THE MINERAL INDUSTRY OF COLORADO

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Colorado Geological Survey for collecting information on all nonfuel minerals.

In 2000, the estimated value[1] of nonfuel mineral production for Colorado was $616 million, based upon preliminary U.S. Geological Survey (USGS) data. This was a 7.3% increase from that of 1999[2] and followed a marginal increase from 1998 to 1999. The State remained 25th in rank among the 50 States in total nonfuel mineral production value, of which Colorado accounted for more than 1.5% of the U.S. total.

More than 80% of Colorado's nonfuel mineral production value came from industrial minerals, especially construction sand and gravel, portland cement, and crushed stone (in descending order of value), the State's three leading nonfuel mineral commodities. In 2000, a $13 million increase in the value of construction sand and gravel, increases in portland cement and molybdenum that totaled about $20 million, plus increases in crushed stone, up $6.4 million, and gold, up more than $3 million, led the State's rise in value. All other nonfuel minerals showed small increases or stayed the same, except for small decreases in industrial sand and gravel and silver. No lead or zinc was produced in 2000 owing to the late January 1999 closing of the State's only operating lead/zinc mine. ASARCO Incorporated's Leadville unit, the Black Cloud Mine, closed because the mine's reserves were depleted. In 1999, a $22 million increase in construction sand and gravel, an $11.7 million rise in crushed stone, a $9 million increase in Grade-A helium, and a $7 million rise in portland cement accounted for most of the increases in value for the year. But these increases were offset by a more than $30 million decrease in the value of molybdenum, decreases in the values of lead and zinc that totaled about $15 million (Black Cloud Mine closure), and about a $5 million drop in gold, resulting in a net decrease for the year (table 1).

Compared with USGS estimates of the quantities produced in the other 49 States during 2000, Colorado remained seventh of 12 gold-producing States. While the State rose to third from fifth of six States that produce Grade-A helium, it dropped to seventh from sixth in construction sand and gravel and to third from second in molybdenum concentrates.

The following narrative information was provided by the Colorado Geological Survey.[3] The Cripple Creek & Victor Gold Mining Co. (CC&V) continued to operate the only major precious-metals mine in Colorado. The Cresson Mine produced 7.5 metric tons (t) of gold in 2000, up 4.5% from that of 1999. Silver production in 2000 at the mine was estimated at about 3.1 t. Based on the average prices for the metals over the entire year, the value of the gold produced was estimated at $67.5 million, and the value for silver was estimated at $500,000. The mine currently employs approximately 300 people. CC&V is a joint venture between AngloGold Ltd. and Golden Cycle Gold Corp.

The company is planning a major expansion at the mine for 2003. The plan calls for a 50% increase in tonnage capacity. This will increase the annual rate of gold production to an estimated 9.95 metric tons per year (t/yr). The company has received necessary permits from State and county regulatory agencies for the expansion project. The current reserve base is sufficient to support gold production at least until 2011 at the expanded production rate. In the last half of 2000, CC&V completed an extension to its leach pad and also began work to relocate State Highway 67 in advance of the mine expansion.

ITEC Environmental Colorado Inc., a Canadian company that had plans to reprocess old mine waste and tailings in Boulder County, abandoned those plans and sold off its land and other assets in 2000. ITEC had hoped to extract copper, gold, silver, and zinc that had been left behind in the tailings by less efficient operators in the past. The continued low gold prices that have resulted in mine closures throughout the United States forced ITEC to scrap its plans in Boulder County.

Phelps Dodge Corp.'s Henderson Mine continued to be North America's largest primary producer of molybdenum. In May 2000, the Henderson Mine cut 130 employees from its work force and cut production by 20%. In 2000, the mine and mill produced approximately 9,000 t of contained molybdenum, down 4.8% from that of 1999.

