Colorado Scientific Society

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

STUDENT NIGHT

Five 15-minute talks on student research from Front Range colleges and universities

Tuesday, November 4, 1997

SOCIAL HOUR

6:30 - 7:30 PM in Geology Museum, Berthoud Hall,
Colorado School of Mines - Refreshments provided

STUDENT PRESENTATIONS

7:30 PM in Ballroom 3 (Rm 244), 2nd floor,
Ben Parker Student Union, Colorado School of Mines

1997 Student Night

The Society will host 1997 Student Night on Tuesday, November 4. This annual event allows students from Front Range colleges and universities to showcase their research before a knowledgeable yet friendly audience. Students were welcomed to repeat talks from the Annual GSA Meeting in October. The program consists of five 15-minute talks and will be held on the campus of the Colorado School of Mines (figure 1).

The Society will present cash prizes ranging from $200 to $50 to students chosen to participate. In addition, all participants will also receive honorary membership in the Society.

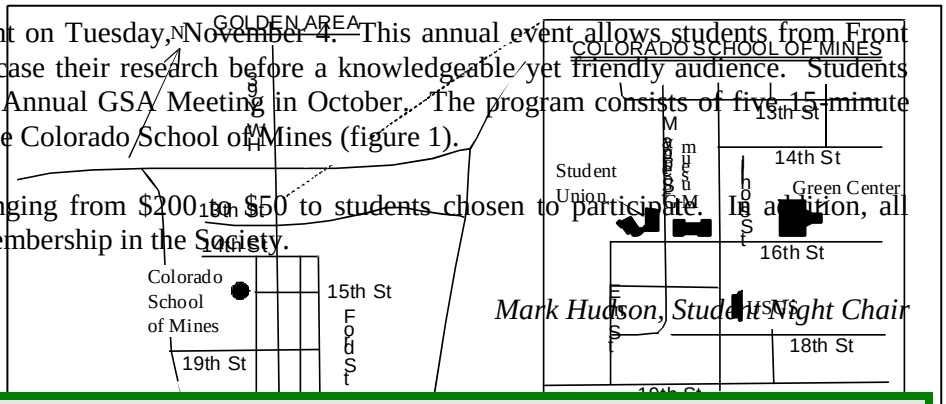

Figure 1. Map showing locations of Student Night activities.

Mark Hudson, Student Night Chair

Student Abstracts

Sm-Nd ISOTOPE SYSTEMATICS IN METAMORPHIC MONAZITE FROM NORTHERN NEW MEXICO, IMPLICATIONS FOR THE ORIGIN OF 1.4 GA HIGH TEMPERATURE-LOW PRESSURE METAMORPHISM

Honorable Mention

Brook Holcombe
Colorado College, Colorado Springs

In the southwestern U.S., the 1.4 Ga "anorogenic perforation" of the continent has been shown to be much more complex than originally conceived. Large areas of 1.7-1.6 Ga rocks have been overprinted by a pervasive high-temperature metamorphism ca 1.4 Ga. Regional geochronological and thermochronological data suggest that following this perturbation, middle crustal rocks cooled (from >500°C to <200°C) very slowly from 1.4- <1.0 Ga.

In northern New Mexico, the Taos and Cimmaron Mountains are cored by a ca 1.76-1.6 Ga complex of plutonic and volcanic rocks, which have had a complex history of deformation and metamorphism. The timing of metamorphism and deformation in these rocks is contentious. However it is clear that ca 1.4 Ga these rocks were overprinted by a high temperature (500-700 °C) low to moderate pressure (3-5 kb) metamorphism. Sillimanite-bearing paragneisses contain abundant clear grains of monazite which are 1.42 Ga. Amphibolitic rocks contain 1.42-1.4 Ga metamorphic sphene and zircon. No 1.4 Ga plutons have been recognized anywhere in the range although volumetrically insignificant pegmatitic pods occur locally. A major question is, therefore, what is the source of the heat for this pervasive metamorphism. We have analyzed the Sm and Nd isotopic composition of single grains of 1.42 Ga metamorphic monazite from the Taos Range and Cimmaron Mountains. The monazites have uniform BSE images with no evidence of growth zoning. We have obtained a range in initial (1.4 Ga) ε_{Nd} from +2 to +6. The $^{147}Sm/^{144}Nd$ values vary from .08 to 0.1. The observation that the T_{DM} ages of the monazites are, within uncertainties, the same as the crystallization age suggests that they were not formed from an average 1.7 to 1.6 Ga crustal reservoir of Nd. Instead, the data suggest that the Nd was derived from a long-term Sm depleted reservoir and implicate a major transfer of mantle-derived fluids and/or magma coincident with the 1.4 Ga metamorphic event.

