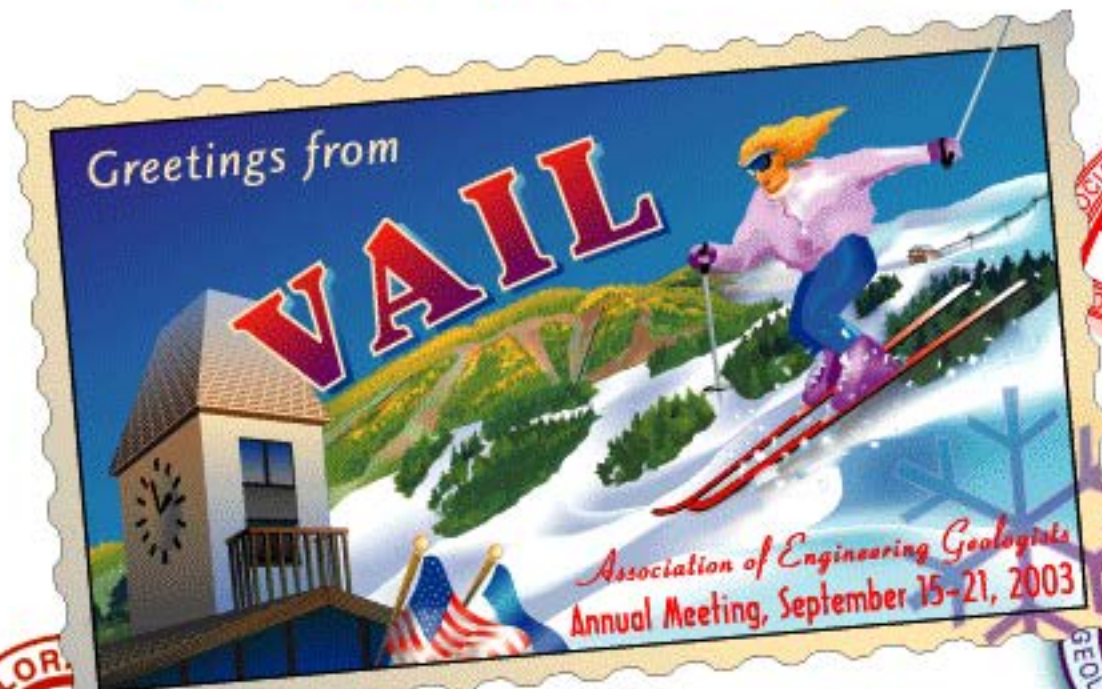


## The Geology of Central Colorado



Explore Central Colorado inside....





## Welcome to Colorado

Greg Walcher,  
Executive Director, DNR

Colorado is well known for its spectacular scenery and geology. This fall, we are fortunate to host two professional meetings that will draw geologists from across the country and the world. These meetings will put the geology of central Colorado on center stage!

The Association of Engineering Geologists will convene its annual meeting in Vail on September 15–21. Then, the American Institute of Professional Geologists will meet in Glenwood Springs for its annual meeting on October 4–9.

Governor Bill Owens joins me in welcoming you to our beautiful State. We hope your meetings are productive and your field trips educational.



## From the Editor

By Dave Noe

In this issue of *RockTalk*, we will highlight the geology of the central Colorado mountains. Our purpose is twofold. First, we wish to orient and inform all visiting AEG and AIPG geologists and tell them about what the area has to offer! Second, we hope to inspire visitors and residents alike to explore this part of our State!

This will introduce you to the fabulous scenic and geologic wonders of this area. The articles are keyed to a map of the area on page 5. For interested readers, page 10 contains a list of where to find more information in the form of Web links and references.

Dave Noe is the Chief Engineering Geologist at CGS.

Design, illustration and layout:  
Larry Scott

## Vail Facts



Founded: 1963  
Elevation: 8,150 feet  
Population: 3,659

Located in the beautiful subalpine valley of Gore Creek, Vail grew almost overnight to become a world-class resort. Now celebrating its 40th year, it has been ranked as the number one ski resort in *SKI Magazine* for 11 of the last 15 years!

Vail's considerable charms are not limited to ski season. The village offers year-round entertainment, and the nearby mountains are popular summer and fall destinations.



## AEG Facts

Founded: 1957 Members: 3,224  
Headquarters: Denver, Colorado  
Web site: [www.aegweb.org](http://www.aegweb.org)

The Association of Engineering Geologists provides leadership in developing and applying geologic principles and knowledge to aid engineering and environmental needs and public welfare.

## Glenwood Springs Facts



Founded: 1883  
Elevation: 5,746 feet  
Population: 7,946

Glenwood Springs is known for its marvelous hot springs, which were used by Native Americans, settlers, and miners. Located at the junction of the Colorado and Roaring Fork rivers, it became a railroad hub and a tourism center.

Today, Glenwood Springs is still a major transportation crossroads and a favorite of tourists who marvel at the region's hunting, fishing, and scenery. And those hot springs!



## AIPG Facts

Founded: 1963 Members: 4,800  
Headquarters: Westminster, Colorado  
Web site: [www.aipg.org](http://www.aipg.org)

The American Institute of Professional Geologists is the largest association dedicated to advancing geology as a profession. AIPG promotes professional responsibility, public service, and certification.



## What to Bring



**Climate:** Central Colorado is subject to extreme climatic variations during the Fall season. Daytime highs can reach the 70's (degrees F), while low temperatures can fall into the 20's. More typically, the average daytime temperatures range between the 40's and 50's. Seasoned visitors prepare for everything: hot sun, rain, wind, and snow!

**Gear:** For driving or any outdoor activities, one should bring layered clothing, a hat, gloves, stiff boots, sunglasses, sunscreen, extra snacks, and water. You may want to bring your camera and videocam, too!

**Altitude:** Many visitors will feel the effects of Colorado's high altitude, which may include headaches, drowsiness, or nausea. The best remedy is to take it easy and drink plenty of water. In extreme cases, one may need to return to lower altitudes.

