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History of the Colorado Geological Survey (1872-1988)

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HISTORICAL SEQUENCE OF ORGANIZATIONAL NAME:

"The First Survey," Colorado Geological Survey, 1907-27
"The Second Survey," Colorado Geological Survey, 1967-Present

NAMES AND TITLES OF ORGANIZATIONAL DIRECTORS AND DATES SERVED:

Director and State Geologist

Russell D. George, 1907-27
John W. Rold, 1969-1992
William P. Rogers 1992 (Acting)
Vicki J. Cowart 1993-present

HISTORY OF THE COLORADO GEOLOGICAL SURVEY* (1872-1988)

John W. Rold, Director and State Geologist, and Stephen D. Schwochow,
Colorado School of Mines

TERRITORIAL AND EARLY STATE GEOLOGISTS

The discovery of gold at Idaho Springs in 1859 marked the beginning of what for Colorado has become a billion-dollar mineral industry. Rich strikes in the 1860's hailed an era of boom towns, prosperity, and great personal triumphs and failures. Even before Colorado statehood, the territorial legislature realized the importance and potential of this emerging industry. An official government representative was needed to assist and advise the fledgling industry and to begin the monumental task of identifying and evaluating the territory's mineral wealth. On February 9, 1872, the legislature empowered the Governor to appoint a Territorial Geologist who was to reside in the territory and serve a 2-year term. Because neither salary nor expenses were budgeted, the early Territorial Geologists made their livings essentially by consulting for the mining industry, and their public contributions were severely limited.

In 1874, J. Alden Smith was appointed as Colorado's first Territorial Geologist and served until 1883 and again from 1885 to 1887. Smith was born in Maine in 1830, and after completing his formal education at age 14, worked in such areas as printing, wool manufacturing, stone cutting, and finally back to newspaper printing. His early fascination with rocks and minerals led to tutored studies in geology and mineralogy. By 1864 his expertise had brought him to Gilpin County where his reputation as a consultant and assayer grew quickly. Smith's most notable work was the first detailed list of Colorado's minerals and gem stones. After its publication in Black Hawk in 1865, it appeared in Ovando Hollister's 1867 classic

*The first portion of this was largely adapted from an article written by Stephen Schwochow entitled "History and Activities of Your State Survey" in *Colorado Miner*, March/April 1980, Volume 2, No. 2, published by the Colorado Mining Association. The last portion was adapted and updated from an article entitled "15 Years of Progress and Problems" by John Rold in the March 1984 issue of *The Outcrop*, the newsletter of the Rocky Mountain Association of Geologists.

historical work, Mines of Colorado, and was republished in 1870 and 1880. He is also recognized for several Telluride gold discoveries and for donating his valuable mineral collection to the University of Colorado. Six competent and highly regarded men succeeded Smith as Territorial Geologist--Ernest Le Neve Foster (1883-85), F. G. Bulkley (1887-89) George E. Kedzie (1889-95), Thomas A. Rickard, a prominent mining editor and prolific author (1895-1901), John Wellington Finch, who later became director of the U.S. Bureau of Mines (1901-05), and B. S. Langridge (1906-07).

THE FIRST SURVEY

So that more formal investigations of the state's resources could be made, the legislature created the Colorado Geological Survey on April 24, 1907. Among the eight objectives, one dealt specifically with mineral resources:

> A study of the geological formations of the state with special reference to its economic mineral resources, namely: the gold, silver, lead, copper, iron and other metallic ores; the clays, coals, oil, gas, building materials, cement materials, artesian and mineral waters and other mineral substances.

Although metals dominated Colorado's mining industry at that time, specific mention was made of nonmetallics, mineral fuels, and water resources. Provisions also were made for a comprehensive bibliography of geology and resources, the publication and distribution of maps and reports, the collection and distribution of mineral specimens, and most importantly—a budget. The act appropriated the State Geologist's salary of $500, and $8 per diem, and an operating fund of $5,000 for fiscal years 1907 and 1908.

By virtue of his chairmanship at the University of Colorado Department of Geology, Russell D. George became State Geologist and first director of the Survey. Born in 1866, George was raised and educated in Ontario, Canada. Following graduation from McMaster University (Toronto) in 1897, he served as an instructor at the University of Chicago, where he earned his Ph.D., and then at the University of Iowa. In 1903 he came to the University of Colorado where he built up the young and ill-equipped Geology Department. His affinity for the mining industry's problems soon established his eminence in the consulting field. For 20 years George and his limited but highly proficient staff produced a series of comprehensive bulletins on the geology and ore deposits of a number of mining districts, along with the first complete bibliography and inventories of molybdenum, clay, manganese, fluorspar, oil shale, and mineral waters. Horace B. Patton, P.G. Worcester, R.D. Crawford, Harry Aurand, and Junius Henderson were among the Survey's noted authors. R.C Coffin's 1921 report on uranium and radium is still an often cited reference. Between 1910 and 1925, the Survey published 31 bulletins. Another major accomplishment was a revision of the then 30-year-old state geologic map originally compiled during the Hayden Survey (1876-81).

