Colorado Scientific Society

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

Rift Basins of the Central and Northern Rocky Mountains —Inheritance from Laramide Structures

Karl S. Kellogg

U.S. Geological Survey

Tuesday, December 9, 1997

Social Hour: 7:00 p.m.
Meeting Time: 7:30 p.m.

Union Square Theatre in the Sheraton Hotel
360 Union Boulevard
Lakewood, Colorado

Table of Contents

Presidential Address

Rift Basins of the Central and Northern Rocky Mountains—Inheritance from Laramide Structures

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Laramide structures in southwestern Montana profoundly influenced the formation of Neogene extensional basins. A model proposed to explain this association also appears to explain uplifts and basins in the northern reaches of the Rio Grande rift in Colorado.

The Hilgard thrust system is a major east-directed structure in southwestern Montana that strikes north along the western side of the Madison Range and forms the eastern structural margin of the Laramide Madison-Gravelly arch, a large east-directed basement uplift. In most places along the system, basement is thrust over a tight footwall syncline in rocks as young as Late Cretaceous. Basement blocks have demonstrably rotated by as much as that of the basement-cover contact, which in some places is overturned. This relationship underscores a major paradox in basement balancing of basement uplifts: stated simply, why don't large open spaces form? A possible solution, which fits the empirical evidence, is domino-style rotation of basement blocks and the inevitable formation of bounding breccia zones.

The Hilgard thrust system is approximately parallel to a zone of Neogene valley-bounding normal faults (Madison fault system) along the eastern side of the Madison Valley, which contains a thick basin-fill sequence that dips eastward into the normal faults. In some places, normal faults exploit older thrusts, downdropping basement blocks into the Madison Valley, leaving only the footwall synclines exposed. This paired thrust-and-normal-fault relationship is strikingly similar to other paired systems across southwestern Montana and may be due to the collapse of the crestal zones of the basement uplifts (arches) during Tertiary extension.

In Colorado, three basins of the northern Rio Grande rift: the San Luis basin, the Arkansas River Valley, and Middle Park basin, are complex half grabens that in most places contain thick Miocene and early Pliocene basin-fill deposits that dip into large flanking normal faults. In the first two cases, the basins lie astride asymmetric Laramide uplifts (San Luis and Sawatch, respectively), whose steep, thrust-faulted sides are on the same side as the deep parts of the Neogene basins. An accommodation zone, across which the asymmetry of both the Laramide uplift and the Neogene basin reverses, separates the San Luis basin-San Luis uplift from the Arkansas River Valley-Sawatch uplift. These relations suggest not only that the locations of the basins are inherited from the Laramide uplift (as Ogden Tweto and others have noted), but also that the asymmetry of the basins is inherited from the vergence of the Laramide uplifts. A more complicated case is Middle Park, where the valley of the Blue River is faulted down to the west, the same side as the steep, thrust-faulted west margins of the Front and Gore Ranges.

A model for the inheritance of basins from Laramide uplifts works equally well to explain both the features observed in southwestern Montana and the northern Rio Grande rift. The model proposes that during regional Laramide contraction, localized regions of extension formed in the axial zones of uplifts. These extensional zones developed in response to sagging of the leading, thrust-bounded edges of the uplift into adjacent synorogenic basins. During subsequent crustal extension, beginning in late Oligocene or early Miocene (perhaps slightly older in Montana), the axial zones collapsed. Normal faults exploited the older, listric thrusts and tilted the axial basin toward the thrust-bounded side of the Laramide uplift.

President's Report

I look back upon the past year's activities with great satisfaction. The year began with the 36th Emmons Lecture in January, at which Dr. B. Clark Burchfiel gave a stimulating talk on the tectonics of the Tibetan Plateau. Our regular programs hosted a series of exceptional and diverse speakers, thanks largely to the efforts of Eric Nelson, 1997 Program Chair. The Spring field trip to the Glenwood Springs area, to examine the spectacular salt-tectonic features of the region, was a huge success. Likewise, the Fall field trip, on which we viewed efforts to clean up environmental pollution along Clear Creek was well-attended. Bob Scott deserves our thanks for organizing these two fine trips. In October, a fascinating virtual visit to Mars with Dr. Bruce Jakosky, via the Pathfinder and Global Surveyor missions followed a delicious Family Night dinner.

Our second annual Student Night in November saw five impressive presentations, for which the Society awarded $575 in prize money. If we make a tradition of Student Night in years to come, I believe the interest from students will snowball. Not only is Student Night a fun and enlightening time for everyone, it is also a splendid way to get students involved with the Society. However, Student Night does involve a tremendous amount of work (provided this year by Mark Hudson, Michelle Tuttle, Lisa Bader, and Mike Machette- thanks so much!), and it remains to be seen whether this "tradition" will continue. I know the Council would like very much to get some feedback from Society members as to whether they feel Student Night is a worthwhile activity.

I should mention one concern facing the Society. From a high of about 550 members in 1984, we now stand at about 340 members. This decline in membership may be due to a lack of aggressive recruitment over the past few years, but also may reflect fundamental changes in the geoscience community, such as gradual (and sometimes not so gradual) downsizing of the USGS, as well as downsizing in the oil and mineral industries. Strategies for turning the tide of reduced membership were discussed at the Fall Council meeting and I believe that implementing these strategies will be a high priority this coming year.

