



2005 Minerals Yearbook

COLORADO

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 2005, Colorado's nonfuel raw mineral production was valued¹ at \$1.75 billion, based upon annual U.S. Geological Survey (USGS) data. This was a \$740 million, or 73%, increase from the State's total nonfuel mineral production value of 2004, following a 50% increase from 2003 to 2004. Colorado rose to 10th from 17th in rank among the 50 States in nonfuel mineral production value, while accounting for nearly 3.2% of the U.S. total in 2005.

The State's two leading nonfuel mineral commodities in 2005, by value, were molybdenum concentrates and construction sand and gravel, followed by cement (portland and masonry), gold, and crushed stone. These five commodities accounted for about 98% of Colorado's total nonfuel raw mineral production value. As was the case in 2004, the largest portion of Colorado's substantial increase in value resulted from the increased production and value of molybdenum concentrates. With a significant increase in the commodity's unit value, a substantial increase in production led to a more than \$600 million increase in its value in 2005. Construction sand and gravel had an increase in value of \$45 million (production up by more than 9%), cement (all data withheld—company proprietary data), crushed stone had an increase in value of nearly 31%, and gold had an increase in value of more than 22%. The unit values of all these mineral commodities were up significantly. A 17% increase in the production of crushed stone resulted in a \$21 million increase, up nearly 31%, in the commodity's value (table 1). The only substantial decrease was in the value of soda ash, the commercial production of which ceased during 2004. Following the 2004 sale of the soda ash operation, a restructuring of the company and its production objectives resulted in a change to different chemical products being produced there.

Approximately 65% of Colorado's nonfuel mineral production value in 2005 resulted from the production of metals—molybdenum concentrates, gold, and silver—in descending order of value; this was a significant increase from 52% in 2004, 30% in 2003, and 23% in 2002. As molybdenum concentrate production significantly increased (up more than 50%) during this time period, its total production value was more than 12 times that of 2002 as the significant growth in molybdenum concentrate prices that began in December 2002 continued on throughout 2005.

Copper prices and molybdenum concentrate prices markedly rose in 2003 and 2004, but the trend toward the recent substantial heights in molybdenum concentrate prices that

¹The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the 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 2005 USGS mineral production data published in this chapter are those available as of December 2006. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>.

began in June 2002 continued on throughout 2003 and 2004, and peaked in 2005. For example, as reported in Platts Metals Week (there in dollars per pound of contained molybdenum) the annual average price of molybdic oxide rose from \$8.27 per kilogram (kg) in 2002 to \$11.75 per kg in 2003 to \$36.73 per kg in 2004 and nearly doubled to \$70.10 per kg in 2005. In June 2005, the monthly average molybdic oxide price reached its highest point of the 4-year run at \$82.54, and then followed a generally downward trend the rest of the year to close at \$61.84 in December. Molybdenum concentrate prices had stayed relatively level during the early months of 2006.

In 2005, Colorado continued to be second in the quantity of molybdenum in concentrates produced among six producing States and was fourth of 11 gold-producing States. The State rose to 9th from 10th in construction sand and gravel and decreased to 10th from 9th in gemstones and to 12th from 9th in gypsum. Additionally, Colorado produced significant quantities of portland cement, crushed stone, and common clays.

The following narrative information was provided by the Colorado Geological Survey² (CGS) and much of the data are based on its own surveys, estimates, and information gathered from company annual reports.

Exploration and Development Activities

Copper.—Constellation Copper Corporation, Lakewood, explored further the Cashin deposit in Montrose County. According to Constellation Copper, the deposit, a sandstone-hosted copper prospect near the Colorado-Utah border, contains an estimated 5.2 million metric tons (Mt) of probable ore reserves grading 0.547% copper. Should Cashin be developed into a producing copper mine, Constellation planned to operate the mine as a satellite operation to the company's Lisbon Valley Mine, about 24 kilometers to the southwest in San Juan County, Utah (Constellation Copper Corporation, 2006³).

Gold.—Wits Basin Precious Minerals Inc., Minneapolis, MN, continued exploration and development work on the Bates-Hunter Mine in Central City, Gilpin County. In late 2005, the company announced the recovery of several promising ore samples, including one that assayed 205 grams (6.6 ounces) per metric ton gold. Sampling was conducted using channel, grab, and muck-pile procedures on four different levels of the mine, ranging from the surface to the 50-meter level.