For More Information, see page 10





## Getting There

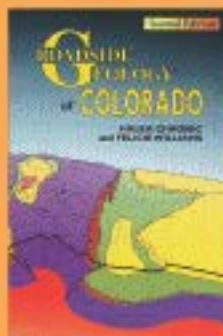


**By car:** Both Vail and Glenwood Springs are located along Interstate Highway 70. Vail is 100 miles from Denver and 150 miles from Grand Junction. Glenwood Springs is 160 miles from Denver and 90 miles from Grand Junction.

**By air:** Most flights to Colorado go into Denver International Airport (DIA). Vail and Glenwood Springs do not have airports, but regional flights may be available to Eagle County Airport near Gypsum and Aspen's Sardy Field.

**By van:** Vail is served by several commercial van shuttle services running from DIA. Glenwood Springs is reached by van service from DIA and Aspen.

**By bus:** Vail and Glenwood Springs are served by Greyhound lines. Both towns have excellent local bus service.



*Geologic guidebooks can make getting there fun and educational.*

**By rail:** Glenwood Springs is served daily by Amtrak's California Zephyr between Denver and Salt Lake City. Vail has no rail service.

**Geologic road logs and tours:** The Roadside Geology of Colorado and the Colorado Geologic Highway Map (available for purchase from CGS; see page 11) are invaluable to have along for identifying and learning about various geological wonders when traveling on Colorado's highways.

**Web sites:** On page 10 we have listed a number of Web sites that contain helpful information about visiting Central Colorado.



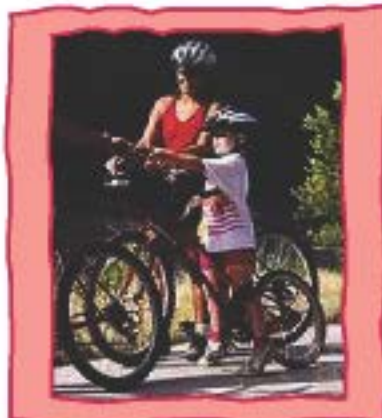
## Scenic Drives and Activities



There is plenty to see in central Colorado. We invite you to stay for an extra few days to enjoy some of the following activities!

**Vail area:** The Leadville Loop (highways I-70, SH-91, and US-24) leads to the Cloud City of Leadville (elevation 10,430 feet) and its historic mines. The return trip passes by Camp Hale, former home of the Army's famous 10th Mountain Division. Other nearby driving destinations include Breckenridge, another mining and resort town, and Piney Lake in the White River National Forest.

**Glenwood Springs area:** A drive up SH-82 to the mining and resort town of Aspen and the Maroon Bells-Snowmass Wilderness makes a great afternoon outing. Another popular drive leads to McClure Pass, Marble, and Redstone to the south on SH-133.



**Bike riding:** Glenwood Canyon and Vail Pass both have paved bike paths. For a great downhill run, take your bike up the Vail Mountain lift. There are numerous mountain bike trails in the area.

**Hiking:** White River National Forest offers numerous hiking trails, including Hanging Lake in Glenwood Canyon, and the Eagles Nest Wilderness near Vail and Maroon Bells-Snowmass Wilderness near Aspen.

**Fishing:** The Frypan River above Basalt is a gold-medal trout stream. Other streams in the area offer good fishing opportunities.

**Golfing:** There are several scenic golf courses in both the Vail and Glenwood Springs areas.

**Caves:** The Glenwood Caverns resort and restaurant, with its showpiece Fairy Cave, has recently opened for business, and is reached by a new and scenic gondola ride.

**Hot Springs:** Glenwood's hot springs resort, and the nearby vapor caves, are a favorite tourist hangout. The resort features the world's largest outdoor hot springs pool.

**Other activities:** Colorado has numerous seasonal activities such as rafting and historic tourist railroads and mines. And come back this winter in order to enjoy our famous skiing!

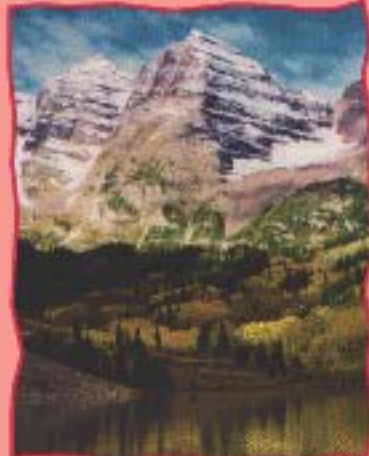


Photo: Dave Noe

*The Maroon Bells near Aspen*



Photo: Norm Thompson



# GEOLOGY

of Central Colorado  
By D. Noe and V. Matthews

Central Colorado's stunning scenery and topography is a product of its geology. As seen in the cross section below, the geologic setting for this region consists of uplifted mountain ranges and plateaus that are separated by deep valleys and basins. The uplifts are cored by intrusive igneous and metamorphic rocks of Precambrian age, and in places by younger, intrusive igneous rocks. The valleys and basins are filled with Paleozoic to Cenozoic sedimentary and volcanic rocks, and Quaternary deposits.

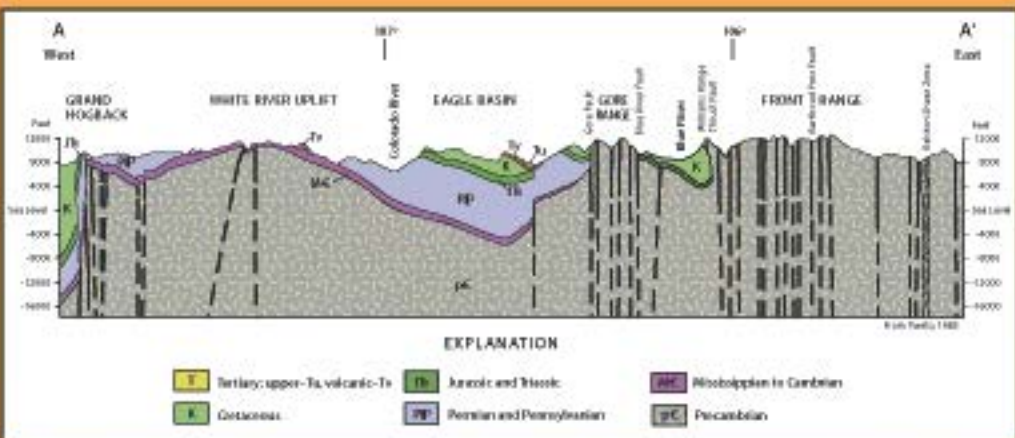
The area's early Paleozoic rocks consist of thin-bedded carbonate and sandstone formations that were deposited in a shallow sea. Good examples are the Sawatch Quartzite (Cambrian) and Leadville Limestone (Mississippian), which are seen in Glenwood Canyon.

