

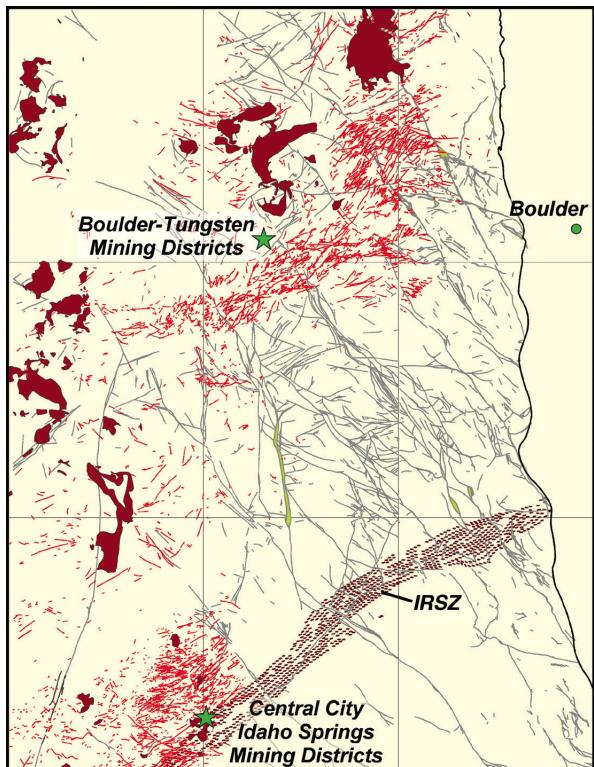
Colorado Scientific Society

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

**Two pre-fieldtrip talks!!!
(field trip on Sat., May 22. See p. 4
for more details and sign-up form)**

Brittle Structures and Inheritance in the Central Front Range of Colorado

*by Jonathan Saul Caine
USGS*



Structural Analysis of the Idaho Springs-Ralston Ductile Shear Zone: Reinvestigating Hypotheses of Inheritance from Proterozoic Structures in the Central Front Range of Colorado

*by Zachary Wessel
Colorado State University*

Thursday, May 20, 2010
**Colorado School of Mines—Department of Geology and Geological Sciences,
Berthoud Hall, Room 241, Golden, CO**
Social half-hour—6:30 p.m. Meeting time—7:00 p.m.

May Talk Abstracts (author bios. on p. 3)

Brittle Structures and Inheritance in the Central Front Range of Colorado

Jonathan Saul Caine

U.S. Geological Survey, P.O. Box 25046, MS 964, Denver, CO, 80225, USA

jscaine@usgs.gov

A long history of mining and geologic mapping in the Front Range of the central Colorado Rocky Mountains has resulted in an exceptionally rich dataset for geologic structures and epithermal ore deposits. These regional-scale data were among the first to lead geologists to ponder the role of Precambrian structural inheritance in the localization of Tertiary mineral deposits. Of particular significance was the idea that localization of epithermal, polymetallic fault veins in this region was controlled by a pre-existing crustal “weakness,” the Proterozoic Idaho Springs-Ralston ductile shear zone (ISRZ) being one prime example. However, recent compilation of structural and mineral deposit data from existing 1:24,000 geologic maps, reports, argon geochronology on fault and hydrothermally altered rocks, and new structural data from outcrop in the Front Range result in five key observations: 1) There is little correlation between the locations of major ductile shear zones, inferred mineral deposit-related plutons, and major brittle fault zones. 2) Mapped features suggest that myriad directions of potential permeability structures in Proterozoic basement rocks existed during the Tertiary and that metalliferous hydrothermal fluids may have flowed in many directions at any given time during the evolution of the Colorado Mineral Belt. 3) Small displacement fault veins with striated and cataclasized margins that carried ore bearing fluids show steep dips and either preferential ENE trends well correlated with model paleostress directions for the Laramide orogeny or radial trends around Late Cretaceous to Tertiary igneous intrusions. These relationships hold regardless of co-planarity with preexisting foliations in metasediments or in massive unfoliated metaigneous plutons. 4) The total gas $^{40}\text{Ar}/^{39}\text{Ar}$ age of alteration is Laramide and the brittle faults are younger. 5) There are only minor differences in orientation and intensity of potential structures that may have controlled permeability from within the ISRZ compared with similar structures outside the ISRZ. These observations suggest that Proterozoic inheritance in the Front Range is not the primary control of mineral deposit permeability structure, location, or orientation. Rather, responsible processes likely include: a) proximity to shallowly emplaced plutons; b) self-generated, hydro-fracture-like permeability due to thermally driven pore fluid pressure changes associated with pluton emplacement; and c) competition between varying magnitudes and orientations of shallow regional horizontal principal stresses, overburden load, and local stress perturbations related to pluton emplacement.