Besides emphasizing the resources and pure scientific contribution, the legislature intended the new Survey to contribute directly to education:

> The Survey shall . . . [prepare] . . . bulletins on the geology, geography and natural resources of Colorado suitable for use in the schools of the State.

The Survey also was empowered to borrow freely upon the geology faculty of the state's colleges; indeed, many of the Survey's staff also taught at the University of Colorado and at Colorado School of Mines.

People-related problems were first hinted at in the second legislated objective:

> An examination of the topography and physical features of the State with reference to their practical bearing upon the occupations of the people.

Although that early Survey published many excellent bulletins and contributed extensively to original geologic mapping of the state, it failed the survival test. Its last publication was issued in 1925. Records and files of that time were lost or destroyed. Old timers have hinted of political intrigue, funding limitations, and rivalry with the Colorado Metal Mining Fund Board, which had been created in 1921 to collect taxes on metal mining properties in order to ". . . make such investigations regarding the prospecting for, mining, production, transportation, buying, selling, treatment or reduction of metalliferous ores . . ." It may well have been a classic conflict between perceived pure research and geological investigations on one hand and the claimed practical value of finding, producing, and selling ore on the other.

In 1927, the Metal Mining Fund was given statutory authority to contract with the U.S. Geological Survey (USGS) for the completion of geologic and topographic mapping. Even though a statute enacted in 1929 placed the Survey under the control of a Geological Survey Board, no records indicate any activity, and no publications were issued. The USGS Colorado Geologic Map, published in 1935, credits "cooperation of the Colorado Geological Survey and the Colorado Metal Mining Fund." Neither USGS nor state records indicate the nature, extent, or timing of that cooperation. It may well represent mapping done by the state survey years earlier.

The exact reasons for or time of the first survey's demise will probably never be known. Although the law remained on the books, activity ceased and the Colorado Geological Survey died of "fiscal malnutrition" sometime in the late 1920's.

THE SECOND SURVEY

Records show that the interim boards and agencies dealing with geologic problems from the 1930's into the 1960's were beset with perennial financial problems, outside political pressures, and internal conflicts. Perhaps as crucial as these problems was their apparent failure to recognize changing attitudes and needs. During the 1960's, the local geological community clearly saw the need for a formal state agency to deal not only with mineral and water resources in general but also with "people" problems and the geological and engineering aspects of construction development and land use.

In 1965 Representative George Fentress, a geologist in the state legislature, began working toward the reestablishment of the Colorado Geological Survey by collecting background information and gaining the support of other state surveys as well as the Association of American State Geologists. The first reorganization attempts outside the legislature came in 1966 when the Rocky Mountain Association of Geologists and American Institute of Professional Geologists formed a joint committee with representation from the Colorado Scientific Society and local chapters of the Association of Engineering Geologists and Society of Exploration Geophysicists. The committee evaluated the laws and sought from the other 47 state geologists advice in writing a meaningful statute. Through the efforts of the RMAG-AIPG committee, chaired by Robert D. Brace, and Representative Fentress, state statutes were amended by House Bill 1282 (1973), C.R.S. 34-1-101, et seq., and on June 9, 1967, the Colorado Geological Survey was recreated. The enabling act set forth the following general purpose:

> . . . to coordinate and encourage . .. the full development of the state's natural resources, as [they] are related to the geological processes that affect realistic development of human and mineral utilization and conservation practices and needs in the state of Colorado, all of which are designed to result in an ultimate benefit to the citizens of the state.

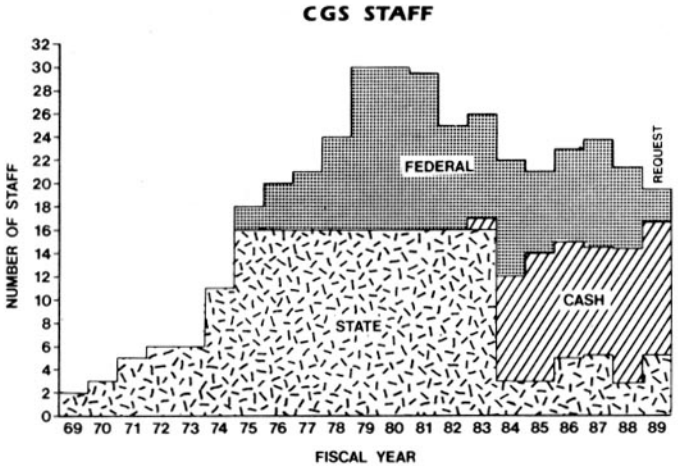
The bill placed the Survey within the newly formed Department of Natural Resources and also provided for at least four operational specialties—mineral deposits, hydrology, mineral fuels, and engineering geology. More importantly nine specific objectives were cited:

