molybdenite at Bispbergs klack occurs principally as disseminated blebs, and rarely in discontinuous quartz-calcite veins.

## Integrated Approach to Three-phase Fluid Flow Modeling: Application to Northern Walker Ridge/Southern Green Canyon, Northern Gulf of Mexico Basin

S. Chereé Stover  
University of Colorado

Recent cross-section reconstructions of the northern Gulf of Mexico Basin have allowed for new insights to be gained concerning the complex geologic processes that governed historic submarine structural development. The reconstructions encompass a time span of 66.4 Ma to present day and indicate a dynamic and interconnected evolution of fault growth, sedimentation, and allochthonous salt deformation. Parallel with enhancing interpretation of the historical geology of the basin, the reconstructions have also reinforced a relatively unknown variable that is of substantial interest to both geohydrology and structural academic fields: historic fluid flow patterns. As the Gulf of Mexico Basin developed over time, the evolution and



magnitude of basin heterogeneities are likely to have had pronounced influences on historic fluid migration, but the flow patterns and scale of heterogeneity influence remain poorly understood. This research focuses on modeling the effects of heterogeneities on historic fluid flow patterns in the northern Walker Ridge/southern Green Canyon region. Through implementing replicas of each reconstruction stage into a 2-dimensional numerical model and linking a series of fluid flow models throughout the reconstructed period, we are able to predict the resultant fluid flow patterns and comprehensively examine the magnitude of heterogeneity influence on the system.

## **Geology, Alteration, and Mineralization of the Cerro San Pedro Gold-Silver Deposit, San Luis Potosi, Mexico**

**David Winterboume**  
**Colorado School of Mines**

The Cerro San Pedro Au-Ag district is located in central Mexico, and has been the site of intermittent mining for over 400 years. District geology is characterized by a complexly folded Cretaceous limestone sequence which has been intruded by a quartz-diorite porphyry. Several episodes of premineral deformation have resulted in north-south fold axes cut by both north-south and younger east-west faults. Intrusion of the porphyry was localized by the north-south structures. Mineralization is characterized by stockwork veins and disseminations in the porphyry and carbonate replacement and manto/chimney bodies in the carbonates.

Five hydrothermal alteration styles are observed at Cerro San Pedro, with mineralization associated with both sericitic and acid-sulfate alteration. Sericitic alteration is characterized by fine-grained muscovite, while the acid-sulfate alteration assemblage includes alunite, jarosite, and kaolinite.

The most important structural controls of alteration are the north-south Mendez-type faults and the east-west Princesa fault. Hydrothermal fluids appear to have migrated upward from depth along the Princesa fault, then north into the Mendez-type faults.

Preliminary results from geochemical studies suggest that there are multiple stages of mineralization. Gold and silver were first introduced during an early sericitic alteration. Gold was subsequently enriched and/or remobilized during a later acid-sulfate alteration event.

### **1998 Colorado Scientific Society Student Night Semi-Finals**

The council of the Colorado Scientific Society decided to try a new format for the 1998 Student Night presentations. In previous years, students sent abstracts directly to the Society, and a selection was chosen for presentation at a Tuesday meeting of the Society. This year, we went to the students, holding semi-finals at Colorado School of Mines, Colorado State University, and University of Colorado. Faculty at adjoining schools, including Colorado College, University of Northern Colorado, UC Denver, and Mesa College, and University of Wyoming were contacted to see if any of their students wanted to give presentations at the semi-finals. As it turned out, only students from the host universities took place in the competitions.

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

First Place: Nick K. Starkey: Secondary hematite: Evidence for molybdenum transport under oxidizing conditions, Bergslagen District, Sweden

Runner Ups:

Alan Miller-Koenig: An investigation into selective dissolution of mineral inclusions for improving Samarium-Neodymium (Sm-Nd) geochronology

Jason C. Ruf: Fracture analysis of the northern San Juan Basin using both shear fractures and joints

Honorable Mentions:

Craig E. Divine: Geologic Heterogeneity and DNAPL Architecture: Considerations for PITTs

David M. Merritt: The Effects of Hurricane Nora on Channel Geometry and Longitudinal Profile of an Ephemeral Sandbed Wash in the Sonoran Desert

October 19<sup>th</sup> Semi-final at Colorado School of Mines

First Place:

David Winterbourne: Geology, alteration, and mineralization of the Cerro San Pedro gold-silver deposit, San Luis Potosi, Mexico

Runner Ups:

Chris Zahm: Prediction of regional groundwater flow and permeability anisotropy using fractured outcrop exposures, Edwards aquifer, central Texas

Michael McCormick: A geohydrologic investigation of produced water migration using parameter estimation

Honorable Mentions:

Matt Farling: Structural geometry of the Banshee triangle zone, Alberta, Canada: a structural interpretation of 2-D seismic

Joseph C. McCarthy: A hydrogeological analysis of Colorado groundwater law

October 22 Semi-Final at University of Colorado

First Place:

S. Cheree Stover: Integrated Approach to Three-phase Fluid Flow Modeling: Application to Northern Walker Ridge/Southern Green Canyon, Northern Gulf of Mexico Basin

Runner Ups:

Donald C. Barber: Constraints on Laurentide Ice Stream Dynamics from Sediment Provenance Studies in Hudson Strait and the Labrador Sea

Hersh Gilbert: Teleseismic Receiver Function Imaging of the Upper Mantle Structure Below the Colorado Plateau and Rocky Mountain Front