Structural Analysis of the Idaho Springs-Ralston Ductile Shear Zone: Reinvestigating Hypotheses of Inheritance from Proterozoic Structures in the Central Front Range of Colorado

Zachary Wessel,^{1*} John Ridley,¹ and Jonathan Saul Caine²

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²U.S. Geological Survey, P.O. Box 25046, MS 964, Denver, CO, 80225, USA

The Idaho Springs-Ralston ductile shear zone (IRSZ) has been described and mapped as a regionally important, long-lived and reactivated crustal structure in the Front Range and Central Rocky Mountain regions of Colorado. It has been interpreted as one of several persistent zones of weakness in the continental crust. The IRSZ has also been associated with the Proterozoic assembly of North America and with the later development of the Colorado Mineral Belt (CMB). Previous research has only partially characterized the style, timing, and sense of displacement of the IRSZ. Characterization at an appropriate scale for robust evaluation of influence on CMB mineralization has in particular been lacking. In view of the proposed weakness of the IRSZ and its control on the localization of Late Cretaceous–Tertiary mineral deposits, we have reinvestigated the structural history of the zone and adjacent rocks. Two fundamental questions were addressed: 1) is the description and interpretation of the IRSZ as a major through-going crustal-scale shear zone accurate?, and 2) is there evidence for repeated reactivation within the shear zone which would support the interpretation that it has formed a long-lasting zone of weakness? Structural domain analysis of compiled USGS map data and newly collected outcrop foliation and lineation data was used to determine if any large-scale fabric patterns exist that indicate the presence of a major shear zone. Multiple tests were performed to determine how regional-scale structural fabrics are influenced by deformation along and adjacent to the IRSZ. A kilometer-scale structure defined by parallel regional, fold-related foliation is mapped and supports the existence of the shear zone. However, geologic units do not show any significant variation or offset in rock types adjacent to and across the shear zone as would be expected at a major through-going crustal structure. The IRSZ does, however, run adjacent to a km-scale synform and is coincident with the south limb of this fold. A change in regional foliation across the fold-shear zone pair, from NE-SW to NW-SE strikes, suggests the zone marks a boundary between structural fabric domains. This boundary indicates that either pre-IRSZ structures had different orientations or that the folding, shearing, or both caused regional realignment of structures. Kinematic analyses of rare meter-scale, discontinuous mylonites in the study area show no evidence of strike-slip movement along the fold limb or the IRSZ, but the kinematics are consistent with both north-side-up and south-side-up sense of shear. The domain analyses indicate the presence of a regional, foliation-parallel structure consistent with the existence of the IRSZ, although mapping, petrologic, and kinematic evidence suggest movement along the IRSZ was not of a crustal-scale magnitude.