The Henderson Mine has completed the upgrade of its mine facilities known as "Henderson 2000." The new 16.9-kilometer (km) single-flight underground conveyor, which replaced the former underground train haulage system, is now fully operational and transporting ore from the mine to the mill area. It is the world's longest single-flight conveyor belt. In addition to this conveyor, two other shorter conveyor links were installed, a new 2,300-metric-ton-per-hour crusher system was built, and new 73-t and 36-t underground haul trucks were added. The efficiencies gained from the successful implementation of Henderson 2000 will enable the mine to

[1]The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the minerals or mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2000 USGS mineral production data published in this chapter are preliminary estimates as of July 2001 and are expected to change. For some mineral commodities, such as construction sand and gravel, crushed stone, and portland cement, estimates are updated periodically. To obtain the most current information, please contact the appropriate USGS mineral commodity specialist. A telephone listing for the specialists may be retrieved over the Internet at URL http://minerals.usgs.gov/minerals/contacts/comdir.html, by using MINES FaxBack at (703) 648-4999 from a fax machine with a touch-tone handset (request Document #1000 for a telephone listing of all mineral commodity specialists), or by calling USGS information at (703) 648-4000 for the specialist's name and number. All Mineral Industry Surveys—mineral commodity, State, and country—also may be retrieved over the Internet at URL http://minerals.usgs.gov/minerals; facsimile copies may be obtained from MINES FaxBack.

[2]Values, percentage calculations, and rankings for 1999 may vary from the Minerals Yearbook, Area Reports: Domestic 1999, Volume II, owing to the revision of preliminary 1999 to final 1999 data. Data for 2000 are preliminary and are expected to change; related rankings may also be subject to change.

[3]John W. Keller, a Geologist at the Colorado Geological Survey, authored the text of mineral industry information submitted by that agency.

lower its overall cutoff grade and therefore increase its ore reserve.

In October 2000, American Soda, L.L.P. began producing soda ash and sodium bicarbonate from a nahcolite deposit in Rio Blanco County. After acquiring its final permits in 1999, the company built a state-of-the-art solution mine, a 71-km dual pipeline, a processing plant, and a railroad spur to produce and ship its sodium products. The mine and plant have a designed production capacity of 900,000 t/yr of soda ash and 140,000 t/yr year of sodium bicarbonate.

The solution mine currently consists of 26 production wells that use hot water to dissolve nahcolite (natural sodium bicarbonate) about 600 meters (m) below the surface. The company controls 2,800 hectares (ha) of mineral leases on Bureau of Land Management (BLM) land. American Soda estimates that the nahcolite in situ resource is 3.2 billion metric tons, with over 900,000 million metric tons (Mt) of recoverable nahcolite.

White River Nahcolite Minerals, LLC, a subsidiary of IMC Global Inc., has been producing sodium bicarbonate by solution mining for several years at a site adjacent to American Soda's new mine. The mine produced 93,000 t of sodium bicarbonate in 2000. The mine's design capacity is 113,000 t/yr. Both food-grade and industrial-grade products are produced.

American Gypsum Co.'s subsidiary, Centex Construction Products, Inc. produced 530,000 t of gypsum in 2000 from its gypsum mine in Eagle County. That is an increase of 29% more than the 1999 production. The gypsum is mined from an open pit using pavement profiler machines that cut a trench 3.7 m wide by 0.15 m deep. The gypsum is manufactured into wallboard and other products at the plant in the town of Gypsum. Production over the next few years is projected to remain near the plant's capacity of about 530,000 t. The mine and plant employ approximately 120 people.

Cement production continued at a high pace in 2000. Holnam, Inc. operated two plants in the State, one near La Porte in Larimer County and one east of Florence in Fremont County. The La Porte plant produced about 426,000 t/yr of cement using the dry process. The Portland plant near Florence produced about 900,000 t/yr using the wet process. However, it is undergoing a $200 million plant expansion that will double the capacity to 1.8 million metric tons per year. The plant is also being converted from the multikiln wet process to a single-kiln dry process. The newly upgraded plant is forecast to begin production in June 2001.

Ohio-based Oglebay Norton Co. mined and marketed "Colorado Silica Sand," a specialty industrial sand that was used for hydraulic fracturing of oil and gas wells, filter media for water purification plants, gravel packs around water wells, and other applications where roundness, permeability, and strength were important parameters. The sand was also used for landscaping purposes. The company quarried the sand near Colorado Springs from Quaternary age eolian deposits that were composed of mostly well-sorted and well-rounded grains of quartz.

The Yule Quarry in Gunnison County continued to produce white marble for use as tile and slab, decorative stone, and monuments. The stone was quarried by Sierra Minerals Corp. of Englewood, CO, and marketed under the name "Colorado Yule Marble."