(1) Assist, consult with, and advise existing state and local governmental agencies on geologic problems;
(2) promote economic development of mineral resource;
(3) conduct studies to develop geologic information;
(4) inventory and analyze the state's mineral resources as to quantity, chemical composition, physical properties, location, and possible use;
(5) collect and preserve geologic information;
(6) advise the state and act as liaison agency on transactions dealing with natural resources between state agencies and with other states and the federal government on common problems and studies;
(7) evaluate the physical features of Colorado with reference to present and potential human and animal use;
(8) prepare, publish, and distribute reports, maps and bulletins when necessary to achieve these purposes;
(9) determine areas of natural geologic hazards that could affect the safety of or economic loss to the citizens of Colorado.

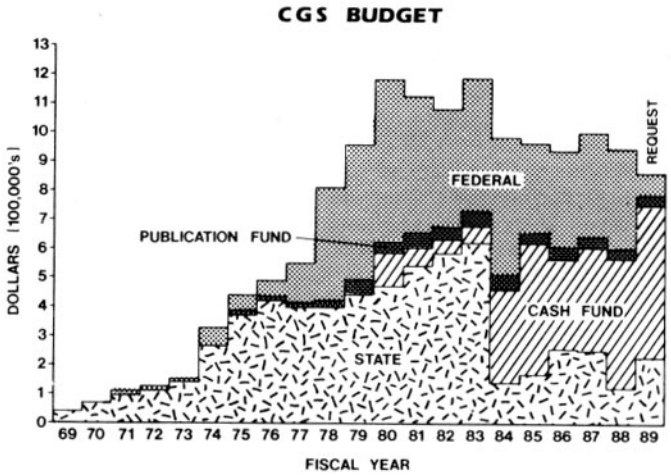
Funding was not appropriated until 1968, and the agency did not begin official operations until February 1, 1969, with the hiring of the new Director and State Geologist, John W. Rold. Born in 1927 in Kirkman, Iowa, John Rold was raised on a ranch near Salida, Colorado. After active service in the U.S. Naval Reserves, he attended the University of Colorado from which he received B.A. and M.S. degrees in geology in 1948 and 1950. His 19 years of experience with Chevron Oil Company earned him the positions of Area Geologist and finally District Geologist. An active member and officer of a number of local and national geological associations, John has also served on many panels and commissions in his position as State Geologist and has published numerous papers on geological, mineral resource, and land-use problems in Colorado.

After evaluating the many growing geological problems of the state in light of his limited fiscal and staff resources, Rold established an overall goal "to ensure the utilization of adequate geologic information in the state's public and private decision making." He often characterized the fledgling agency's role as being "like the yeast in bread dough." The Survey relied heavily on the many active geological societies in the area and on the U.S. Geological Survey and U.S. Bureau of Mines in attempting to achieve that goal.

Growing problems of oil-shale development, underground nuclear detonations, landslides, swelling soils, burgeoning ski area developments and subdivisions in hazardous areas, geologically related construction problems, and environmental controversies nearly engulfed the new one-man agency. Fortunately, attempts to address and mitigate these serious problems resulted in much-needed state-funded staffing increases from 1 in 1969 to 16 (11 geologists and 5 support staff) by 1975. That number remained static at 16 through 1983. Lack of increased state-funding support since 1975 forced the implementation of federal grants and contracts to better address many of the state's critical resource- and hazard-investigation needs. State funding of $632,000 in 1983 was drastically reduced to $139,000 in 1984. Accordingly, state-funded staff was reduced from 16 to only 3, but 10



Historical staffing patterns.



Historical funding.

positions were authorized by cash funding—if sufficient fees could be generated to cover their salaries and expenses. To date, the Survey has been marginally successful in replacing those state funds with cash income generated from other sources.

ACCOMPLISHMENTS AND ACTIVITIES

One of the Survey's most noteworthy long-term contributions was insuring that geologic factors were addressed in Colorado's numerous land-use laws passed in the early 1970's. The first of these, Senate Bill 35, (1972), C.R.S. 30-28-101, et seq., the subdivision law, sets minimum standards for all subdivision of lands in unincorporated areas of the state. Specifically, it requires investigation of geologic factors that would impact the proposed land use and requires review and recommendations for those subdivisions by the Colorado Survey. House Bill 1041, (1974), C.R.S. 24-65.1-101, et seq., legally defines geologic hazards and authorizes cities and counties to identify, designate, and manage activities in geologic hazard and mineral resource areas. House Bill 1034, (1975), C.R.S. 29-20-101, et seq., empowers cities and counties to consider geologic hazards when regulating

development and activities within their jurisdictions. House Bill 1529, (1973), C.R.S. 34-1-301, et seq., requires consideration of mineral resource values in zoning decisions and essentially constrains development over commercial sand and gravel deposits in the populous Front Range counties. Other provisions in HB-1529 provided the nation's first statewide reclamation law affecting all mineral resource development. House Bill 1574, (1973), C.R.S. 34-01-201 and 202, et seq., legally defines the practice of geology and professional geologists.