Jonathan Saul Caine is a Research Geologist with the U.S. Geological Survey. His work is focused on characterization of fault zones, fracture networks, and fluid flow in the Earth's upper crust. He combines structural geology, hydrogeology, geochemistry, petrophysics, and detailed field studies to understand fault-zone architecture and permeability structure; fault-rock textures, deformation mechanisms, weakening mechanisms, kinematics, and reactivation; direct fault-rock dating; and fault- and fracture-network related fluid flow as it pertains to groundwater supply, mineral deposits, hydrocarbon migration, and environmental geochemistry of hydrothermally altered and complexly deformed crystalline-rock and sedimentary basin aquifer systems. Caine also works closely with graduate students and colleagues at the University of Colorado, Boulder, the Colorado School of Mines, and Colorado State University. He received his B.A and M.A. in Geology from S.U.N.Y. New Paltz (1986 and 1991) and his Ph.D. from the University of Utah (1999).

Zachary Wessel is a Ph.D. candidate at Colorado State University. His dissertation is focused on a detailed study of the Idaho Springs-Ralston Shear Zone (IRSZ). The study includes performing local scale and regional scale structural domain analyses of metamorphic and deformational fabrics, petrographic and petrologic analyses of metamorphic suites within and bounding the shear zone, and a comparison of the structural variance and compatibilities between the IRSZ and the Moose Mountain Shear Zone. Zachary completed a B.S. and M.S. in Geology at Ohio University (2001 and 2004). His M.S. project focused on the structural and temporal relationship between low- and high-grade metamorphic suites, igneous intrusives, and an associated mylonite zone in the Creignish Hills of Cape Breton, Nova Scotia. His research interests include the interaction of igneous and metamorphic suites, ductile deformation and deformation mechanisms, and continental-scale deformational processes. He also has an extensive knowledge and understanding of sedimentary processes, structural analysis, and geophysical data interpretation as related to natural resource exploration. After completion of his Ph.D., Zachary will begin work for El Paso Oil & Gas in Houston, Texas.



May President's Message from Scott Minor

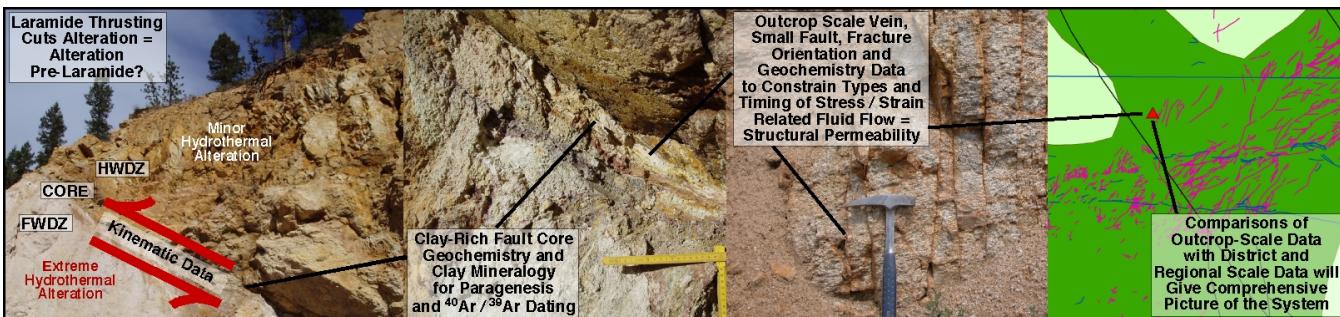


I can't believe I am already writing my final president's message before the summer break. My spring has been breezing by way too fast, although I suspect the two weeks of field work I just "enjoyed" had something to do with my rapid perception of time. Mapping and measuring youthful tectonic deformation in coastal southern California is exciting and absorbing work for me in and of itself. However, I must say that my interest in, and desire to understand, active tectonism is heightened this field season by the dramatic and humbling displays of Earth's power and energy afforded by the recent large earthquakes and volcanic eruptions around the world (including recent the M7.2 Mexicali quake near the S. Calif.-Mexico border). The unexpected or poorly predicted occurrence of many such natural events and even human-induced disasters involving geologic factors, like the ongoing catastrophic oil "eruption" in the Gulf of Mexico, continue to stump earth scientists and hopefully challenge us to dig a little deeper into how the physical world works.