In early September 2000, the Kelsey Lake diamond mine near the Wyoming border in Larimer County began operations again after being shut down since 1998. It was the only commercial diamond mine in the United States. The Great Western Diamond Co., a subsidiary of the Canadian company McKenzie Bay International Ltd., was the owner and operator of the project. It bought the property from the previous owner, Redaurum Ltd., in 1999. The reserve was estimated at 17 Mt grading 3.4 to 4.6 carats per 90 t of kimberlite ore. The ore continues to a depth of at least 107 m, according to drill data released by the company in press reports. The mine and recovery plant employ about 25 people at full production. In 1996, a 28.3-carat light-yellow diamond was recovered at the mine, the fifth largest diamond ever found in the United States.

The Sweet Home Mine in Park County continued to produce some of the most prized specimen-quality rhodochrosite crystals in the world. Since 1991, the former silver mine has produced the cherry-red crystals from open cavities in hydrothermal quartz-calcite-sulfide veins. Some of the larger crystals have commanded prices of more than $100,000.

Exploration for additional reserves continued in 2000 at the Cresson Mine near Cripple Creek. CC&V completed approximately 76,000 m of exploration drilling in 2000, and an equal amount is planned for 2001. In June 2000, CC&V announced that exploration drilling had increased the measured ore reserve to 152 t of gold compared to 134 t at the end of 1998. This increase took into account the depletion that is due to ongoing mining. The company estimated that the reserve, plus nonreserve mineralized material, contains approximately 311 t of gold.

Summo Minerals Corp. of Denver completed 18 exploration holes in 2000 on the Doctor Mine zinc exploration project in Gunnison County. Zinc occurs mainly as the carbonate mineral smithsonite. According to company press releases, this preliminary drilling identified a steeply dipping zone of zinc oxides averaging 15 m wide, 38 m thick, and at least 152 m long grading 6.38% zinc.

Leadville Mining and Milling Corp. continued exploration activities at its Hopemore Mine near Leadville. The company completed its phase I and phase II reverse-circulation surface drilling programs that tested shallow gold-silver mineralization on Breece Hill near the Hopemore Mine. Phase III drilling began in the fall of 2000 and will continue into the spring of 2001. Underground core drilling activity also continued into 2000, with several zones of gold-silver mineralization being encountered. The company has also been actively expanding its land position in the Leadville mining district.

A large, new cement plant has been approved by State regulators to be built southeast of Pueblo. The Rio Grande Portland Cement Corp., a subsidiary of the Mexican company Grupo Cementos de Chihuahua, S.A. de C.V., plans to build the $165 million plant and produce 900,000 t/yr of cement. The company has signed a lease with the Colorado State Land Board to mine limestone from a local deposit. Construction is slated to begin sometime in 2001.

Ameralia, Inc. continued development work on their planned in situ solution nahcolite mine in the Piceance Basin near the currently (2000) operating American Soda and White River nahcolite mines. Ameralia plans to produce sodium bicarbonate at a rate of 140,000 t/yr. In late 1999, the BLM approved the company's development plans. According to company press

releases, the company drilled and completed several monitoring wells in 2000 to collect base line water data prior to solution mining activity. Core drilling and resource evaluation work performed in 1996 on the company's 535-ha Rock School Lease determined a nahcolite mining interval height of 155 m that averaged 26.4% nahcolite.

Radar Acquisitions Corp. of Calgary, Alberta actively pursued its Titanium Ridge project on the plains of eastern Colorado. Garnet, some rare-earth minerals, titanium minerals (ilmenite and rutile), and zircon occur as placer deposits in the Late Cretaceous Fox Hills Sandstone. In addition, deposits of lignite coal overlie the heavy-mineral deposits. The coal was also being considered for its economic potential. The company conducted a feasibility study on the project, which covers a total of about 5,300 ha. On the portion of the property drilled so far (about 650 ha), a consulting engineering firm has determined a heavy-mineral resource of 16 Mt and approximately 90 Mt of lignite coal. Radar has also completed tests on bulk samples to determine the appropriate methods for recovering the heavy minerals.

Colorado's gold-mining industry avoided legislation that would have amended the State constitution to ban open pit gold mines that use cyanide heap-leach or vat-leach technology. Following the example set by Montana in 1998, a group named the "Alliance for Responsible Mining" started a petition in early 2000 to get an initiative on the November ballot banning the mining method. In May, however, the Colorado Supreme Court upheld the argument by the mining industry that the titles of the initiative were misleading in that they prohibited mines from expanding the operations of existing mines, even if their present permit allows them to do so. Although the antimining group continued its efforts after the court setback, the initiative failed to make the ballot in 2000.