Two later laws addressed school construction and residential swelling soil problems. House Bill 1045, (1984), C.R.S. 22-32-124, et seq., requires that:

> Prior to the acquisition of land for school building sites or construction of any building thereon, the board of education also shall consult with the Colorado Geological Survey regarding potential swelling soil, mine subsidence and other geologic hazards and to determine the geologic suitability of the site for its proposed use.

Senate Bill 13, (1984), C.R.S. 6-6.5-101, requires every seller of a new home to at least 14 days prior to closing the sale provide the buyer a "summary report of the (hazard) analysis and the site recommendations" and "for those sites in which significant expansive soils is recognized, the builder shall supply each buyer with a copy of a publication detailing the problems with such soils, the building methods to address these problems during construction, and suggestions for care and maintenance to address such problems." The preceding statutory language describes the Colorado Survey Special Publication 14 which is sold in quantity to homebuyers. This law provided a windfall for publication sales and over 40,000 copies have been sold and distributed through 1988.

Geologic Hazards

Robert B. Sennett, the first engineering geologist hired by the Survey, began the first geologic hazards investigations in 1970. After Sennet left the Survey, William P. "Pat" Rogers was hired in June 1971. He developed the program and the Engineering and Environmental Section. Early important contributors to engineering geology and hazards programs were Walter Rahe Junge, Stephen S. Hart, Lewis R. Ladwig, Arthur I.. Mears, David C. Shelton, and James M. Soule. Somewhat later Timothy D. Bowen, Susan H. Cannon, Jeffrey L. Hynes, Candace L. Jochim, Robert M. Kirkham, Julia E. Turney, and Bruce K. Stover joined the organization and made important contributions to the understanding of and mitigation of geologic hazards.

The study and mapping of geologic hazards has captured much of the state Survey's interest throughout its existence. Under the impetus of HB-1041 several county-wide or regional hazards mapping projects were completed by either Colorado Survey staff or contracted consultants. Topical research and mapping has addressed swelling soils, snow avalanches, landslides, mine subsidence, earthquakes, rockfalls, debris flows, and hazardous canyons. Marble, Vail, Crested Butte, Big Thompson, Muddy Creek, Castle Rock, and Telluride Airport were sites of newsworthy hazard investigations.

Geologic review of projects constitutes a major portion of the extensive hazard-mitigation program. In fact, since 1972 the Survey has reviewed nearly 12,000 SB-35 projects. To our knowledge, no significant geologic hazard problems, other than those from swelling soils, have developed in any of those 12,000 subdivisions that were approved and constructed on the basis of the geologic

recommendations. The geologic-review system has proved so worthwhile that cities and towns have voluntarily submitted over 700 subdivisions for the Survey's geologic review. Over 900 other major developments—ranging from dams to large mines and large construction projects—were reviewed to ensure that potential geologic problems were addressed. Preconstruction geologic review of state building activities is estimated to have saved the state an average of $500,000 in annual construction, repair, and maintenance costs.

Although numerous earthquakes had occurred in the Denver area in the 1960's, they were linked to injection disposal in a deep well at the Rocky Mountain Arsenal and even area professionals seemed little concerned with statewide Seismicity. In 1980, with USGS funding, Pat Rogers and Bob Kirkham began an extensive evaluation of the state's seismic hazards. Their work and the resulting publications defined the problem and raised public and professional consciousness. Now developers of major dam and construction projects commonly evaluate and design for seismic risk.

Natural radioactivity is legally defined as a geologic hazard, consequently, in 1986 the Colorado Survey cooperated with the Colorado Department of Health and then carried out the EPA-sponsored statewide radon survey. Needed follow-up research and area evaluations have been stymied by lack of funds.

One of the later significant contributions of the Engineering and Environmental Section was site selection and geologic and geotechnical characterization of a proposed Superconducting Supercollider site in northeastern Colorado. The quality of the site and the geologic analysis have won high praise from outside reviewers and have gained Colorado a place on the select list of the nation's six most favorable sites.