Speaking of tectonics, at the April CSS meeting a full-capacity crowd was treated to two exceptional talks by Warren Hamilton on his model of modern plate tectonic processes and the Earth's first 4 billion years before plate tectonics. Besides eloquently presenting some compelling geologic and geophysical evidence for the way Earth does and did work, Warren educated many of us on "zombie science" and how it has pervaded much of earth science and biased and distorted the conventional view of plate tectonics. Thanks, Warren, for your stimulating presentations..... images of those red zombies floated around my head for only a week afterwards!

There is still time and room to sign up for the Spring CSS fieldtrip to look at and discuss interesting and important structural and hydrothermal features in the basement rocks of the central Front Range. Please see the field trip info. and sign-up sheet on page 4 of this newsletter. I am already getting excited about our upcoming Fall fieldtrip to the Aspen area honoring CSS past-president Bruce Bryant, who has spent much of his exceptional career mapping and studying the geology of the mountains surrounding Aspen. I hope you will join us on this trip in late September (see preliminary announcement on page 6) to see some spectacular geology and beautiful scenery, including what hopefully will be peak fall colors. You also will not want to miss the September meeting just prior to the fieldtrip when Bruce will be honored, followed by a series of talks on aspects of the Aspen region geology. Unfortunately, our plan to hold the CSS Family Day outing in May at the Denver Museum of Nature and Science had to be dropped due to a scheduling conflict. However, we are now looking into having the event at the Morrison Natural History Museum, most likely in June. The event may even include a tour of one of the nearby dinosaur quarries. Please be on the lookout for an email announcement of the Family Day event in the next few weeks.

May each of you have a productive, safe, and fun summer!



Colorado Scientific Society Spring Field Trip, Saturday, May 22, 2010

Ductile and Brittle Structures, Kinematics, and Hydrothermal Alteration in the Central Colorado Front Range

Trip Leaders: Jonathan Caine (USGS) and Zachary Wessel (Colorado State Univ.)

Scope: The evolution of the Colorado Rocky Mountain Front Range is intimately associated with pervasive brittle deformation, fluid flow, economic mineral deposition, and hydrothermal alteration. Regional to local structural control of the major mining district plays and hydrothermal mineral deposits has long been hypothesized in the Colorado Mineral Belt. However, the controls on strength, permeability, and rheology of various geological structures in relation to mineral deposit formation are poorly documented and understood. As part of ongoing USGS research, structures resulting from protracted brittle deformation in the Front Range are being examined in detail using an integrative approach to better understand this complex system. The field trip objectives are to show participants key localities that exemplify the details of structures, data and conceptual models, and foster dialogue. Some topics to be discussed include 1) the structural geologic history; 2) ductile deformation; 3) evolution and localization of brittle fault zones, polymetallic fault veins, and hydrothermal alteration systems; and 4) hypotheses regarding structural and permeability inheritance in the central Front Range.

Logistics: May 22, 2010. Meet at 8 A.M. at the Cold Springs Park-N-Ride at 6th and Union Ave. The trip will return to the same location by 5:30 P.M. All transportation during the field trip will be provided by rental vans. Participants should bring boots for short hikes, a hard hat if working around road cuts is of concern, sunblock, sunglasses, cameras, and any geology equipment desired. We will visit road cuts, natural outcrops, and quarries in the vicinity of the Central City and Boulder-Tungsten mineral districts and the Idaho Springs-Ralston Shear Zone. Bring a sack lunch and drinks will be provided.

Contact: Cal Ruleman, cruleman@usgs.gov; 303-236-7804

Cost: \$20/person, and students are FREE!