Consolidated Global Minerals Ltd., Vancouver, British Columbia, Canada (through its Colorado subsidiary Mount Royale Ventures, LLC) continued development and testing work at its Front Range Gold Project in the Gold Hill District

²James A. Cappa, Geologist and Chief, James Burnell, Geologist, and Beth Widman, Geologist, Mineral Resources and Mapping, Colorado Geological Survey, authored the text of the State mineral industry information provided by that agency.

³A reference that includes a section mark (§) is found in the Internet Reference Cited section.

west of Boulder. Mine development work was focused on the Cash Mine. About 150 meters of new drift was completed and previously mined areas along the Cash and Freiberg veins were accessed. Stopes were developed and existing drifts were enlarged and improved to accommodate modern mining equipment.

Commodity Review

Industrial Minerals

Cement.—Holcim (US) Inc. operated the Portland Plant near Florence where it employed about 180 people and accounted for nearly 80% of the State's cement production. Limestone from the Fort Hays Member of the Niobrara Formation was the principal raw ingredient for Holcim's cement product. CEMEX, Inc., Houston, TX, operated a cement plant near Lyons. CEMEX employed about 100 people at its plant.

GCC-Rio Grande, Inc., El Paso, TX (a subsidiary of Mexico's Grupo Cementos de Chihuahua) continued the planning and permitting process for development of a new cement plant at Pueblo. Construction of the plant and associated mining facilities was begun in mid-2005.

Clay and Shale.—Colorado clay mines produced an estimated 300,000 metric tons (t) of common clay in 2005, representing a 19% increase compared with that produced in 2004. The clay was mined primarily in eastern Colorado, especially near the Front Range in Douglas, Elbert, El Paso, Fremont, Jefferson, and Pueblo Counties. Texas Industries Inc. (TXI), Dallas, TX, mined the Pierre Shale deposit in northern Jefferson County, producing a material for use as lightweight aggregate. This low-density, popcorn-like aggregate is produced when the raw shale is expanded under kiln-fired conditions. TXI employed about 40 people at its mine and processing facilities, mining 370,000 t of shale to yield 283,000 cubic meters of lightweight aggregate.

Crushed Stone and Sand and Gravel.—Production of aggregates in 2005 was estimated to be 57 Mt, 78% of which was sand and gravel. The total value of aggregates was \$370 million, up 22% from that of 2004 (table 1). Production of industrial sand and gravel was estimated to be more than 63,500 t based upon average production values for the years 2003 and 2004. Colorado's leading producer of industrial sand and gravel was O-N Minerals, Cleveland, OH.

Dimension Stone.—Production of dimension stone increased by 3.8% in 2005 compared with revised production estimates for 2004. The principal Colorado dimension stones include granite, marble, rhyolite, and sandstone. Colorado Stone Quarries (a subsidiary of Polycor, Inc., Quebec, Canada) produced about 4,630 t of stone at its Yule Marble quarry near Marble, an increase of about 40% compared with that of 2004. The majority of Yule marble is now being made into slab and tile for international sales, although some is still used for sculpting. Colorado Quarries Inc., Canon City, produced about 45,600 t of decorative, precast, and landscape stone from several operating quarries. Arkins Park Stone Corporation produced an estimated 7,260 t of buff (light pinkish-brown) sandstone as well as "Berthoud Pink" and "Berthoud Sunset" sandstone from the

Permian Lyons Sandstone. Arkins Park operated three quarries near the town of Masonville using about 40 employees.

Gypsum.—American Gypsum Co., the principal miner of gypsum in the State, produced 577,000 t of gypsum at its mine and wallboard plant, near Gypsum, representing a 2.6% increase in production compared with that of 2004. During the year, the company began the process of developing a new mining area northeast of the current site. It was anticipated that mining would gradually shift to the new site as reserves were depleted at the original site. Most gypsum production goes towards the manufacture of wallboard and plaster products; however, gypsum is also used as a cement ingredient, as a soil conditioner, and in other industrial uses such as glassmaking and smelting. Colorado Lien (a subsidiary of Pete Lien & Sons, Inc., Rapid City, SD) and a few other small operations produce gypsum for cement or soil conditioners. Colorado Lien produces about 45,400 metric tons per year (t/yr) of gypsum from its Munroe Quarry north of Fort Collins near Livermore.