After a long period of erosion, the Ancestral Rockies were worn down, and deposition of sediments in continental sand dunes, red beds, and floodplains occurred during late Paleozoic and early Mesozoic time.

Central Colorado was again inundated by a shallow seaway during Cretaceous time. The Dakota Sandstone, Mancos Shale, and Mesaverde Group record this marine incursion and the subsequent re-emergence of continental deposits. These rocks may be seen in the Grand Hogback at New Castle near Glenwood Springs, and in the Wolcott area. About 70 million years ago, the Rocky Mountains rose again during the Laramide uplift, and were eroded, leveled, and buried.

The Tertiary Period featured abundant volcanic activity in central Colorado. Many of the hills around Glenwood Springs are

Era	Period/ Epoch	Formation	Thick (m)
Cenozoic	Pliocene or Miocene	Sedimentary units	0-250
	Q - Miocene	Volcanic units	0-400
Mesozoic	Cretaceous	Uinta, Green River, and Wasatch Fms	0-3,300
		Mesaverde Group	1,450
		Mancos Shale	1,400
Paleozoic	Jurassic	Morrison Fm	75-150
		Entrada Sh	20-30
	Triassic	Chinle Fm	20-90
		State Bridge Fm	0-1,500
Paleozoic	Permian	Maroon Formation	1,150-4,900
		Eagle Valley Fm	100-1,000
	Pennsylvanian	Eagle Valley Evaporite	unknown
		Belden Fm	50-250
	Mississippian	Leadville Ls	45-60
	Devonian	Chaffee Grp	60-70
	Ordovician	Manitou Fm	40
Dotsero Fm		20-30	
Cambrian	Sawatch Qtz	65-165	
Proterozoic Igneous and Metamorphic Rocks			



Geologic Cross-Section across Central Colorado

Source: Tweto, 1979

In later Paleozoic time, central Colorado underwent a major change as the Ancestral Rocky Mountains were uplifted out of a shallow sea. Coarse, red sediments were shed from the mountains, and salts and evaporites formed in the adjacent, restricted seaways. Good examples are seen as the Maroon Formation near Vail and Aspen and the Eagle Evaporite near Glenwood Springs (Pennsylvanian).

capped by basalt flows. A major period of uplift during the Neogene brought the Rockies to their current elevation. This was followed by river incision and regional evaporite dissolution.

Many of Central Colorado's higher-elevation valleys (like Gore Creek at Vail) were sites of alpine glaciation during Quaternary time. A host of Quaternary deposits occur in the area, including till, outwash, alluvium, loess, colluvium, alluvial fans, and landslides.