Extended Registration Deadline: **FRIDAY, MAY 14, 2010**

Make Checks Payable To: Colorado Scientific Society

Mail Checks To: Cal Ruleman, USGS

Box 25046, Denver Federal Center

MS 980

Denver, CO 80225

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“Ductile and Brittle Structures, Kinematics, and Hydrothermal Alteration in the Central Colorado Front Range” CSS Spring Field Trip sign-up form Saturday, May 22, 2010

Name(s) _____

Address: _____

Phone: _____ E-Mail: _____

Number of registrants _____ x \$20 = _____ (enclosed); Number of students (free) _____

Please include this form with your payment.

Write check to: *Colorado Scientific Society*

CSS Memorial Funds—2010 Student Research Grants Awarded By Don Sweetkind

This year we received 26 applications for Memorial Funds grants and we were able to fund 12 of those applicants. Grants were awarded to 2 Ph.D., 9 M.S., and one undergraduate research projects. The review panel consisted of Matt Morgan (CGS), Bruce Gellar (CSM), and Don Sweetkind (USGS).

Twelve awards totaling \$11,900 were made from the five Memorial Funds. The Tweto and Oriel Funds for research in the Rocky Mountains supported all or part of five proposals for \$5,555 total. The Eckel Fund for research in engineering geology awarded \$1,600 to support three proposals. The Snyder Fund for research on Precambrian geology of the Rocky Mountains awarded \$3,526 to four proposals. A total of \$1,200 for two proposals for research on Quaternary geologic problems was awarded from the Pierce Fund.

During the past 23 years (including this year), the Society has helped support the graduate research of 198 students, awarding a total of \$157,600 (an average of almost \$800 per grant). This achievement is extraordinary for an organization of our size and exemplifies the commitment of CSS members to promote high-quality research in the earth sciences through charitable contributions to the Memorial Funds. Here are this year's winners sorted by fund:

Tweto and Oriel Funds

- Kristin Jacob (Ph.D. student, University of Colorado at Boulder) \$1,005: "The Petrogenesis of Silicic Magmas Based on U-Pb Zircon Geochronology and Geochemical Studies: The Never Summer Igneous Complex, Colorado."
- Scott McFadden (M.S. student, Iowa State University) \$1,000: "The origin of nodular sillimanite rocks and their genetic relationship to metamorphosed Proterozoic Cu-zn and Pb-Zn deposits, Colorado."
- Sean Polun (M.S. student, Idaho State University) \$1,200: "Dike Related Rifting in the Quaternary Blackfoot Volcanic Field, SE Idaho: Implications for Geothermal Energy Development."
- Josh Maurer (M.S. student, Bowling Green State University) \$1,750: "Reinterpretation of depositional environment and timing of the Devonian Ignacio and Elbert formations; San Juan Basin, Colorado."

Eckel Fund

- Natalie Kramer (M.S. student, Colorado State University-Fort Collins) \$650: "Using Ground Penetrating Radar to characterize the stratigraphic architecture of post-glacial valley fill, Rocky Mountains, Northern Colorado."
- Trevor Ycas (B.S. student, Fort Lewis College) \$600: "Dendrochemical Signatures of Anthropogenic Metal Pollution in Engelmann Spruce (*Picea engelmannii*): an investigation of historic metal concentrations in a highly mineralized hard-rock mining district."

Snyder Fund

- David Reioux (M.S. student, University of Montana) \$526: "Metamorphic evolution of the southern Highland Mountains, Montana, and implications for the reconstruction of Laurentia."
- Jennifer Gifford (Ph.D. student, University of Florida) \$1,000: "A New View into the Lower Crust and Upper Mantle of the Great Falls Tectonic Zone."
- Karri Sicard (M.S. student, The University of Wyoming) \$1,000: "Understanding the relationship between Cretaceous and Tertiary magmatism, deformation, and metamorphism in a metamorphic core complex and partial crustal section East Humboldt Range, Nevada."
- Stephanie Mason (M.S. student, University of New Mexico) \$1,000: "Paleomagnetism of Oligocene Ignimbrites from the Western Margin of the San Luis Basin: Implication for the Kinematic Evolution of the Rio Grande Rift."