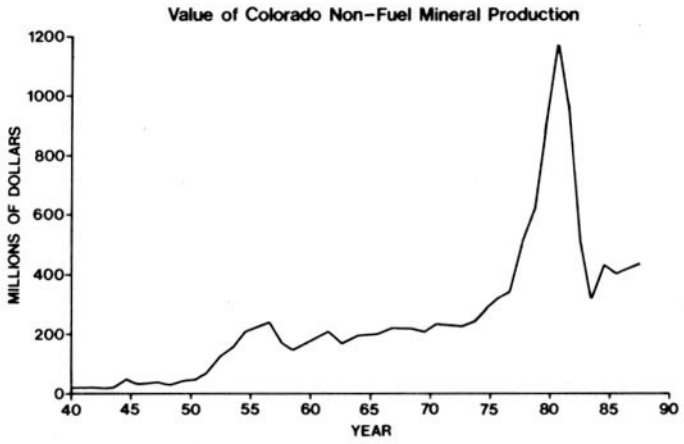
MINERAL RESOURCES

Mr. Allison L. Hornbaker came from the Kansas Geological Survey in 1970 and headed the Mineral Resources section until his retirement in 1985. He was ably assisted for 11 of those years by Stephen D. Schwochow, Donna B. Collins and James Nelson-Moore also made important contributions. After Hornbaker's retirement, Mark W. Davis was hired to direct the Mineral Resources program.

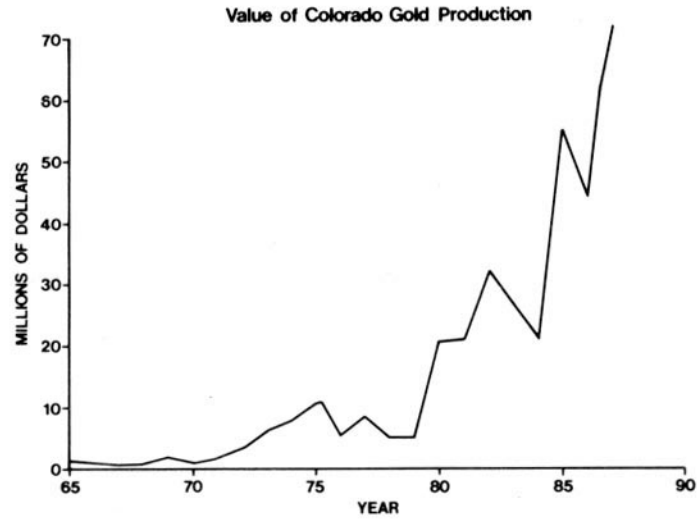
HB-1529 in 1973 required the Colorado Survey to map the sand and gravel deposits in the ten populous Front Range counties. The 213 maps generated by this project became part of the documentation for county planning processes. Other mineral resource maps and reports subsequently were completed for Mesa, Moffat, and Routt Counties. A major comprehensive inventory of radioactive mineral occurrences and producing areas in the state was published in 1978 at the height of the exploration boon and sold out within 10 weeks. Information about metallic mineral occurrences and mines compiled for the U.S. Geological Survey's Computerized Resource Information Base (CRIB), provides a wealth of basic data and historical information for both research and exploration. A statewide map and directory of operating metal mines has proved its value to industry and the public. Numerous smaller investigations of the state's various industrial minerals answered specific resource questions in local areas. The geology and resource potential of strategic minerals in Colorado were evaluated in a 1984 publication.

MINERAL FUELS

Mr. D. Keith Murray was hired in 1973 to develop a mineral fuels program and direct that section. Major



Except for a dramatic peak at 1980 due to high molydenum production and prices, the curve shows a steady increase in total nonfuel mineral production value.



The dramatic increase in gold production may be doubled by current exploration and proposed development projects.

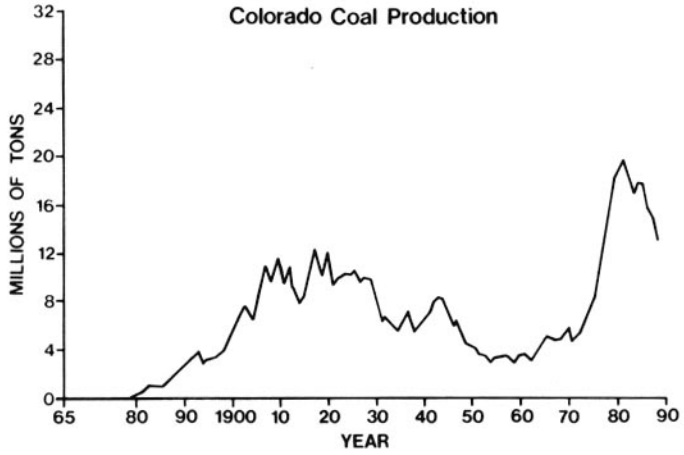
contributors to that program since then have included Wynn Eakins, Steven M. Goolsby, Bruce S. Kelso, Peter Rushworth, Ann H. Scanlon, and Carol M. Tremain. Lew Ladwig became section head in 1979 and directed the program until he became Minerals Director for the Colorado Board of Land Commissioners in 1987. Administrative duties of the section subsequently were assigned to Mark Davis.