Over $9,000 in ten separate student grants was awarded by the Society from the Tweto, Eckel, Oriel, and Pierce Memorial Funds. Proposals were highly competitive (40 were received), and the Memorial Funds Committee (Rich Madole—Chair, Greg Holden, Susan Landon, David MacKenzie, and John Rold) spent many hours evaluating the proposals and selecting the recipients. My heartfelt thanks go to you all.

It has taken the energies of a large group of people to make the Colorado Scientific Society function successfully this last year. Dave Nealey, our Newsletter Editor, put up with numerous last-minute editorial changes (mostly from me!) as well as long evenings of copying, labeling, and stamping the Newsletter. Bruce Bryant coordinated the President's Award for the Best Paper of the Year. Our dazzling Web Page is largely the result of Randy Schumann's creative efforts. Lastly, I'd like to thank the many other people that have contributed to the Society's activities in countless ways.

I have certainly enjoyed serving as your President and I wish Eric Erslev a highly successful tenure as your new President.

Karl S. Kellogg

Memorial Funds Report

The Colorado Scientific Society Memorial Fund program was started in 1984 with the Ogden Tweto Fund. In 1986, we added the Steven Oriel Fund and, in 1990, the Edwin Eckel Fund. The most recent addition, the Bill Pierce—Heart Mountain Fund, was established in 1994. As a result of generous contributions by family, friends, and Society members, the funds have grown substantially since their inception. As of December 1, 1997, the total value of our Memorial Fund investments was roughly $125,000 (this includes about $9,200 in interest reserved for the 1998 awards).

The finances of the Funds are looking good. During 1997, we earned fixed interest income from GNMA and FNMA bonds ($10K-30K each) that have a variety of maturity dates over the next nine years. Most of these bonds were purchased in March of 1995, soon after the short-term peak in bond rates. As a result, we now receive an average of about 7.2% interest from long-term investments that protect the capital of the funds.

Over the past 13 years, the Society has awarded 86 scholarship grants for an aggregate value of $60,190. We are realizing the benefits of compounding interest, in terms of number and amounts of awards granted. As a result, the total value of scholarship grants is well above the 1993 level (see table below). However, our goal is to increase the average amount of individual grants above the $1000 as (inflation has decreased the buying power of those scholarship dollars by about 50% since 1984). Therefore, your continued support of this important and highly visible program of the Colorado Scientific Society is much appreciated. Remember that your **entire** contribution goes towards grants and your contribution is 100% tax deductible.

Michael N. Machette, Treasurer

Amount of Awards
(Amounts in parentheses are interest from Endowment Fund)

Year	Eckel	Oriel	Tweto	Pierce	Total
1984			1300		1300
1985			1050		1050
1986		0	650		650
1987		400	1700		2100
1988		450	900		1350
1989		530	1940		2470
1990	0	1190	2910		4100
1991	650	1500	3100		5250
1992	1270	1890	3500		6660
1993	1000	1290	3030		5320
1994	1250 (200) 1450	1400 (200) 1600	3125 (465) 3590	0	5775 (865) 6640
1995	1041 (159) 1200	1282 (118) 1400	2440 (460) 2900	775 (75) 850	5538 (812) 6350
1996	1160 (140) 1300	1608 (192) 1800	2652 (248) 2900	1768 (132) 1900	7188 (712) 7900
1997	1750	2400	3900	1700	9050
Total	$12,770	$14,450	$33,370	$4,450	$60,190

Number of Awards
(Partial grants are scholarships that were co-sponsored by two funds)

Eckel	Oriel	Tweto	Pierce	Total
		3		3
		3		3
	0	2		2
	1	2		3
	1	1		2
	1	2		3
0	1.5	3.5		5
1	2	4		7
2	2	5		9
2	1.5	4.5		8
2.5	2.5	5	0	10
2	2	5	1	10
2	3	4	2	11
2	3	4	1	10
13.5	20.5	48	4	86

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Student Night

Congratulations to all participants of the November 1997 Colorado Scientific Society Student Night program. Michael Kaplan (Colorado University, Boulder,INSTAAR) won first place honors for his presentation "Late Quaternary glacial history of the mid-outer Cumberland Sound, eastern Canadian Arctic." Aaron Kullman and Wayne Belcher (both of Colorado School of Mines) won second and third place honors, respectively. Max Scuta (Colorado School of Mines) and Brooke Holcombe (Colorado College) earned honorable mention. All students presented impressive, high-quality research and have bright futures ahead.

Thanks to all those Society members who helped to make Student Night a successful event. Special acknowledgments go to Janine and Charlie Sturdavant of Golden City Brewery for providing delicious beverages for the preceding social hour.

Mark Hudson

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.

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).

Election Ballot

Candidates for Upcoming CSS Election

The Society will elect its officers for 1998 at the December 9 business meeting. The Council at its Fall Council meeting on November 6 approved candidates for President-Elect and Councilors. 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 802156-0495.

Colorado Scientific Society
Mail-in Ballot

President-Elect

- ☐ Ken Pierce
- ☐ _____(write in)

Councilors 1998-2000 (vote for two)

- ☐ Eric Nelson
- ☐ Ted Ball
- ☐ _____(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.

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

Colorado **S**cientific **S**ociety
P.O. Box 150495
Lakewood, CO 80215-0495

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