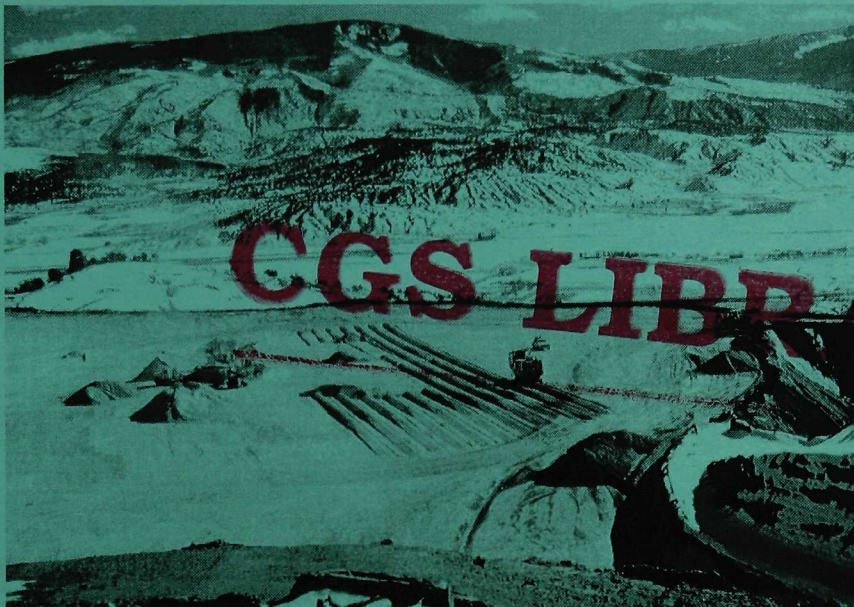


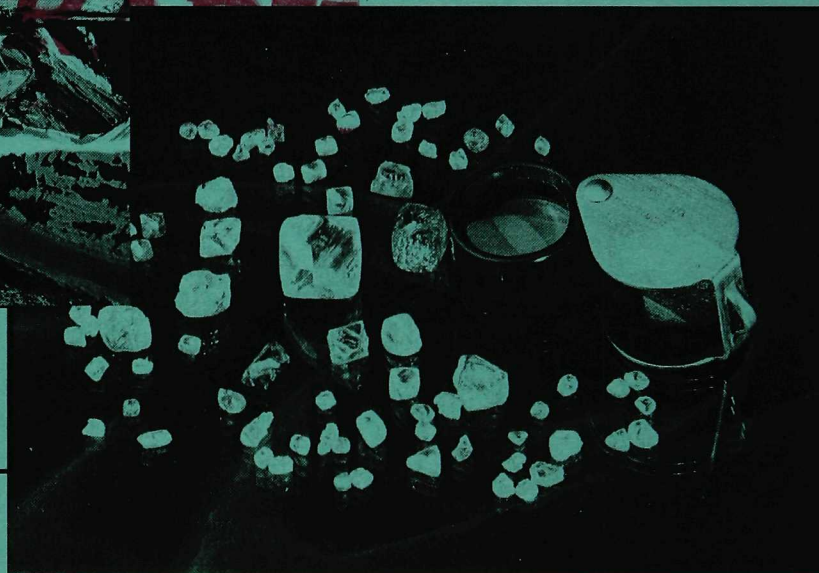
*Information Series 40*

# **Colorado Mineral and Mineral Fuel Activity, 1995**

By James A. Cappa  
and Carol M. Tremain



Colorado Geological Survey  
Department of Natural Resources  
Denver, Colorado  
1996



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Cover photographs: left—overview of the Eagle Gypsum Mine, Eagle County by James Cappa; right—diamonds from Kelsey Lake Mine, Larimer County. The large octahedral diamond by the hand lens is a 14.2 carat gem quality diamond. Photo courtesy of Howard Coopersmith, Colorado Diamond Co.



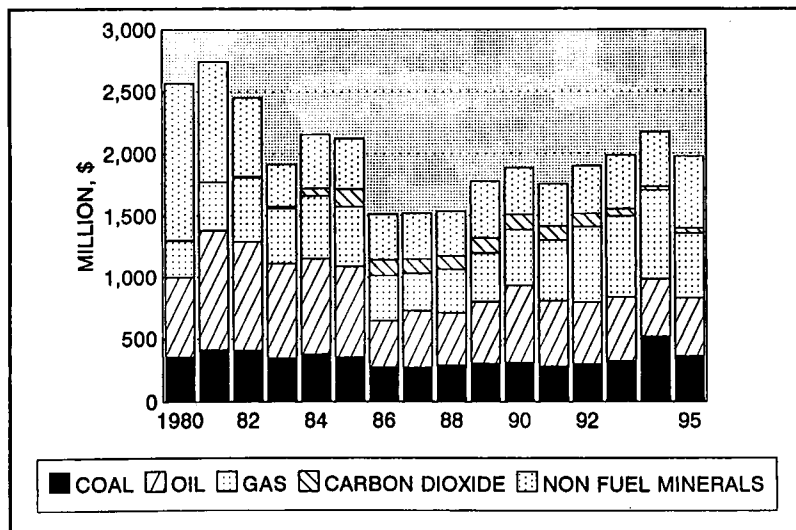
# INTRODUCTION AND ECONOMIC FACTORS

The Colorado Geological Survey Mineral and Mineral Fuels Section estimates the total value of 1995 mineral fuel production in Colorado to be \$1,398 million dollars. The value of the coal production is estimated at \$363 million, oil at \$529 million, natural gas at \$464 million; and CO<sub>2</sub> at \$42 million (Fig. 1). Record and near-record levels of production for coal and natural gas have occurred in spite of lower prices during most of the year. The price for oil increased in 1995; however, the value was offset by decreased production.