Pierce Fund

- Chris Denison (M.S. student, Colorado State University) \$1,000: "Geologic implications for the mountain pine beetle epidemic, Willow Creek Pass, Grand County, CO."

Grant awarded using a mix of Tweto, Eckel, and Pierce funds:

- Christopher Florian (M.S. student, University of Colorado at Boulder) \$1,150: "High Plains Lake Coring Project."



FIRST ANNOUNCEMENT

The Grand Loop Field Trip—A Tribute to Bruce Bryant
September 24–26, 2010

This Fall's field trip will entail a geologic journey into Bruce's old stomping grounds and go out to Glenwood Springs, up through Aspen, and back around over Independence Pass and through the Upper Arkansas River Valley. We plan to look at a variety of geologic topics and disciplines from the Proterozoic to the Quaternary. Geologic highlights will include the geology of the Maroon Bells, spectacular glaciated valleys, Quaternary geology of the Roaring Fork Valley, and the Oligocene Grizzly Peak caldera. We plan to stay in Glenwood Springs the first night, with the option of staying at the old hot springs lodge and having a soak. The second night will be around Aspen, with a motel or camping option. Aspens should be in peak color at the time of the trip as well. We are trying to plan this trip as cost efficient as possible so PLEASE let us know as quickly as possible if you are interested in being part of this geologic journey. Final cost will be issued after registration deadline.

Preliminary Cost Estimate:

\$50/person for transportation

Glenwood Springs Lodging—Hotel Colorado and Hot Spring Soak \$140/room
Holiday Inn \$89/room + \$17/person for Soaking

Aspen Lodging—St. Moritz Hotel \$79/room or \$33/person for dorm style

or

Camping—FREE!!!

STUDENTS, DO NOT BE DETERRED BY THE COST, WE WILL DO OUR BEST TO FIND
A DRAMATICALLY REDUCED RATE FOR ALL OF THOSE INTERESTED.

Departure Date: Friday Sept. 24 at 3:30 pm

Registration Deadline: Friday, August 20, 2010,

Return Date: Sunday Sept. 26 by 5:00 pm

No money down—final cost to be decided after Aug. 20th

PLEASE RSVP ASAP to Cal Ruleman at cruleman@usgs.gov or 303-859-0911



Earth Science Meetings and Talks

Newsletter items must be received by the 25th of each month.

Colorado Scientific Society's regular meetings are held the 3rd Thursday of the month at the Colorado School of Mines in Golden (**unless otherwise advertised**). Social time begins at 6:30 p.m. and talks start at 7:00 p.m.

For more information, contact Scott Minor, at 303-236-0303, sminor@usgs.gov

Café Scientifique Wynkoop Brewery, evening science talks at 6:30. Free, except for beer. <http://www.cafescicolo.org>

CO-AIPG May Luncheon—May 18, *Emily Duncan, ERM, Denver, CO*, “Recent Rule-Making and Carbon Costs: Proactively Playing the Carbon Market.” 11:30 AM social gathering; Noon luncheon and subsequent speaker presentation. The meeting will be held at the Petroleum Club (3rd Floor in the Denver Athletic Club building), 1325 Glenarm Street, Denver. Please make an advance reservation so that seating and food preparation are adequate to cover attendance. Cost is \$25 with advance reservation and \$30 at the door. Paid parking available along the street (metered) or in the adjacent parking lots. Contact Jim Russell by Noon on May 14 for reservations at 303-278-4456 (home), 303-815-3901 (cell), or via e-mail at summitdatasvcs@msn.com.

Denver Mining Club—May 17, *Allan P. Juhas, Consultant Economic Geologist*, “Reconnaissance for Gold in Kenya.”