Honorable Mentions:

Vicki Rystrom: Technical Aspects of a High-Resolution, Low Altitude Aeromagnetic Survey

John C. Marler: Effects of the Elkhorn Fault on the Hydrogeology of the South Park Basin, Park County, Colorado



## 1998 Family Night

The 1998 family night of the Colorado Scientific Society provided excellent food, a fascinating dinner decor and an informative yet interactive presentation on the "Incredible Climate of Colorado". A group of nearly 40 CSS members and spouses accompanied by several energetic children met at the Geology Museum of the Colorado School of Mines to visit, view the exhibits and eat an excellent buffet featuring roasted chicken and salmon. We then crossed the road to the student center where we joined more than a dozen others for Nolan Doesken's presentation on Colorado's climate. Nolan's unconventional style had everyone on the edge of their chairs, from internationally-recognized geoscientists to third graders. He started with about 100 slides of Colorado weather, only commenting on every third slide. Then he gave the test – 10 questions to find out how much we knew. This test made my exams look trivial. For instance do you know that Canon City has the warmest winter climate in the state? Well, the bad news is that we did not do very well – the high was 4 out of 10, a score that most farmers would have beaten easily. The good news is that the society is in good hands – Ken Pierce, the president-elect, achieved the top score and was awarded the prize.

Eric Erslev, Colorado State University (970 491-6375, [erslev@cnr.colostate.edu](mailto:erslev@cnr.colostate.edu))

## Some notes from the President-Elect, Ken Pierce

**Wally Broecker** of Lamont-Doherty Earth Observatory will give the S.F. Emmons Lecture on "*Thermohaline circulation: the Achilles heel of our climate system*" on Jan. 12, 1999 at the Green Center of CSM.

We are lining up scientists for open positions. Our nominations for next year's elective offices are:

**Mark Hudson** has agreed to run as President-Elect. Mark is relatively young for a Survey scientist in these days, where he is a general geologist with the National Geologic Mapping team and also a paleomagnetician.

**Emmett Evanoff** of the University of Colorado Museum has agreed to run as councilor. In addition to involvement with CU, Emmett is also associated with the Denver Museum of Natural History.

**Bob Jarrett** has also agreed to run for council. We're delighted to have someone from Water Resources Division of the USGS to be on council and hopefully involve hydrologists and other earth scientists with the Society.

We are delighted to have the following involved Society members chair two of our key committees.

**Eric Nelson** (CMS) will chair the Program Committee. He did this the year before last and lined up an excellent, interesting, and varied set of talks.

**Sherm Marsh** (USGS, retired) will run the field trip committee. He did this awhile back, and people are still talking about the interesting trips and great meals.

## Museums and News

**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 Morrison Town Hall, 110 Stone Street in Morrison starting at 7 p.m.



# Earth Science Meetings and Talks

**Colorado Scientific Society's** regular meetings are held the 2<sup>nd</sup> Tuesday 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 Eric Erslev at (970) 491-6375 or erslev@cnr.colorado.edu.

**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 calling Marybeth Davies (303) 573-3909x223. 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 "DIPS"). 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 Jim Cappa, (303) 866-2611.

**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 1999 at the December 8 business meeting. If you cannot attend the business meeting, please clip the election ballot below and return it by December 5 to : The Colorado Scientific Society, P.O. Box 150495, Lakewood, CO 80215-0495

President-Elect	<input type="checkbox"/>	Mark Hudson
	<input type="checkbox"/>	_____ (write-in)
Councilors 1999-2001 (vote for two)	<input type="checkbox"/>	Emmett Evanoff
	<input type="checkbox"/>	Robert Jarrett
	<input type="checkbox"/>	_____ (write-in)
	<input type="checkbox"/>	_____ (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://rainbow.rmi.net/~css/>



## Colorado Scientific Society Officers, Councilors, and Chairpersons

### OFFICERS

President: Eric Erslev, CSU, (970) 491-6375  
President-Elect: Ken Pierce, USGS, 236-1244  
Treasurer: Michael N. Machette, USGS, 273-8612  
Secretary: Stephen F. Personius, USGS, 273-8611  
Past President: Karl Kellogg, USGS, 236-1305

### COUNCILORS

1996-1998: James A. Cappa, CGS, 866-2611  
1996-1998: Richard B. Wanty, USGS, 236-1819  
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: Ted Ball, Consultant

### COMMITTEE CHAIRPERSONS

Arrangements:	Aaron John Kullman, CSM, 273-3066
Database Manager:	Robert C. Bucknam, USGS, 273-8566
Best Paper Award:	Bruce Bryant, USGS-retired, 236-1234
Field Trips:	Lee Shropshire, UNC, (970) 351-2285
History:	Marjorie E. MacLachlan, USGS-retired, 986-7192
Membership:	Dean Kleinkopf, USGS, 236-1412
Memorial Funds:	Karl Kellogg, USGS, 236-1305
Memorial Funds Treasurer:	Michael N. Machette, USGS, 273-8612
Newsletter Editor:	Scott Lundstrom, USGS, 236-7944
Outreach (signs):	Peter J. Modreski, USGS, 236-5639
Program:	Ian Ridley, USGS, 236-5558
Publicity:	David Moore, USGS, 236-1271
Science Fair:	Chuck Weisenberg, 279-7629
Webmaster:	Randy Schumann, USGS, 236-1525

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