Colorado's mineral production in 1995 is estimated at \$578 million (Fig. 1). Improvement from prior years is due chiefly to escalated production of gold and molybdenum and a substantial price increase for molybdenum through most of the year. Declines in the production of sand, gravel, and aggregate balanced some of the gains in the hard rock mining industry. The total value of both mineral and mineral fuel commodities produced in the state during 1995 is \$1,976 million (Fig. 1).

In addition to actual produced commodities, the value of Colorado's mineral and mineral fuel resources is realized in employment, taxes, and royalties that flow back to the state and local governments. Colorado's share of federal mineral royalties has decreased to \$31.8 million in 1995 from a high of \$54.7 million in 1991 (Fig. 2). Some of this decrease is due to overhead costs subtracted by the federal government. A substantial portion of the Colorado share of royalties goes directly to public education and local governments (Fig. 2).

Severance taxes on mineral and mineral fuel production also provide revenue to state and local governments. According to state law, 50 percent of the severance tax revenue flows to local governments and 50 percent flows into a State trust fund to replace depleted natural resources and complete water projects. Legislation passed in 1996 will allow some of the state share of severance tax to be used by agencies within the Department of Natural Resources that promote and regulate the mineral and mineral fuel industries. Severance tax collections for the past five years have varied between \$12 million and \$22 million (Fig. 3).



*Figure 1. Value of Colorado mineral and mineral fuel production.*

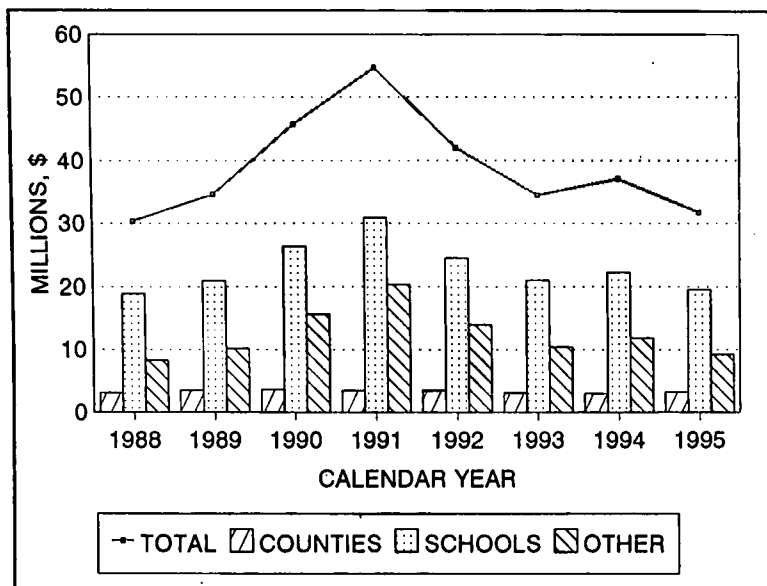


Figure 2. Federal mineral lease revenue distribution in Colorado.

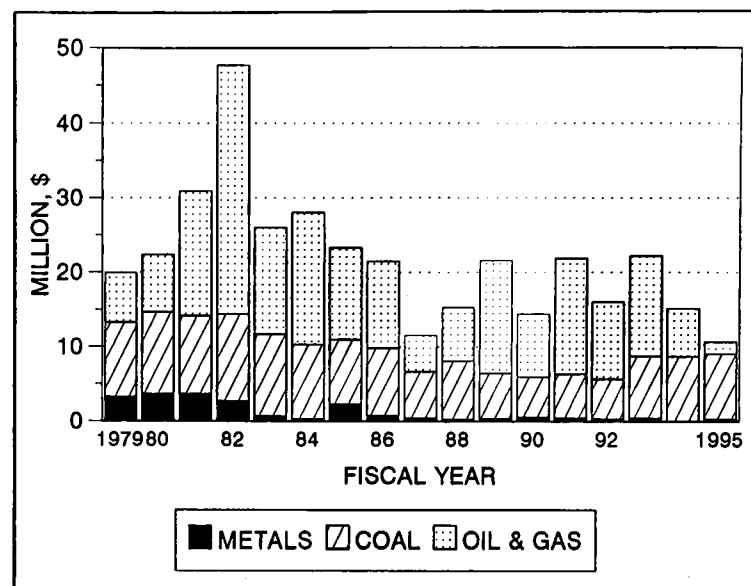


Figure 3. Colorado severance tax collections.