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN COLORADO 1/ 2/

(Thousand metric tons and thousand dollars unless otherwise specified)

Mineral	1998		1999		2000 p/	
	Quantity	Value	Quantity	Value	Quantity	Value
Clays:						
Bentonite	W	W	1	W	1	W
Common	257	1,840	373	2,530	373	2,530
Gemstones	NA	257	NA	261	NA	274
Lime	40	1,820	40	2,380	40	2,400
Sand and gravel, construction	42,900	195,000	45,200	217,000	46,900	230,000
Stone:						
Crushed	12,000	63,800	13,200	75,500	14,000	81,900
Dimension metric tons	14,200	3,410	14,700	3,430	18,300	4,120
Combined values of cement, gold, gypsum (crude), helium (Grade-A), lead (1998-99), molybdenum concentrates, peat (1998), sand and gravel (industrial), silver, zinc (1998-99), and items indicated by symbol W	XX	306,000	XX	273,000	XX	295,000
Total	XX	572,000	XX	574,000	XX	616,000

p/ Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined values" data. XX Not applicable.

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

2/ Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 2
COLORADO: CRUSHED STONE SOLD OR USED, BY KIND 1/

Kind	1998				1999			
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value
Limestone	6	2,470	$16,200	$6.56	5	2,570	$12,500	$4.87
Granite	8 r/	6,150 r/	29,500 r/	4.79 r/	8	7,400	40,000	5.41
Sandstone and quartzite	9	651	3,450	5.30	8	779	6,670	8.56
Traprock	1	W	W	5.52	1	W	W	10.42
Volcanic cinder and scoria	2	W	W	4.46	2	W	W	4.41
Miscellaneous stone	6 r/	W	W	5.46	7	W	W	5.43
Total or average	XX	12,000	63,800	5.34	XX	13,200	75,500	5.71

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

TABLE 3
COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS
IN 1999, BY USE 1/ 2/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Construction:			
Coarse aggregate (+1 1/2 inch):			
Riprap and jetty stone	287	$1,860	$6.48
Other coarse aggregate	32	90	2.81
Total or average	319	1,950	6.11
Coarse aggregate, graded:			
Concrete aggregate, coarse	1,570	12,800	8.17
Bituminous aggregate, coarse	870	6,660	7.66
Bituminous surface-treatment aggregate	W	W	16.50
Railroad ballast	4	15	3.75
Other graded coarse aggregate	314	2,960	9.44
Total or average	2,760	22,500	8.15
Fine aggregate (-3/8 inch):			
Stone sand, concrete	W	W	5.57
Stone sand, bituminous mix or seal	1,250	6,110	4.87
Screening, undesignated	W	W	W
Other fine aggregate	218	1,050	4.82
Total or average	1,470	7,160	4.86
Coarse and fine aggregates:			
Graded road base or subbase	710	2,910	4.09
Unpaved road surfacing	40	186	4.65
Terrazzo and exposed aggregate	44	231	5.25
Crusher run or fill or waste	956	3,700	3.87
Other coarse and fine aggregates	120	406	3.38
Total or average	1,870	7,430	3.97
Other construction materials	320	1,470	4.59
Agricultural:			
Poultry grit and mineral food	(3/)	(3/)	22.74
Other agricultural uses	(3/)	(3/)	22.00
Chemical and metallurgical, cement manufacture	(3/)	(3/)	4.87
Special:			
Asphalt fillers or extenders	(3/)	(3/)	20.29
Other fillers or extenders	(3/)	(3/)	27.52
Other miscellaneous uses and specified uses not listed	(3/)	(3/)	9.17
Unspecified: 4/			
Reported	3,810	18,800	4.93
Estimated	870	4,300	4.95
Total or average	4,680	23,100	4.94
Grand total or average	13,200	75,500	5.71

W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.
2/ Includes granite, limestone, miscellaneous stone, sandstone and quartzite, traprock, and volcanic cinder and scoria.
3/ Withheld to avoid disclosing company proprietary data; included in "Grand total."
4/ Reported and estimated production without a breakdown by end use.