LATE QUATERNARY GLACIAL HISTORY OF MID-OUTER CUMBERLAND SOUND, EASTERN CANADIAN ARCTIC

First Place

Michael R. Kaplan
INSTAAR, Colorado University, Colorado Springs

Cumberland Sound is a major marine embayment along the southeast coast of Baffin Island, eastern Canadian Arctic. During the Late Quaternary this was an ideal setting for an ice stream connecting the interior of the northeastern Laurentide Ice Sheet (LIS) and the northwestern sector of the North Atlantic Ocean. Therefore, Cumberland Sound and adjacent southeastern Cumberland Peninsula are key areas for studying northeastern LIS dynamics and ice/sheet ocean interactions, despite little current knowledge of this

history. Glacial geologic studies along the coastline of Cumberland Peninsula provide evidence for both ice sheet and local ice cap activity whereas numerical modeling tests the physical plausibility of ice sheet reconstructions inferred from the field program in this region.

The two dominant geomorphic landscapes on southeastern Cumberland Peninsula are (1) glacially modified low-lying areas and (2) weathered high plateaus lacking evidence of recent glacial activity. The orientation of striations indicates that ice flowed SW and SE into the low-lying areas of Cumberland Peninsula before entering the Sound. In addition, mapping of the limits and elevations of postglacial marine submergence (raised marine features such as wave-washing and beaches above present sea level) along the coast of Cumberland Peninsula indicate that the Sound was isostatically depressed by the LIS. Dates based on ^{26}Al and ^{10}Be (cosmogenic) isotope concentrations in glacially-modified bedrock range from 12,000 to 20,000 years, constraining the timing of both glacial activity on the Peninsula and the presence of the LIS. Cosmogenic isotope dates from the higher plateaus are older and, as expected, show more scatter: dates range from 29,000 to 61,000 years, indicating complex exposure histories. Together, these lines of evidence suggest that recently much of Cumberland Peninsula was affected by erosive (warm-based) local glaciers while the adjacent Sound was inundated by a low-surface slope ice stream. During this time the high plateaus must have been covered by thin cold-based ice and/or have remained unglaciated. The latter explanation is more compatible with recent lake sediment studies on some of the plateaus. Numerical modeling allows simulation of this hypothesized reconstruction in addition to providing insights into the necessary boundary conditions for such glaciologic behavior. This study provides the first data for the glacial history of southeastern Cumberland Peninsula. The results highlight the glaciologic role Cumberland Sound may have played during the Late Quaternary Period, given its influence on the dynamics and configuration of the northeastern LIS.

FRACTURE NETWORK PREDICTABILITY IN RELATION TO BED THICKNESS, LITHOLOGY, AND FAULT PROXIMITY, BRUSHY CANYON FM., WEST TEXAS

Second Place

Aaron John Kullman
Colorado School of Mines, Golden

Characterization of fracture networks is important for assessing reservoir quality and fault sealing. Knowledge of how lithology, bed thickness, and faulting can control fracture spacing and orientation greatly enhances the predictability of fractures in the subsurface. The effect of fractures on cementation and sealing is also important.

Outcrops of the Permian Brushy Canyon Fm. in the Delaware Mountains of West Texas provide an excellent analog to many large, deep-water sandstone reservoirs. The Brushy Canyon Fm. is interpreted to be a slope and basin low-stand sequence of fine-grained sandstones and siltstones deposited in deep-water channels and fans. Migration of carbonate- and hydro-carbon-bearing fluids accompanied Basin and Range normal faulting.