May 24, *Christie Wright, Park County Historian. Park County, Colo.*, “Mining Fatalities.” **May 31, No meeting.** “Memorial Day Holiday.” The DMC meets every Monday at the Littleton Country Buffet near Bowles and Wadsworth (8100 W. Crestline Ave., in the shopping center) 11:30–1:00. Purchase of lunch required. <http://www.denverminingclub.org>

Denver Museum of Nature and Science —“The Science Lounge,” Entertainment, Science, and Cocktails. \$8 member, \$10 non-member, cash bar. For schedule see: <http://www.dmns.org/sciencelounge>

Denver Region Exploration Geologists' Society (DREGS) meets in the Mutual Consolidated Water Building, 12700 West 27th Avenue, Lakewood. Social 6:00-7:00 p.m. Presentation at 7:00 p.m. Meetings are normally scheduled for the first Monday of each month. For information contact Jim Piper, (303) 932-0137, or the website <http://www.dregs.org>

Denver Well Logging Society (DWLS)—The DWLS meets on the third Tuesday of each month, Sept. through May. Lunch and a technical talk at the Wynkoop Brewery begins at 11:30 a.m., 18th and Wynkoop Sts. in Denver.

To make your reservations for the luncheon, please use the new PayPal page, *no later than noon on the Thursday prior to the lunch*. http://dwls.spwla.org/Luncheon_Reservation.htm

Lufkin Field Trips LLC presents: Black Hills, South Dakota Field Trip, July 22–25, 2010; Cost: \$740 payable by check no later than June 1. Members of the Colorado Scientific Society will receive a 10% discount on this trip. Trip cost includes all meals, transportation, lodging, and fees for admission to all scheduled activities. Alcoholic beverages consumed at meal time are not included. All travelers will receive the recently published Guidebook to Geology of the Black Hills, South Dakota, by Lufkin, Redden, Lisenbee, and Loomis. *For more information, please contact Dr. John Lufkin, Director, 303-997-7365, or email, lufk3@comcast.net.

Rocky Mountain SEPM—May 25, *Gregory P. Wahlman, Wahlman Geological Services, 12303 Lanny Lane, Houston, Texas 77077*, “Diverse Origins and Facies of Carbonate Microporosity.” Reception at 11:30, lunch at noon, speaker at 12:30. Reservations: luncheons@rmssepm.org, or call Steve Stancil 720-929-6536, before noon of preceding Friday. \$20.00 lunch, \$3 talk only. Wynkoop Brewing Company, 1634 18th St., Denver. <http://www.rmssepm.org/luncheons.shtml>

Tate Geological Museum at Casper College presents the 16th Annual Symposium. June 4–6, 2010, Third Annual Fossil Preparation and Collections Symposium. The theme of this year's conference is “Beneath Wyoming Waves: Marine Paleontology.” Keynote speaker is Dr. Judy Massare from the State University of New York, Brockport. Her topic is Jurassic Ichthyosaurs. Register by phone at 307-268-2447.

Univ. of Colorado, Boulder, Geol. Sciences Colloquium—Weds., 4:00 p.m., Benson Earth Sci. Auditorium, Rm. 180. Refreshments at 3:30 p.m. on the 3rd floor. <http://www.colorado.edu/geolsci/>

Western Interior Paleontological Society—Field Trip, Sat., May 22, 2010 *Baculite Mesa (near Pueblo, CO)*, Trip Leader: Malcolm W. Bedell, Jr. This field season marks the 20th anniversary of WIPS' first trip to the Cretaceous marine outcrops of Baculite Mesa, known, as the name suggests, for fossils of Baculites. Many other invertebrate fossils can be found there including ammonites, gastropods, nautiloids, scaphites, and various pelecypods. Exposures of Pierre Shale as well as Tepee Buttes can be explored. For more details, go to: www.westernpaleo.org

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<http://www.coloscisoc.org>



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