Little up-to-date information existed on Colorado's coal resources, which were being extracted at a rate of only 5 million tons per year in 1969. Because no state funds could be obtained, a major data-acquisition program was initiated through U.S. Bureau of Mines, USGS, and Department of Energy grants. The numerous coal-resource investigations resulting from the grants now portray the depth, quality, quantity, and distribution of much of the state's 129-billion-ton coal resource. Thirty-nine formal publications and 30 open-file reports have contributed not only to an increase in coal production to over 19 million tons in 1982 but also to a better understanding of coal-development problems. In the early 1970's staff contributed considerably toward addressing the environmental, economic, and technical aspects of oil shale development and to the successful promulgation of the federal leasing

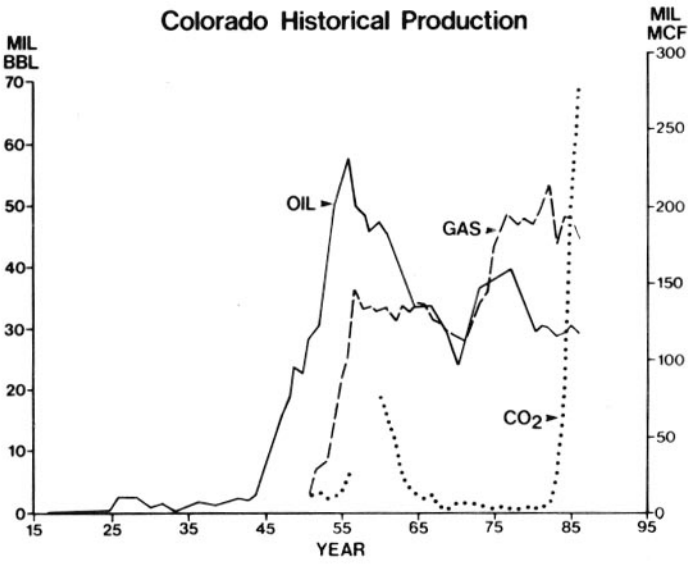
program. A widely used statistical summary and map of Colorado's oil and gas fields resulted from a contract with the Colorado Oil and Gas Conservation Commission. Pioneering investigations of the potential for development of coalbed methane depicted and estimated a resource of over 100 trillion cubic feet and helped spawn a significant coalbed methane industry in the state.

GROUND WATER INVESTIGATIONS

This program was developed by Richard H. Pearl, who in 1970 came from the Water Resources Division of USGS. He directed the program until major budget cuts in 1983 eliminated the section. Important contributors to the ground-water and geothermal programs were made by Barbara A. Coe, Jay D. Dick, Michael J. Galloway, Robert M. Kirkham, and Ted G. Zacharakis.



Though declining since 1980, production is still high by historical comparison.



Production responded dramatically to markets, pricing, exploration, development and field decline.

Water resources investigations of Boulder County and the mountainous portion of Jefferson County, done in cooperation with USGS, have helped home buyers, developers, and those local governments understand and address problems associated with this critical resource in the Front Range region. A study of the Denver Metro sewage-sludge-disposal site and Lowry landfill by the same cooperator was the first indicator of Lowry's pollution problems. A water quality atlas and water temperature maps of the state provide valuable background data for water users, industry, and government. Hundreds of shorter investigations of ground-water resources and ground-water pollution addressed problems of homeowners, small businesses, and local governments.

GEOTHERMAL RESOURCES

A major federally funded program to define and evaluate Colorado's geothermal resources resulted in 26 publications and 9 open-file reports addressing that potential. Investigators mapped and analyzed 56 thermal areas. The geology and geothermal potential of 14 of these areas were investigated for possible local commercialization. In addition, the feasibility of geothermal heating of state buildings in several areas of the state was investigated.

WASTE DISPOSAL

The Colorado Geological Survey was a forerunner in the development of geologic criteria for the safe long-term disposal of hazardous wastes and the evaluation of sites for the disposal of toxic waste and low-level radioactive waste, as well as uranium mill tailings and landfills.

GENERAL CONTRIBUTIONS

Several major compilations released by the CGS have facilitated research and mineral exploration by others in the geological profession. A bibliography and index of all Colorado geological publications from 1875 through 1975 was published in 1976. This volume, the first of AGI's state compilations through GeoRef, and later supplements are widely used in research and mineral exploration. Through the Colorado Survey's encouragement and partial funding, USGS compiled and published a new revised geologic map of Colorado in 1979, as well as statewide gravity and aeromagnetic maps.