Sedimentological architecture within the Brushy Canyon Fm. contributes significantly to fracture development. Scan line surveys along cliffs demonstrate that fracture spacing is related, in part, to lithology and bed thickness. Fracture spacing and bed thickness generally show a positive correlation. Spacing and variance of fractures are smallest in thin fine-grained sandstone beds, and largest in organic-rich siltstone beds.

Also, faults and associated fractures can act as fluid conduits, fluid barriers, or both, depending on the history of diagenesis related to fluid migration. Fracture spacing in sandstone beds increases parabolically away from faults. Carbonate-filled veins are concentrated near faults. Outcrop seismic velocity measurements quantify a diagenetic alteration halo across faults resulting from multiple fluid migration and precipitation events. Furthermore, fracture orientation and spacing are dissimilar in the hanging-wall vs. foot-wall of some faults, suggesting that cementation-related fault sealing and reservoir damage may be asymmetric around these faults.

FLOW UNITS AND UPSCALING OF A COMPLEX CARBONATE RESERVOIR USING A 3-D GEOLOGICAL MODEL

Honorable Mention

Max Scuta
Colorado School of Mines, Golden

The purpose of this study is to define reservoir flow units in a complex carbonate reservoir using cores, logs, outcrop analogs, production data, by applying sequence stratigraphy concepts as well as the interpreted structural evolution for this area. A further objective is to construct a 3-D geological model of this field, which

has been upscaled for reservoir simulation purposes and modeled to predict seismic response.

The reservoir is the Permian San Andres Formation, which is composed of stacked cyclic shallow marine carbonates deposited in a distally steepened ramp setting. Pervasive dolomitization, fracturing and subsequent plugging with anhydrite cement, in addition to moldic, interparticle and intercrystalline porosities are the result of extensive diagenesis.

Time-lapse logging using resistivity logs and injectivity profiles, and the use of porosity-resistivity overlays show that there are significant zones of unswept pay. Borehole images provide information to interpret bedding and fracture orientation, and allows recognition of breakouts that define the in-situ stress orientation. Combining these elements with the sequence stratigraphic interpretation has allowed the creation of a 3-D geological model using *Stratamodel*. This software package provides input into the Eclipse reservoir simulator using scaling up approaches contained in *Geolink/Gridgenr* software packages. *Stratamodel* is also used to distribute the attributes needed for the 3-D synthetic seismogram.

This study provides a bridge between geologic, engineering, and seismic data. Such combined data can be used as a tool for helping predict reservoir behavior and improving exploitation in this and other similar carbonate reservoirs. A 3-D model becomes a powerful visualization tool that can help make strategic reservoir-management decisions.

DEVELOPMENT OF A PROTOTYPE GEOSCIENTIFIC INFORMATION SYSTEM OF THE HARAPPA ARCHAEOLOGICAL SITE, PUNJAB PROVINCE, PAKISTAN

Third Place

Wayne R. Belcher
Colorado School of Mines, Golden

The Harappa archaeological site, located in the Punjab Province, Pakistan, consists of several large mounds of cultural material on the Ravi River flood plain. The Harappa site is part of the Bronze Age Indus Valley Civilization, initially discovered at Harappa. Current excavations, which begun in 1986, focus on the evolution and dynamics of this ancient urban center.

My research has incorporated both traditional 2D-GIS and 3D-visualization methods inherent in geoscientific information systems (GSIS) to produce a database with a graphical user interface. Several GIS and GSIS products were integrated to construct these products.

Data from the Harappa excavations include thousands of entities or items, such as site maps, area maps, structure plans and sections, trench plans and sections, artifact information records and collections, and archaeologic interpretations. A subset of the data was used to develop methodologies to manage, synthesize, and visualize; and to examine interrelationships of site-wide topographic and stratigraphic models, paleotopography, archaeologic structures, reconstructions, archaeologic trenches, and artifact distributions.

The prototype includes a multi-scaling user interface to visualize data at appropriate scales (site, structure, and trench) to present topographic/stratigraphic data, to manage and display excavation data, and to present archaeologic reconstructions of structures. The accuracy and appropriateness of the 3D-visualization methodology were evaluated by qualitative and quantitative analyses.