Source: Kirkham and others, 2002

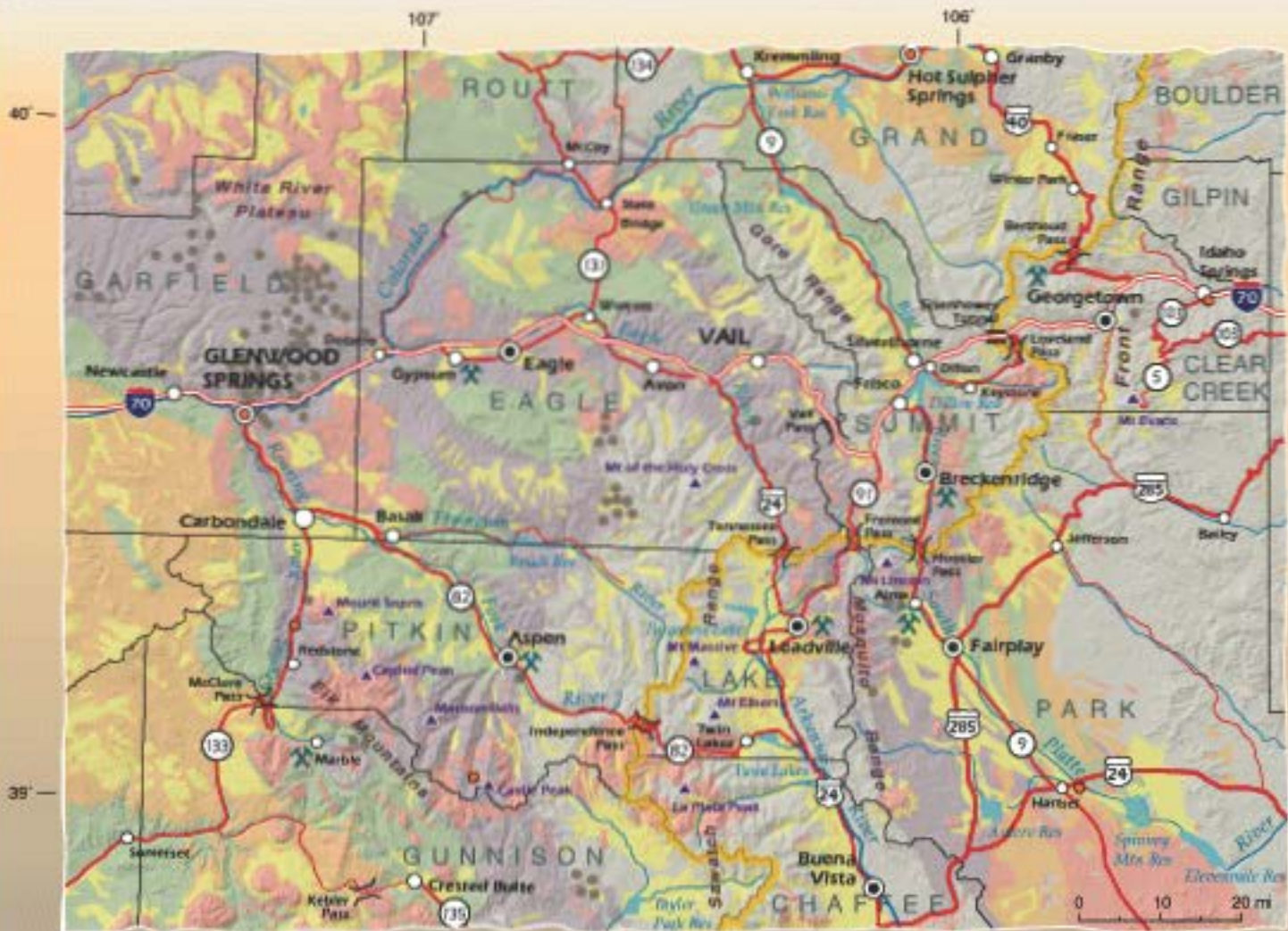
### Stratigraphic Column

For more information on Colorado Geology, visit the CGS exhibit in the Department of Natural Resources Building at the Colorado State Fair in Pueblo, August 16-31, 2003.



# INDEX MAP OF

# CENTRAL COLORADO



Map area



## Explanation

- County seat
- Caves
- Hot springs
- ✕ Mining area
- ▲ Fourteener or other important peak
- Continental Divide
- Quaternary
- Tertiary
- Tertiary Volcanics
- Mesozoic
- Paleozoic
- Precambrian



# MINERAL RESOURCES

of Central Colorado

By James A. Cappa



Central Colorado has an abundance and variety of mineral resources, ranging from gold and silver to oil shale and coal.

**Precious and base metals:** Within this region, several important mining districts have produced both precious and base metals. Ore deposits in these districts are generally hosted by carbonate rocks of Late Paleozoic age, mostly the Leadville Limestone. Laramide age, (75–35 million[M] years) porphyritic igneous rocks are important in localizing these mineral deposits. These great mining camps are no longer productive. The last mine to operate, the Black Cloud Mine in the Leadville district, closed in 1999. The Leadville district produced approximately 3.3 M ounces (ozs) of gold, 265 M ozs of silver, 2,354 M pounds (lbs) of lead, 1,936 M lbs of zinc, and 110 M lbs of copper. Other nearby mining districts include the Aspen district with a production of 101 M ozs of silver; and the Gilman district with a production of 68 M ozs of silver, 1,905 M lbs of lead, and 323 M lbs of zinc.

**Molybdenum:** The huge, world-class Climax Mine is now on a standby basis. The Henderson Mine of Clear Creek County remains as Colorado's sole molybdenum producer. These two deposits are hosted by rhyolite porphyry intrusive complexes. Through its life, the Climax Mine produced about a million tons of elemental molybdenum with a "year-mined" value of \$4 billion.

**Oil and gas:** The Piceance Basin covers much of central Colorado. It contains several important oil and gas fields including the Rangely field, which has produced 865 million barrels of oil and 770 billion cubic feet of gas in its long life.

Today, the Piceance Basin is a major natural gas producing area with several fields producing from Cretaceous and Tertiary age rocks. There are about 480 billion barrels of oil in the shale of the Tertiary Green River formation of the Piceance Basin. Shell Oil Co. is conducting research on in-situ recovery of oil from these oil shales.

**Coal:** There are several coal fields in the central Colorado area. The Grand Hogback Coal Field near Glenwood Springs produced 4 million short tons of bituminous coal; the Carbondale Coal Field produced 31 million short tons of anthracite and high-volatile bituminous coal. None of these mines are active.

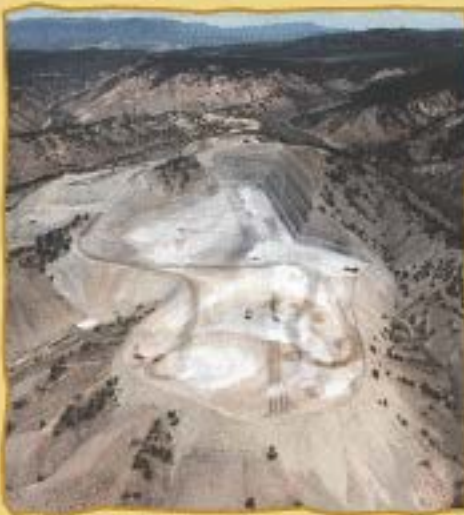


Photo: Jan White

*Gypsum from the Eagle Valley Evaporite is mined in strips and processed at the nearby town of Gypsum.*



Photo: Jeff Scovill

*State Mineral. This rhodochrosite crystal comes from the Sweet Home Mine near Alma.*

#### Industrial and other minerals:

There are several other important mineral resources that are produced in central Colorado. Gypsum is mined from the Pennsylvanian age Eagle Valley Evaporite near the town of Gypsum. The mine produces about 500,000 tons of gypsum a year, which mostly goes into wallboard fabrication.

The Yule Marble Quarry near Marble produces outstanding white marble dimension stone. Yule marble, with its high quality and purity has been used for several of the nation's important monuments including the Tomb of the Unknowns at Arlington National Cemetery, and the Lincoln Memorial in Washington D.C.

Beautiful specimens of gem-quality rhodochrosite, the new Colorado state mineral, are produced from fracture zones at the Sweet Home Mine near Alma.

*Jim Cappa is the chief mineral and mineral fuel geologist at CGS.*



# GEOLOGIC HAZARDS

## of Central Colorado

By Jonathan L. White



The complexity of the central Colorado mountain ranges has placed a wide range of rock and soil types at the ground surface. Hard, jointed basement rocks to poorly cemented sedimentary rocks and dissolution-prone evaporite rocks are exposed or are mantled by younger surficial deposits (soils). This terrain, with its high mountain ranges, steep slopes and cliffs, narrow valleys and gorges, and variable lithology, is prone to a host of geologic hazards.