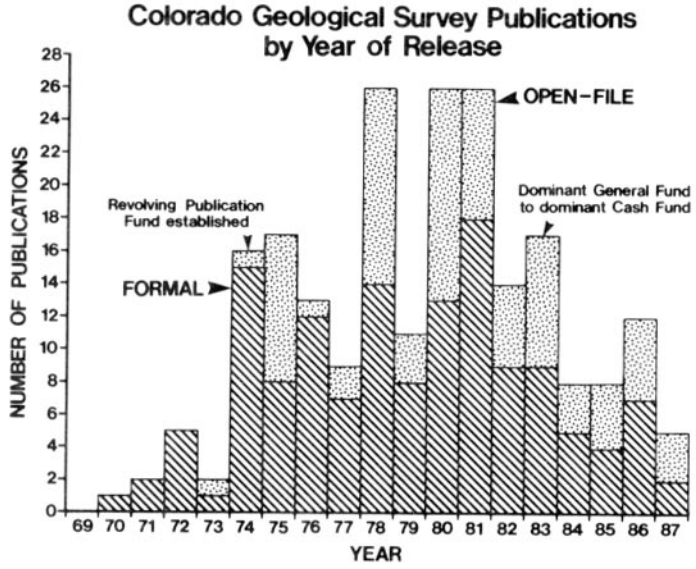
The Colorado Survey addressed the public understanding of geology with two major popular contributions. *Prairie, Peak and Plateau* was written on contract by John and Halka Chronic. Its appeal was reflected by sales of 48,000 copies. *Natures Building Codes* explains in cartoons, sequential diagrams, and laymen's language the impacts of geologic factors on construction in Colorado. Subsequent publications prepared especially for the homeowner explained and addressed the problems of swelling soil and mine subsidence.

The Colorado Survey figured prominently in establishing a State Mapping Advisory Committee, the Rocky Mountain Groundwater Symposium, the Rocky Mountain Coal Geology Symposia, and the Governor's Environmental Geology Conferences. It co-hosted the state's first Geothermal Symposium, a Seismicity Symposium, the 15th Industrial Minerals Forum, a Mine Subsidence Symposium, and the National Highway Geology Symposium. It has hosted numerous workshops and training sessions for geologists, planners, engineers, and government

officials on geological hazards, geologic factors in land use, and mineral resources. Staff presented more than 1,000 talks through 1988 ranging from technical papers for scientific societies to lectures and educational presentations to schools, colleges, and service clubs throughout the state.

In 19 years the Colorado Geological Survey's investigations have resulted in 142 formal publications and 92 open-file reports. Over 147,000 separate publications whose printing and distribution were paid for by more than $470,000 in sales were sold and distributed. Staff contributed numerous articles on Colorado's geologic problems to scientific journals and other outside publications. Thousands of minor investigations and evaluations conducted for state and local governmental agencies and private individuals resulted in less formal responses in the form of letters or short unpublished reports. Prior to July 1, 1983, CGS responded each year to thousands of informal geologic inquiries from the general public, local officials, geologic and engineering practitioners, and industry on a wide variety of geology-related subjects. The 1987 level of state funding drastically curtailed this important activity.

One of the more important actions to affect the Survey in recent years was the appointment in October 1987 by Governor Roy Romer of a Geological Survey Task Force. The Task Force was ably chaired by Stanley Dempsey, President of Royal Gold, Inc., and formerly and executive with AMAX. The charge to this group of 16 people representing the state's mineral industry, business, academic, local and federal government agencies, legislative and public communities was to



Shows the dramatic increase in formal publications when the Joint Budget Committee initiated a revolving publication fund in 1974 and the marked decline in 1984 after the change from dominantly general funding to predominantly cash funding. The decline would be even more dramatic except for the fact that several projects commenced under general funding were stalled and could not be completed and published until later years. The Survey since 1970 has sold and distributed a total of over 247,000 separate publications.

investigate the geologic needs of the state and to examine, evaluate, and strengthen the Colorado Geological Survey and its mission.

The Executive Summary of their report completed in February 1988 follows:

After lapsing for several decades owing to lack of funds, the Colorado Geological Survey (CGS or Survey), was reestablished in 1967 by legislative action, following recommendation by geologists and legislators. The newly formed Survey was to encourage resource development while mitigating geologic hazards and environmental concerns. Less than a decade ago, the CGS was among the country's top state geological surveys and served as a role model for the surveys of other states. The CGS produced important documents in mineral and energy resources and aided the legislature in formulating some of the most innovative and effective land use legislation anywhere.

Currently, however, the CGS is unable to meet Colorado's geological services needs. In 1983, responding to a directive to cut direct state government spending, the legislature reduced general fund support to many agencies, including the CGS. The legislature also provided for more reliance on cash funding of agency projects. Since then, a majority of the Survey's operating expenses have been derived from fees it charges for its services.