Helium.—Grade-A helium is produced at Duke Energy Field Service's Ladder Creek natural gas processing plant near Cheyenne Wells in eastern Colorado. The helium is liquefied at minus 458° F to separate it from the natural gas produced in the process. The Ladder Creek plant produced 2.7 million cubic meters of Grade-A helium from local sources in 2005.

Soda Ash.—Natural Soda, Inc., Rio Blanco County, recovered naturally occurring sodium bicarbonate from nahcolite at its U.S. Bureau of Land Management leases in the Piceance Basin in northwest Colorado. In 2005, Natural Soda Inc. produced 76,500 t of sodium bicarbonate, from its solution mine and recovery plant, a 6% increase compared with that of 2004. Both food-grade (baking soda) and industrial-grade sodium bicarbonate products were produced at the plant. The facility has a sodium bicarbonate production capacity of about 100,000 t/yr.

Metals

Gold and Silver.—The Cripple Creek & Victor Gold Mining Company (CC&V), a joint venture between AngloGold Ashanti Ltd. of South Africa and Golden Cycle Gold Corporation of Colorado Springs, produced 10,250 kilograms (kg) of gold in 2005. The quantity of gold recovered from the Teller County mine was up slightly from that of 2004. The company's stated ore reserves were 121.8 Mt having an average grade of 0.617 grams per metric ton (g/t) gold at yearend. These reserves were considered sufficient to keep the mine operating until at least 2013.

Silver was recovered as a byproduct of CC&V's gold mining activities in Teller County. Approximately 5,260 kg of silver was produced in 2005.

LKA International, Inc., Gig Harbor, WA, announced production of 794.5 kg of gold in 2005 from its Golden Wonder Mine, Hinsdale County. The Golden Wonder Mine is a small but high-grade underground gold mine near Lake City in the San Juan Mountains. In 2005, production increased by 78% compared with that of 2004 as the average grade of ore mined increased by 73% to 677 g/t gold (LKA International, Inc., 2006). Further development of the mine during the year had

resulted in the intersection of a significantly higher grade of ore at a level below the existing area being mined (LKA International, Inc., 2005).

Molybdenum.—All of Colorado’s molybdenum production was generated from the Henderson Mine in Clear Creek County. The mine, located in the Front Range west of Idaho Springs, is North America’s leading primary producer of molybdenum. This large, underground block-cave mine is owned by Climax Molybdenum Company (a subsidiary of Phelps Dodge Corp., Phoenix, AZ). Production of molybdenum metal in 2005 was 15,100 t, a 19% increase compared with that produced in 2004. The estimated gross value of this production was \$1,020 million, an increase of 158% compared with that of 2004. Climax continued to benefit from the increase in the price of molybdenum metal, peaking in 2005 at nearly five times its 2003 average price of \$17.64 per kilogram (\$8 per pound). The company added 157 people to its workforce at the mine and mill complex during the year, raising it to a level of about 560.

The Climax Mine, also owned by Phelps Dodge, was the first major molybdenum mine in the United States. It is located on the Continental Divide at Fremont Pass between Leadville and Copper Mountain in Lake and Summit Counties. The mine has been on care-and-maintenance status since 1995. Phelps Dodge reported that the Climax deposit contains proven millable reserves of 140 Mt of ore grading 0.19% molybdenum. The significant increase in the price for molybdenum since 2003 prompted the company to begin to evaluate the feasibility of restarting the mine.

Vanadium.—Colorado was the only State to produce vanadium ore in 2005. Vanadium was a coproduct of uranium production from mines operated by Cotter Corporation in Montrose County. Cotter had opened four mines in the Colorado Plateau area of western Colorado during the period 2002 to 2005. However, economic factors forced the company to close all of these mines in November 2005. Although these mines were known mainly as a source of uranium, production of vanadium exceeded production of uranium, both in quantity and value. In 2005, Cotter’s four mines produced 41,400 t of ore containing about 623,000 kg of vanadium measured as vanadium pentoxide.

References Cited

LKA International, Inc., 2005, LKA International to develop Golden Wonder Mine further: LKA International, Inc. press release, January 5, 1 p.
LKA International, Inc., 2006, LKA releases highlights of 2005 year-end financial results: LKA International, Inc. press release, April 19, 2 p.