An integrated data management and visualization approach can serve to archive and preserve Harappa data and interpretations for future generations of archaeologists. The results of this work can also be applied to other geologic work such as geotechnical site investigations, seismological work, and environmental engineering work, due to analogies between geology and archaeology.

Earth Science Meetings

Colorado Scientific Society's regular meetings are held the 2nd Tuesday of the month (unless otherwise advertised). Social time begins at 7:00 p.m. and program is at 7:30 p.m. Contact Karl Kellogg at 236-1305 for information.

Denver International Petroleum Society (DIPS) meets the 2nd Friday of each month at the Wynkoop Brewing Co., 18th 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 Kristine Peterson (303) 980-6770. 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: $13 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, 866-2611.

Denver Mining Club meets Thursdays from 11:30 a.m. to 1:00 p.m. at the Country Harvest Buffet at Villa Italia, 7200 W. Alameda Avenue, Lakewood. For more information contact Dick Beach at (303) 986-6535.

November 13 — Hal Leith, Gemologist, "Gems/Minerals"

November 20 — Bob Henson, Writer/Meteorologist, UCAR Communication, "El Niño: What's Behind the Hype?"

December 4 — James A. Cappa, Chief, Minerals and Mineral Fuels Section, Colorado Geological Survey, "Colorado Mineral and Mineral Fuel Activity, 1996"

December 11 — Ross Bhappu, CEO, Copper Ventures, Ltd., "Role of New Technologies in the Mining Industry"

December 18 — Bob Neukirchner, Pres., Eagle Engineering Services, Inc., "Effects of Ore Body Inundation—A Case Study of the Eagle Mine, Minturn, Colorado"

Colorado School of Mines Van Tuyl Lectures

For information call the Dept. of Geology at 273-3800.

Colorado State University Geology Lectures

All presentations are at 4:00 p.m. in room NR 316, with the exception of the AAPG Distinguished Lecture, which will be at NOON. For information, contact Eric Erslev at (970) 491-6375.

Museums, Internet, News

Friends of Dinosaur RidgeÖfor 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.

Morrison Natural History MuseumÖis open 1-4 p.m., Wednesday through Sunday. The Museum is located on State Highway 8, Ω mile south of Morrison. Fireside chats are cosponsored periodically by Friends of Dinosaur Ridge (see above).

Fall Field Trip Enlightening

Carl Norbeck led an interesting field trip to the Clear Creek watershed on October 4. About 20 CSS members and friends learned of exciting community and private activities that are coming together to protect waters that feed into the Denver metro area. The trip was designed for geoscientists to become more knowledgeable about geoenvironmental issues of the Clear Creek watershed and efforts underway to provide the communities downstream with clean water.

Figure 2. CSS members listen to Carl Norbeck explain the use of anaerobic methods at an abandoned mine.

The Clear Creek Watershed Forum, along with numerous organizations and individuals, has the goal of maintaining the environmental soundness of Clear Creek. The consortium is nationally recognized as a stellar example of cooperation between the community, local industry, the state, and the EPA.

Carl Norbeck, geologist and coordinator for the forum, emphasized various environmental issues related to mining, industry, agricultural, and urban use of Clear Creek. He also reported on remediation results that have been achieved through the efforts of private, community, and governmental agencies. Several of the stops were made at EPA Superfund sites, including wetlands in the Silverplume area that are being used in an experimental metal removal method, and the Argo Tunnel in Idaho Springs. Also in Idaho Springs, *Jack Reed* (USGS) described the Precambrian rocks that make up the Clear Creek area. Other stops included the McClelland Mine at Dumont, the Black Eagle Mill at Idaho Springs, and the casino at the Gregory Incline in Black Hawk. At Lions Park and Vanover Park in Golden, we heard how Colorado School of Mines, Coors, and the Clear Creek Water Users Alliance are engaged in cleanup, stream improvements, and diversion structures.

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.

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

(Last Name)	**(First Name)**	**(Middle)**
(Address)	**(Telephone)**	**(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!!

The 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.

Arrangements	*Fund Raising*	*Newsletter*	*Publicity*
Best Paper Award	*History*	*Outreach*	*Science Fairs*
Field Trips	*Membership*	*Program*	*Web Site*

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

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