**Mass movement:** Geologic hazards related to steep slopes, such as rockfall, landslides, debris flows, and avalanches are common in central Colorado.

Rockfall incidents result in one to two fatalities and several injuries a year, on average. Most towns and roadways in valleys or canyons are at some level of risk. Rockfall mitigation and protection devices can be found along I-70 (especially in Glenwood Canyon), and at various locations in the Vail and Glenwood Springs areas.

Entire slopes underlain by weak substrate can fail as landslides. The shearing and downward movement creates head scarps and flanks where the ground surface has ruptured and torn and

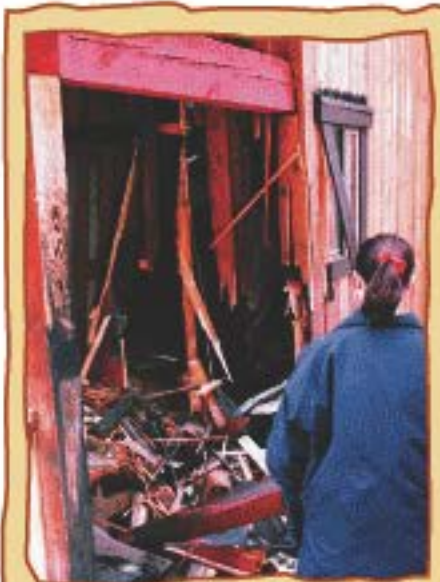


Photo: Jon White

*Luckily, no one was home when an 8-ton boulder crashed into this Vail condo.*

rumped surfaces where the earth movements have distorted the ground. Vail, Dowd's Junction, Wolcott Junction, Green Mountain Reservoir, and Marble are all affected by landslides.

Debris flows are related to flash floods that can course down hillsides and ephemeral streams. Large amounts of rock and soil can bulk the flood with mud and debris that flows out onto alluvial/debris fans. Many towns and roads in central Colorado are located on these fans and are at risk. The activity of these fans increases dramatically after wildfire events.

Avalanches also pose dangers to mountain towns and roads and back-country users. Special zoning or engineering designs must be used in avalanche areas to ensure the safety of residential structures and other land uses. (See page 9)

**Other geologic hazards:** Ground-collapse related hazards and water-quality issues are a concern where evaporite rocks outcrop. Dissolution and plastic "flowage" of these rocks has caused regional collapse (see page 8), and karst features such as sinkholes. Sinkholes can occur spontaneously without warning and are hazards along the Lower Roaring Fork and Eagle River corridors. Evaporite dissolution also contributes significant salt loading to the Colorado River (see page 9).

Some colluvial, alluvial, and eolian deposits, derived from clay- and silt-rich sedimentary rocks, are prone to collapse in semi-arid environments after being wetted. These hydrocompactive soils are common along valley floors and walls (as debris-flow fans) and in upland swales or pediment surfaces.

The earthquake potential of Late Cenozoic faults along the ranges of central Colorado may also be of concern. The article on page 8 discusses recent research on these faults and their seismicity.



Photo: W. P. Rogers

*Glenwood Springs is built on alluvial fans below the steep side-slopes of the Roaring Fork valley. This debris-flow event in 1977 inundated much of the east side of town.*

Jon White is a Senior Engineering Geologist at CGS.





## The Eagle and Carbondale Salt Collapse Centers

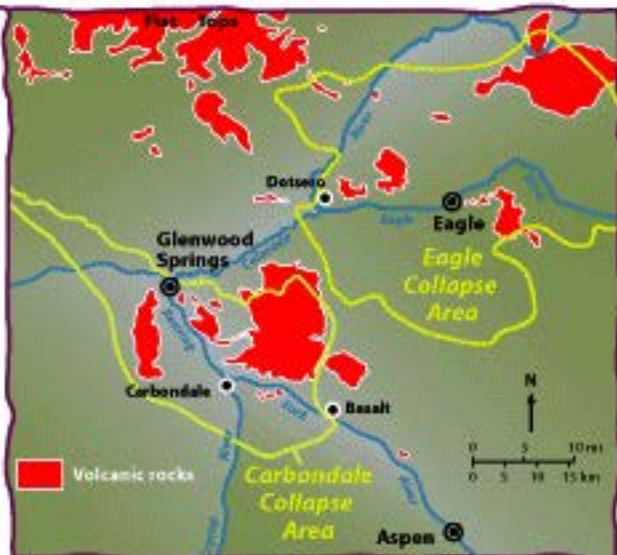
By Bob Kirkham

Mapping by the CGS and USGS in central Colorado has uncovered a fascinating story of underground salt movement at a grand scale. Two large areas totaling nearly 1,400 square miles, called the Eagle and Carbondale salt collapse areas, are the sites of regional salt flowage and dissolution in the Pennsylvanian Eagle Valley Evaporite.

Our research indicates that the salt began flowing in response to differential loading by the overlying rock, a process triggered by incision of the Eagle, Colorado, and Roaring Fork rivers. Flow and dissolution of the salt began about 10 million years ago and accelerated about 3 million years ago.

Where the salt evacuated, the overlying bedrock underwent as much as 4,000 feet of regional collapse. The timing of regional collapse was determined by age-dating several Neogene volcanic rocks deformed by the collapse. Back-tilted alluvial terraces and faulted surficial deposits document more recent movements. Underground salt dissolution continues, as indicated by the loading of the rivers with large amounts of dissolved salts. The Glenwood hot springs are a major source of salt loading.

Today, the evaporite forms salt anticlines beneath the river valleys. The halite has dissolved, leaving only gypsum at the surface. Good examples of folded gypsum strata may be seen near Eagle, Gypsum, and Glenwood Springs. GSA Special Paper 366 tells this story in more detail (see page 10).



Map showing the extent of the Eagle and Carbondale salt collapse areas.

Bob Kirkham is newly retired and was formerly a Senior Geologist at CGS.



## Late Cenozoic Faults and Seismicity

By Vince Matthews

Late Cenozoic (<25 million years ago) extension strongly affects central Colorado, creating rift grabens and significant uplift of the flanking areas. This tectonic activity is the northward

extension of the activity in the San Luis Valley and the Rio Grande Rift. A growing awareness that central Colorado may have a greater earthquake hazard than previously recognized has led to a resurgence of study on seismicity and faulting.