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Constellation Copper Corporation, 2006, Technical report—Cashin copper deposit: Lakewood, CO. Constellation Copper Corporation, 76 p., accessed July 30, 2008, at URL http://constellationcopper.com/art/lisbon/Constellation_Cashin.43-101.162302.KG.pdf.

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN COLORADO^{1,2}

(Thousand metric tons and thousand dollars)

Mineral	2003		2004		2005	
	Quantity	Value	Quantity	Value	Quantity	Value
Clays:						
Bentonite	W	W	5	W	3	W
Common	259	1,580	249	1,510	255	1,610
Gemstones	NA	281	NA	360	NA	358
Lime	26	2,330	26	2,570	29	3,900
Sand and gravel:						
Construction	37,500	213,000	40,900	235,000	44,700	280,000
Industrial	70	W	W	3,300	W	W
Stone:						
Crushed	10,400	64,000	11,100 ^r	68,300 ^r	13,000	89,100
Dimension	5	1,610	16	1,980	18	2,400
Combined values of cement, gold, gypsum (crude), helium (Grade-A), molybdenum concentrates, silver, soda ash (2003-04), and values indicated by symbol W	XX	391,000	XX	699,000	XX	1,380,000
Total	XX	673,000	XX	1,010,000 ^r	XX	1,750,000

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. Withheld values included in "Combined value" data.

XX Not applicable.

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

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

TABLE 2
 COLORADO: CRUSHED STONE SOLD OR USED, BY KIND¹

Kind	2004			2005		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone	6	1,800	\$10,800	6	1,540	\$11,300
Dolomite	1	W	W	1	42	290
Marble	1	W	W	1	W	W
Granite	9	5,230	33,900	10	6,240	42,400
Traprock	--	--	--	1	W	W
Sandstone and quartzite	5	3,210	18,400	7	4,430	30,400
Volcanic cinder and scoria	3	159	1,010	3	159	1,080
Miscellaneous stone	10 ^r	W	W	7	583	3,590
Total	XX	11,100 ^r	68,300 ^r	XX	13,000	89,100

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 3
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS
 IN 2005, BY USE¹

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+1½ inch):		
Riprap and jetty stone	579	4,760
Filter stone	W	W
Other coarse aggregate	211	1,620
Total	790	6,380
Coarse aggregate, graded:		
Concrete aggregate, coarse	(2)	(2)
Bituminous aggregate, coarse	945	7,530
Bituminous surface-treatment aggregate	(2)	(2)
Railroad ballast	(2)	(2)
Other graded coarse aggregate	1	3
Total	1,970	17,000
Fine aggregate (-¾ inch):		
Stone sand, concrete	494	1,200
Stone sand, bituminous mix or seal	858	2,920
Screening, undesignated	(3)	(3)
Other fine aggregate	14	57
Total	1,370	4,180
Coarse and fine aggregates:		
Graded road base or subbase	351	1,550
Unpaved road surfacing	(4)	(4)
Crusher run or fill or waste	257	1,910
Other coarse and fine aggregates	30	215
Total	638	3,670
Agricultural, limestone	(5)	(5)
Chemical and metallurgical, sulfur oxide removal	(6)	(6)
Special, mine dusting or acid water treatment	(6)	(6)
Unspecified:⁷		
Reported	4,030	27,600
Estimated	4,100	28,000
Total	8,170	56,000
Grand total	13,000	89,100

W Withheld to avoid disclosing company proprietary data; included with "Other coarse aggregate."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Withheld to avoid disclosing company proprietary data; included in "Total."

³Withheld to avoid disclosing company proprietary data; included with "Other fine aggregate."

⁴Withheld to avoid disclosing company proprietary data; included with "Other coarse and fine aggregates."

⁵Withheld to avoid disclosing company proprietary data; included with "Unspecified: Reported."

⁶Withheld to avoid disclosing company proprietary data; included in "Grand total."

⁷Reported and estimated production without a breakdown by end use.