TABLE 4
COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1999, BY USE AND DISTRICT 1/ 2/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1 1/2 inch) 3/	W	W	W	W	107	957
Coarse aggregate, graded 4/	--	--	--	--	W	W
Fine aggregate (-3/8 inch) 5/	W	W	--	--	W	W
Coarse and fine aggregate 6/	W	W	W	W	W	W
Other construction materials	--	--	--	--	89	319
Agricultural 7/	--	--	W	W	--	--
Chemical and metallurgical 8/	--	--	W	W	W	W
Special 9/	--	--	W	W	--	--
Other miscellaneous uses and specified uses not listed	--	--	W	W	--	--
Unspecified: 10/						
Reported	155	784	--	--	2,420	12,300
Estimated	--	--	--	--	720	3,600
Total	173	888	909	7,940	9,460	54,200

	District 5		District 6		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1 1/2 inch) 3/	W	W	--	--	--	--
Coarse aggregate, graded 4/	W	W	--	--	--	--
Fine aggregate (-3/8 inch) 5/	W	W	--	--	--	--
Coarse and fine aggregate 6/	W	W	W	W	--	--
Other construction materials	231	1,150	--	--	--	--
Agricultural 7/	--	--	--	--	--	--
Chemical and metallurgical 8/	--	--	--	--	--	--
Special 9/	--	--	--	--	--	--
Other miscellaneous uses and specified uses not listed	--	--	--	--	--	--
Unspecified: 10/						
Reported	1,160	5,430	W	W	24	134
Estimated	18	80	W	W	--	--
Total	2,420	11,300	241	1,100	24	134

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ No production for District 3.
3/ Includes riprap and jetty stone and other coarse aggregate.
4/ Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, railroad ballast, and other graded coarse aggregate.
5/ Includes screening (undesignated), stone sand (bituminous mix or seal), stone sand (concrete), and other fine aggregate.
6/ Includes crusher run (select material or fill), graded road base or subbase, terrazzo and exposed aggregate, unpaved road surfacing, and other coarse and fine aggregates.
7/ Includes poultry grit and mineral food and other agricultural uses.
8/ Includes cement manufacture.
9/ Includes asphalt fillers or extenders and other fillers or extenders.
10/ Reported and estimated production without a breakdown by end use.

TABLE 5
COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1999,
BY MAJOR USE CATEGORY 1/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	7,580	$40,400	$5.33
Plaster and gunite sands	102	824	8.08
Concrete products (blocks, bricks, pipe, decorative, etc.)	363	2,690	7.41
Asphaltic concrete aggregates and other bituminous mixtures	2,560	12,500	4.89
Road base and coverings	5,630	24,000	4.27
Road and other stabilization (cement and lime)	554	2,630	4.74
Fill	1,850	5,680	3.07
Snow and ice control	96	550	5.73
Other miscellaneous uses 2/	260	1,850	7.12
Unspecified: 3/			
Reported	12,200	57,000	4.68
Estimated	14,000	69,000	4.93
Total or average	45,200	217,000	4.80

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes filtration.
3/ Reported and estimated production without a breakdown by end use.

TABLE 6
COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1999,
BY USE AND DISTRICT 1/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (including concrete sand)	677	4,350	1,730	8,710	W	W
Concrete products (blocks, bricks, pipe, decorative, etc.) 2/	73	574	W	W	--	--
Asphaltic concrete aggregates and other bituminous mixtures	177	1,450	W	W	691	2,990
Road base and coverings 3/	2,410	11,700	1,090	4,510	328	966
Fill	325	1,260	305	975	W	W
Other miscellaneous uses 4/	170	1,230	W	W	--	--
Unspecified: 5/						
Reported	2,160	9,510	4,520	21,000	198	1,600
Estimated	3,900	19,000	3,600	16,000	200	700
Total	9,850	49,500	11,800	53,500	1,600	7,060
	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (including concrete sand)	3,380	18,500	W	W	122	820
Concrete products (blocks, bricks, pipe, decorative, etc.) 2/	W	W	102	820	W	W
Asphaltic concrete aggregates and other bituminous mixtures	928	4,620	W	W	W	W
Road base and coverings 3/	391	1,140	1,020	3,360	951	4,920
Fill	W	W	330	540	55	134
Other miscellaneous uses 4/	W	W	75	498	48	200
Unspecified: 5/						
Reported	3,460	16,100	1840	8720	17	98
Estimated	3,100	19,000	1300	5300	1,900	8,800
Total	12,400	64,300	6,240	27,200	3,280	15,500

W Withheld to avoid disclosing company proprietary data, included in "Total." -- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes plaster and gunite sands.
3/ Includes road and other stabilization (cement and lime).
4/ Includes filtration, and snow and ice control.
5/ Reported and estimated production without a breakdown by end use.