The CGS recently mapped three 7.5-minute geologic quadrangles in Summit County. CGS also has been investigating the Williams Valley faults under a National Earthquake Hazard Reduction Program grant from the USGS and is studying the Frontal Fault of the Gore Range under a contract from the Federal Emergency Management Administration (FEMA).

Mapping in the Vail to Glenwood Springs area by the CGS and USGS reveals the existence of Neogene regional collapse because of dissolution of underground salt deposits. Although this phenomena caused a collapse of the surface on the order of one-half mile vertically, geologists doubt that this activity is related to earthquakes.



Quaternary faults in central Colorado (Widmann and others, 2000). This area has 14 peaks greater than 14,000 feet above sea level.

Vince Matthews is Senior Science Advisor and is responsible for managing Mapping, Earthquakes, and Outreach at CGS.



A Holocene fault scarp (red line) along the west flank of the Sangre de Cristo Range.

For more information on earthquakes in Colorado, visit the CGS Web site (See page 10)





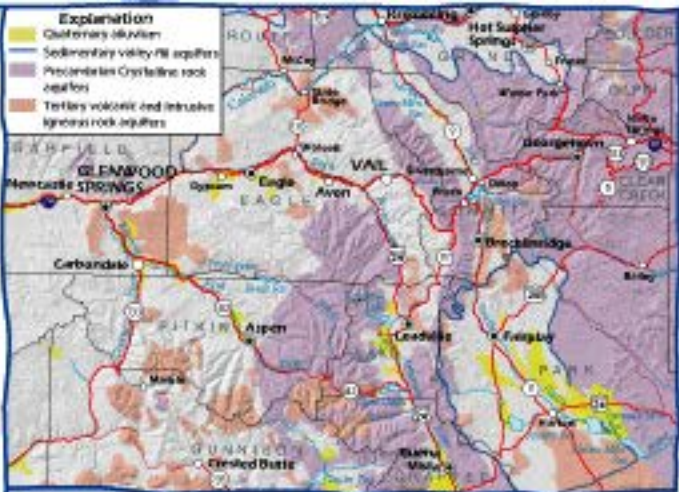
## Water Resources and Water Quality

By Matt Sares

In spite of the semi-arid nature of most of the state, central Colorado is rich in water resources. The headwaters of three major rivers—the Colorado, South Platte, and Arkansas—are found in the area. Rain and snowmelt runoff are stored in several major reservoirs and are transferred by trans-basin diversions from the western slope to the water-poor eastern slope. Water supply from surface and ground water is a huge issue, especially in light of the State's recent multi-year drought.

Ground-water resources in central Colorado are used locally for domestic and public water supplies. The alluvial aquifers adjacent to streams are mostly thin and shallow. Fractured crystalline-rock aquifers supply limited ground water to homes in the Front, Gore, Tenmile, Mosquito, and Sawatch ranges and from basalt rocks south and east of Glenwood Springs. The Eagle Basin east of Glenwood Springs and the Piceance Basin to the west contain ground water in several carbonate and sandstone formations.

Watersheds in central Colorado provide good-quality water in general. Yet there are several water-quality concerns in some areas. This



Rivers and aquifer types in Central Colorado.

includes salinity loadings to the Colorado River from the Eagle Basin, Roaring Fork River and hot springs near Glenwood Springs; metals and acidity from abandoned mines and natural acid rock drainage; and impacts from increased development in mountainous terrain. Several completed and ongoing projects are helping to address these issues.

The CGS is currently conducting a statewide analysis of locations where underground water storage technologies are feasible. This review is a key element of the state water supply assesment being conducted by the Colorado Water Conservation Board.

Matt Sares is the Chief of Environmental Geology at CGS



Red Mountain, on the Continental Divide east of Aspen, is a natural source of metals and acidity to nearby creeks.



## Avalanches

By Knox Williams

Snow avalanches have always threatened Coloradans—about 400 deaths occurred from 1860 to 1950, and 198 from 1950 to 2003 (especially among backcountry recreationists). The most avalanche-prone counties are Pitkin (33 deaths since 1950), Summit (33), and Clear Creek (21). Avalanches block highways, damage buildings and structures, and destroy forests. Roughly 350 avalanches hit Colorado highways each winter; most are purposely released with explosives. The I-70 corridor is threatened with about 80 avalanche paths from Glenwood Canyon to Georgetown. A forecasting and mitigation program keeps closures along all Colorado highways to a minimum.

**Land-use concerns:** In the mining era, avalanches repeatedly damaged or destroyed houses and mine structures. In more recent years, avalanche zoning by some Colorado towns and counties has restricted building in avalanche-prone areas and therefore greatly minimized avalanche damage. Summit, Pitkin, Gunnison, and San Juan counties, plus the town of Vail, have enacted avalanche-hazard regulations. Typically, they prohibit residential construction in high-risk zones, while in moderate-risk zones, construction may be permitted if engineered for expected impact pressures. The East Vail residential area is a prominent example of applying avalanche zoning.

**CAIC:** The mission of the Colorado Avalanche Information Center (CAIC) is to reduce the impact of avalanches on transportation, industry, and recreation. The CAIC does daily hazard forecasts to CDOT and backcountry recreationists and hosts avalanche awareness classes.



Avalanche zoning. These condos in Vail surround the runout zone of an avalanche path.

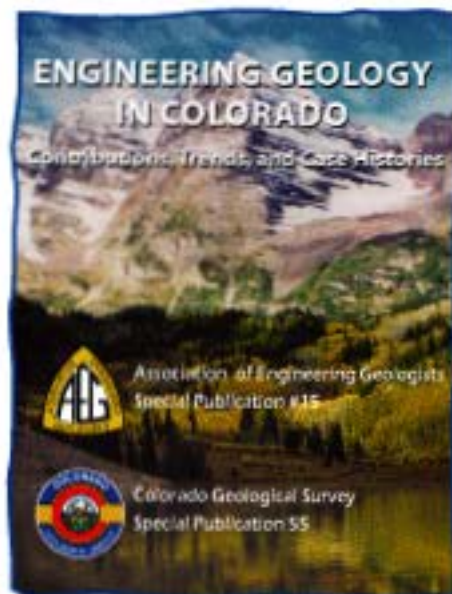
Knox Williams is the Director of the Colorado Avalanche Information Center, part of CGS.