Although the Survey has done well at developing its cash-funded program, the overall change in funding has had a dramatic effect on the Survey staff. From 1975 until 1983, the CGS received an allotment for 16 full-time professionals. The average general–funded staff for the past five years has been four. Moreover, because only four people remain of that nationally recognized core, the leadership of a few years ago has been diminished.

The Survey's focus has shifted as well. The organizational structure is decidedly weighted toward short-term responses. This arrangement also allows the users to dictate the priorities and focus of the CGS. The majority of the Survey's current workload is geared toward engineering and environmental services and away from encouraging economical development of mineral resources and mineral fuels, industries experiencing a cyclical slump.

Another effect of reduced general fund support has been that CGS no longer has the resources to initiate joint, mutually beneficial projects with federal agencies.

Similarly, the funding negotiation process has made working for other state agencies difficult, and in turn, caused other agencies to staff their own geoscientists.

Regardless of the reasons for the current situation, the mission and responsibilities of the CGS to the economic, environmental and social well being of Colorado are too important to neglect. The Task Force makes the following recommendations to improve the value and viability of the Survey.

1. No changes are needed in the CGS's enabling legislation.

2. The Governor should create a permanent CGS advisory board that would aid in long range planning, aid in setting state geological priorities and provide continuity of direction and planning.

3. The CGS with assistance from the recommended Advisory Committee should establish a clearly defined research program involving the CGS, local universities and federal projects.

4. The CGS, to best promote the economic development of the state and its mineral resources, should step up the development, production and distribution of maps, publications and presentation for the economic geology community.

5. The CGS should collect, store and make available to the public basic geological, geophysical and geochemical data, and physical specimens of geologic value such as significant drill cores and cuttings.

6. The CGS should resume sponsorship of educational and technical programs, conferences and workshops on geological and mineral resource topics of significance to Colorado.

7. The CGS should be general funded to the necessary level to provide services to other Colorado agencies.

8. The CGS should be general funded to the necessary level to provide emergency response and short-term consultation services to local governments.

9. The CGS should be allotted general funds to support a cadre of personnel sufficient to meet its statutory

responsibilities and the activities recommended in this report.

10. The CGS should continue to seek cash funding to the extent that it meets the intent of the agency's mission and does not infringe on private consultants.

11. The USGS and CGS should continue their cooperative efforts and intensify their goal of setting mutual priorities on geological mapping and research.

12. The CGS should continue to cooperate with and seek funding from other federal agencies that have missions consistent with CGS efforts.

As a result of the Task Force efforts, the legislature, even in 1988's climate of severe general budge restrictions, funded one additional geologist for the Survey staff.

AVALANCE FORECASTING

In May 1987, the administration of the cash-funded Colorado Avalanche Information Center was transferred to the Colorado Survey from the Executive Director's office of the Department of Natural Resources. Avalanches are a legally defined geologic hazard. The Colorado Survey has been involved with avalanche mapping since 1975. This transfer expands the Survey's hazard mitigation program to include temporal prediction as well as spatial. The four person Avalanche Center, officed with the National Weather Service, combines weather conditions and forecasts with snow conditions and the reports of 30 field observers to make daily avalanche hazard forecasts. These forecasts are routinely disseminated with radio and television weather reports. Daily-recorded forecasts are available on local telephone hotlines throughout the state.

SUMMARY

The past 19 years have been truly a time of significant progress and serious problems. Marked progress has been made towards achieving the overall goal of ensuring the utilization of adequate geologic information in both public and private decision-making. The Survey has succeeded in encouraging the public and private sectors to utilize geologic information in land use, waste disposal, and construction decisions throughout the state. A majority of builders, developers, and governmental officials at both local and state levels have come to realize that geologic factors contribute significantly to many of their major everyday problems. They also now realize that geologic information can contribute towards solving those problems and that geologic information can provide better, cost-effective, long-term solutions to many problems.

In those 19 years the Survey has markedly improved and increased the quantity, quality, availability, and utility of publicly available geologic information. Geologists, engineers, and planners now better understand the location, distribution, and the causal bases for the occurrence of Colorado's many geologic processes that may react adversely to human activities. Together they are learning how to avoid and mitigate geologic hazards and how better to utilize the state's land resources. Improved understanding of the location, quantity, quality, and potential development impacts of Colorado's plentiful and varied mineral resources has aided geologists, industry, government agencies, and the general public.

Despite these accomplishments, problems and frustrations still abound. Seldom has adequate staff or funding been available to address, let alone solve, many of our growing geology or resource problems. Many developers and governmental officials still fail to realize that moneys spent on geologic investigations in the early stages of project development represent a cost-effective investment that ultimately saves money in construction, repairs, and long-term maintenance costs.

Looking to the future, it is hoped that the value of past and current work by the Survey will become more apparent and decision-makers will come to realize that geological investigation and information are a worthwhile investment in Colorado's future.

John W. Rold, Director, Colorado Geological Survey,
1969-1992