TABLE 4
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2005, 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 (+1½ inch) ³	W	W	--	--	W	W
Coarse aggregate, graded ⁴	--	--	--	--	W	W
Fine aggregate (-¾ inch) ⁵	W	W	--	--	W	W
Coarse and fine aggregates ⁶	W	W	--	--	W	W
Agricultural ⁷	--	--	--	--	--	--
Chemical and metallurgical ⁸	W	W	--	--	--	--
Special ⁹	W	W	--	--	--	--
Unspecified:¹⁰						
Reported	--	--	--	--	3,950	27,100
Estimated	309	2,100	358	2,500	3,100	21,000
Total	427	3,470	358	2,460	9,140	63,200
Use	District 5		District 6		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch) ³	W	W	--	--	--	--
Coarse aggregate, graded ⁴	W	W	--	--	--	--
Fine aggregate (-¾ inch) ⁵	612	1,510	--	--	--	--
Coarse and fine aggregates ⁶	W	W	42	210	--	--
Agricultural ⁷	W	W	--	--	--	--
Chemical and metallurgical ⁸	--	--	--	--	--	--
Special ⁹	W	W	--	--	--	--
Unspecified:¹⁰						
Reported	--	--	20	124	57	343
Estimated	383	2,600	--	--	--	--
Total	2,960	19,300	62	334	57	343

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²No production for District 3.

³Includes filter stone, riprap and jetty stone, and other coarse aggregates.

⁴Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), railroad ballast, and other graded coarse aggregate.

⁵Includes stone sand (bituminous mix or seal), stone sand (concrete), and screening (undesigned), and other fine aggregate.

⁶Includes crusher run or fill or waste, graded road base or subbase, unpaved road surfacing, and other coarse and fine aggregates.

⁷Includes limestone.

⁸Includes sulfur oxide removal.

⁹Includes mine dusting or acid water treatment.

¹⁰Reported and estimated production without a breakdown by end use.

TABLE 5
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2005,
 BY MAJOR USE CATEGORY¹

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	6,660	\$51,600	\$7.75
Plaster and gunitite sands	49	444	9.10
Concrete products (blocks, bricks, pipe, decorative, etc.)	67	499	7.43
Asphaltic concrete aggregates and other bituminous mixtures	2,320	21,100	9.08
Road base and coverings ²	7,590	41,000	5.40
Fill	1,330	5,610	4.23
Snow and ice control	70	881	12.52
Other miscellaneous uses ³	413	3,330	8.06
Unspecified: ⁴			
Reported	12,600	73,100	5.80
Estimated	13,600	82,400	6.04
Total or average	44,700	280,000	6.26

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

²Includes road and other stabilization (cement).

³Includes railroad ballast and filtration.

⁴Reported and estimated production without a breakdown by end use.

TABLE 6
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2005, BY USE AND DISTRICT¹

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	1,460	14,800	1,370	9,100	283	2,990
Asphaltic concrete aggregates and other bituminous mixtures	620	7,420	W	W	W	W
Road base and coverings ³	2,010	11,300	1,130	8,360	732	2,460
Fill	125	611	454	1,490	5	60
Snow and ice control	9	72	W	W	--	--
Other miscellaneous uses ⁴	123	1,050	351	1,700	75	900
Unspecified: ⁵						
Reported	365	2,050	7,310	44,400	276	1,670
Estimated	2,210	13,400	3,790	23,000	867	5,260
Total	6,930	50,700	14,400	88,100	2,240	13,300
Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	1,390	10,400	1,890	12,100	375	3,100
Asphaltic concrete aggregates and other bituminous mixtures	387	2,850	W	W	W	W
Road base and coverings ³	308	1,120	1,130	4,060	2,290	13,600
Fill	433	2,110	90	248	218	1,090
Snow and ice control	W	W	W	W	21	206
Other miscellaneous uses ⁴	171	1,430	263	1,840	788	7,830
Unspecified: ⁵						
Reported	2,060	12,400	1,210	7,190	688	3,940
Estimated	4,960	29,800	1,210	7,330	599	3,630
Total	9,700	60,200	5,790	32,800	4,970	33,400
Use	Unspecified districts					
	Quantity	Value				
Concrete aggregate and concrete products ²	--	--				
Asphaltic concrete aggregates and other bituminous mixtures	--	--				
Road base and coverings ³	--	--				
Fill	--	--				
Snow and ice control	--	--				
Other miscellaneous uses ⁴	--	--				
Unspecified: ⁵						
Reported	688	1,330				
Estimated	--	--				
Total	688	1,330				

W Withheld to avoid disclosing company proprietary data; included in "Other miscellaneous uses." -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes plaster and gunite sands.

³Includes road and other stabilization (cement).

⁴Includes filtration and railroad ballast.

⁵Reported and estimated production without a breakdown by end use.