To learn more about avalanches and to join the Friends of the CAIC, visit our Web site: [geosurvey.state.co.us](http://geosurvey.state.co.us)



## Recent Activity and New Publications at CGS

The 2002 Colorado Mineral and Mineral Fuel Activity Report (IS-67) was released at the Northwest Colorado Coal Conference in May. On hand were (L-R), Les Hampton (Moffat County Commissioner), Stuart Sanderson (Colorado Mining Association President), Jane Norton (Colorado Lieutenant Governor), Ron Cattary (DMG Director), Greg Walcher (DNR Executive Director), and Jim Evans (Associated Governments of Northwest Colorado Director).



### New AEG/CGS Special Publication

Available for \$30, from AEG or CGS publications, or at the meeting. This CD-Rom volume contains over 60 papers involving the practice of engineering geology in Colorado.

## MESSAGES IN STONE

Colorado's Colorful Geology

Colorado Geological Survey



Special Publication 52

### New Landmark CGS Publication

Available for \$16.95, this much anticipated work contains a wonderful overview of all things geologic in the Centennial State, including 157 pages full of impressive facts, photos and figures.

## GROUND WATER ATLAS OF COLORADO



Special Publication 53

Available for \$40, this 210 page atlas (11x17) contains 200 photos, graphs, maps, and illustrations on all of Colorado's aquifers and basins.

## ENGINEERING GEOLOGY IN COLORADO

Contributions, Trends, and Case Histories



Association of Engineering Geologists  
Special Publication #15



Colorado Geological Survey  
Special Publication 55

## Useful Web Sites and References to Articles

The following is a listing of Web sites and references that pertain to the articles in this issue of *RockTalk*. It is not an exhaustive listing, but we have assembled enough information to get interested readers started.

### Organizations:

Department of Natural Resources—  
<http://dnr.state.co.us>

Colorado Geological Survey—  
<http://geosurvey.state.co.us>

Colo. Avalanche Info. Center—  
<http://geosurvey.state.co.us/avalanche>

Division of Minerals and Geology—  
<http://mining.state.co.us>

American Inst. of Prof. Geologists—  
[www.aipg.org](http://www.aipg.org)

Assoc. of Engineering Geologists—  
[www.aegweb.org](http://www.aegweb.org)

AEG Rocky Mountain Section—  
[www.aegrms.org](http://www.aegrms.org)

### Tourist resources:

Vail area information—  
<http://vailsummer.net>

[www.frommers.com/destinations/vail](http://www.frommers.com/destinations/vail)  
[www.vailchamber.org/visitvail/bus\\_schedule.html](http://www.vailchamber.org/visitvail/bus_schedule.html)

Glenwood Springs area—  
[www.glenscape.com](http://www.glenscape.com)

[www.frommers.com/destinations/glenwoodsprings](http://www.frommers.com/destinations/glenwoodsprings)

[www.hot springspool.com](http://www.hot springspool.com)

[www.glenwoodcaverns.com](http://www.glenwoodcaverns.com)

[www.rfta.com](http://www.rfta.com) (local bus)

Nearby resort information—  
[www.aspensnowmass.com](http://www.aspensnowmass.com)

[www.leadville.com](http://www.leadville.com)

<http://breckenridge.snow.com>

White River National Forest—  
[www.fs.fed.us/r2/whiteriver](http://www.fs.fed.us/r2/whiteriver)

Colorado Ski Country USA—  
[www.coloradoski.com](http://www.coloradoski.com)

Fishing information—  
<http://wildlife.state.co.us/fishing/fishcond.asp>

Biking information—[bicyclecolo.org](http://bicyclecolo.org)

Golfing information—  
[www.golfcolorado.com](http://www.golfcolorado.com)

Amtrak—[www.amtrak.com/trains/californiazephyr.html](http://www.amtrak.com/trains/californiazephyr.html)

Marble quarry—  
[www.yulemarble.com/history.html](http://www.yulemarble.com/history.html)

Tourist mines—  
<http://mining.state.co.us/tourist.html>

### Selected geology references (available at CGS unless otherwise noted):

\* Roadside geology of Colorado, 2nd edition: H. Cronin and F. Williams (2002).

\* Colorado geologic highway map: R. Christianson and Western Geographics (1991).

\* Colorado mineral and mineral fuel activity, 2002 –J. Keller and others (2003)

\* Collapsible soils and evaporite karst hazards of the Roaring Fork River corridor –J. White (2002)

\* Colorado Late Cenozoic fault and fold database and internet map server, Part I –B. Widmann and others (2002) (<http://geosurvey.state.co.us/pubs/ceno>).

\* Ground water atlas of Colorado –R. Topper and others (2003)

\* Late Cenozoic evaporite tectonism and volcanism in west-central Colorado –R. Kirkham and others, eds. (2002) (from Geological Society of America).



# State of Colorado

Bill Owens, Governor

Department of Natural Resources

Greg E. Walcher, Executive Director

Division of Minerals and Geology

Ronald W. Cattary, Director

Natural Resource Trustee

## Colorado Geological Survey

Ronald W. Cattary, Interim Director

and State Geologist

James A. Cappa, Mineral Resources

Vince Matthews,

Senior Science Advisor

David C. Noe, Engineering Geology

Randal C. Phillips, GIS and

Technical Services

Patricia Young, Administration

and Outreach

Matt Sares, Environmental Geology

Knox Williams, Colorado Avalanche

Information Center

Administration and Outreach

Betty Fox, Brenda Hannu,

Melissa Ingrisano, Dorl Vigil

Avalanche Information Center

Dale Atkins, Nick Logan, Scott Toepfer

Mapping, Outreach, and Earthquakes

John Keller, Bob Kirkham,

Matt Morgan, Beth Widmann

Engineering Geology and Land Use

Karen Berry, Jill Carlson, Sean Gaffney,

Celia Greenman, Jim Soule,

T.C. Wait, Jon White

Environmental Geology

Peter Barkmann, David Bird, Ralf Topper,

Bob Wood

GIS and Technical Services

Cheryl Brchan, Karen Morgan,

Larry Scott, Jason Wilson

Mineral Fuels

Chris Carroll, Genevieve Young

Minerals

John Keller, Beth Widmann

RockTalk is published by the

Colorado Geological Survey

1313 Sherman Street,

Room 715, Denver, CO 80203

Back issues and subscriptions can be

obtained FREE by contacting CGS or

download them from our Web site

Phone: (303) 866-2611

Fax: (303) 866-2461

E-mail: [cgspubs@state.co.us](mailto:cgspubs@state.co.us)

Web site: <http://geosurvey.state.co.us>

### THIS ISSUE

Editor: Dave C. Noe

Design, Layout & Illustrations: Larry Scott

Editing & Production: Cheryl Brchan

## CGS Awards for the 2003 Colorado State Science and Engineering Fair

By T.C. Wait

The CGS presented a special award for Outstanding Earth Science Project at the Colorado State Science and Engineering Fair April 10-12, 2003. The Fair was held at Colorado State University in Fort Collins.

Jeffrey Hrcncir, an 8th grader from Grand Junction, placed first in the Junior Division with his project, "Reconstructing the Paleoclimate of the Green River Formation." His project involved collecting and classifying fossil leaf samples and relating their structure to determine the average temperature and precipitation present at that time.

Jade Brooks, an 11th grader from Fort Garland, placed first in the Senior Division with her project, "Hydrophobicity: How Hydrophobic Soils affect Runoff within a Watershed," which looked at runoff predictions and results from different drainage basins within the Million Fire burn area by South Fork, Colorado.



Senior division winner,  
Jade Brooks

The CGS judging team of T.C. Wait, Jim Soule, and Peter Barkmann would like to thank all the students who presented their outstanding projects at the Science Fair.



Junior division winner,  
Jeffrey Hrcncir

T. C. Wait is an engineering geologist at CGS.

## How to order CGS publications

### MAIL:

Colorado Geological Survey,

1313 Sherman Street,

Room 715, Denver, CO 80203

Phone: (303) 866-2611

<http://geosurvey.state.co.us>

Fax: (303) 866-2461

E-mail: [cgspubs@state.co.us](mailto:cgspubs@state.co.us)



accepted.

**Prepayment required**

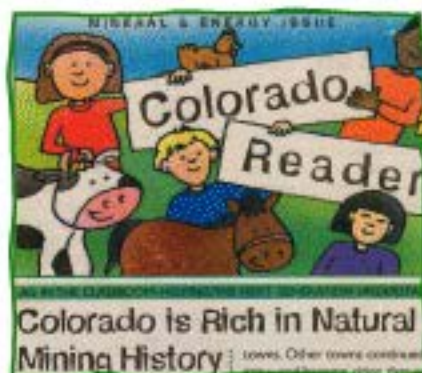
### SHIPPING AND HANDLING

Please contact the CGS for shipping and handling costs.

### DISCOUNTS

Available on bulk orders.

*Call for a complete publication list*



*Teachers, for copies of the Colorado Reader on minerals and geology, contact the CGS. A teachers guide is also available.*





# About the Colorado Geological Survey

Ron Cattany, Interim Director

The Colorado Department of Natural Resources is proud of the ongoing accomplishments of the Colorado Geological Survey. Since its reincarnation in 1968 it has provided technical assistance to the public and private sectors in the areas of geological and scientific importance. Its work has earned international recognition.

This issue of RockTalk focuses on the variety of projects underway in the

central mountains of Colorado under different funding sources, for various constituents:

**Mapping:** The Mapping group has completed twelve 1:24,000-scale geologic maps in the Glenwood Springs area and is currently doing mapping in Summit County.

**Minerals and Mineral Fuels:** The MMF group researches and publishes summaries of mineral and mineral fuel resources and production from the area.

**Engineering Geology:** The ENG group assists local governments by conducting land use reviews for geologic suitability, does research on geologic hazards, and responds to geology-related emergencies.

**Environmental Geology:** The ENV group conducts research in the areas of ground water and water quality, including the mapping of non-point sources of salt loading to the Roaring Fork River above Glenwood Springs.

**Avalanche Information Center:** The CAIC does avalanche training and forecasting for CDOT, ski areas, and the general public.

**GIS and Technical Services:** The GTS group provides technical and computer assistance and graphics and publication production to all CGS sections.

**Outreach:** All of our sections conduct outreach to different constituent groups. A good example is our 2002 workshop on collapsible soil and evaporite karst hazards, which was held in El Jebel for a broad group of attendees.

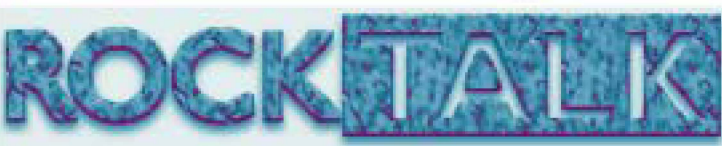
**Publications:** CGS publishes and sells numerous reports and maps. Please see our web site for a listing of these publications.

Thank you for your continued interest in the work of the Colorado Geological Survey.

Ron Cattany is the Interim Director and State Geologist of CGS

## Inside This Issue:

*A special guide to the geology of central Colorado written in honor of the national annual meeting of the Association of Engineering Geologists (Vail, September 15-21, 2003) and the American Institute of Professional Geologists (Glenwood Springs, October 12-17, 2003)*



POSTED STANDARD  
FIRST CLASS PAID  
DENVER, CO  
PERMIT 738

Colorado Geological Survey  
Division of Minerals and Geology  
131 Sherman Street, Room 71  
Denver CO 80203  
PLA 341100040

DOI: <https://doi.org/10.58783/cgs.rt0603.odcf9607>