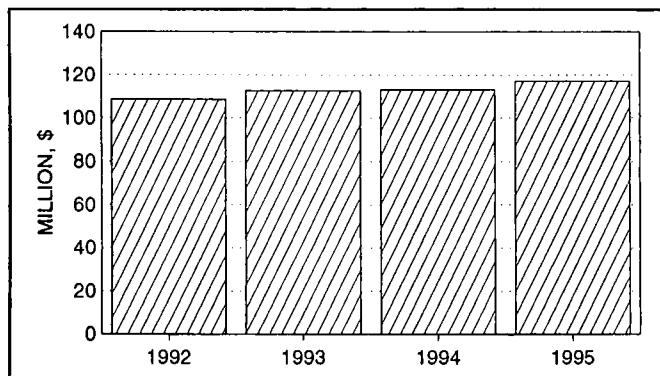


Figure 4. Property tax revenues from mineral properties.

Property taxes paid in 1995 to the counties from mineral and mineral fuel properties totaled \$117 million (Fig. 4). La Plata and Weld Counties both received over \$30 million each in property tax revenue. Denver County was the only county that did not receive any revenue from mineral related property tax.

The University of Colorado College of Business Administration estimates the employment in the mineral and mineral fuel industries in 1995 to be 15,600—or down 0.6 percent from the 1994 level of 16,700. This sector of the economy continues a steady ten year decline in employment from a 1986 level of 25,800 persons. The average annual wage of \$46,000 of mineral and mineral fuel workers is high in comparison to other sectors of the state's economy. The total contribution of mineral and mineral fuel employees' wages to the state's economy is about \$717 million.

## COAL

### Production

The Colorado coal industry has exhibited an overall trend of production growth through the 1970s, 1980s, and early 1990s (Fig. 5). In 1993 and 1994, Colorado coal companies produced record amounts of coal and the Energy Information Administration (EIA) ranked Colorado 10th and 13th among coal producing states in those years. Production in 1995 was 25,900,839 tons, down just slightly from the 1994 record level of 26,033,591 tons despite the fact that the number of producing coal mines decreased from 17 mines at the beginning of the year to 14 at the end.

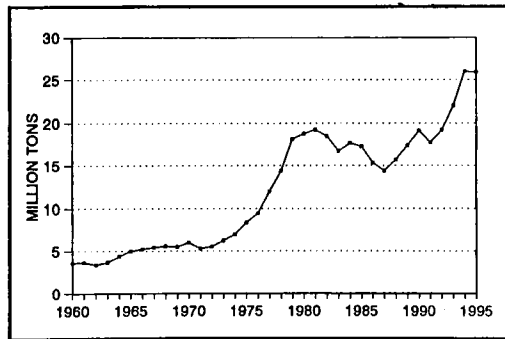


Figure 5. Colorado coal production, 1960–1995.

By the end of December 1995, the mines still producing employed 1,694 (Table 1) people down from 1,875 at the end of 1994. Thirteen of the mines, accounting for over 90 percent of the production, were located in the Uinta and Green River coal regions of north-west Colorado (Fig. 6). Production from the dozen underground mines was two-thirds of the total with production from surface mines making up the remainder.

Coal was mined in 11 of Colorado's 63 counties in 1995: Delta, Fremont, Garfield, Gunnison, LaPlata, Las Animas, Mesa, Moffat, Montrose, Rio Blanco, and Routt. The Cyprus Amax Twentymile Mine in Routt County (Fig. 7) was the state's largest underground producer with 5,846,803 tons. ARCO's West Elk Mine in Gunnison County was the second largest underground producer with 5,318,650 tons. The third most productive mine in the state, and the most productive surface mine, was the Colowyo Mine in Moffatt County with 4,395,865 tons (Fig. 8).

Colorado coal production in 1994 was valued at \$520 million according to the Colorado Mining Association (CMA). Prices averaged \$19.76 per ton that year (EIA, October 1995). The CMA reports

average prices of \$14.21 per ton term and \$12.69 spot through June 30th, 1995. At an approximate average price of \$14 per ton, the 1995 production would be valued at \$363 million.

### Consumption

In 1994, approximately half of Colorado's coal production was burned in the state and half shipped out of state. This trend appears to be holding in 1995; approximately half of Colorado's coal production is being shipped to 14 other states, with Kentucky, Texas, and Illinois being the largest consumers (EIA, February 1996). In addition, a total of 752,000 tons (approximately 3 percent of the State's production) was shipped to four foreign countries in 1994: Taiwan, Hong Kong, Japan, and Korea (EIA, October 1995).

Total coal consumption in the state in 1994 was 17,475,000 tons (EIA, October 1995). A dozen Colorado power plants consumed the majority of the total or 16,536,000 tons (Table 2). This coal originated in Colorado's western slope mines and Wyoming's Powder River Basin. Several industrial plants also burned coal; industrial consumption was 857,000 tons in 1994. Residential and

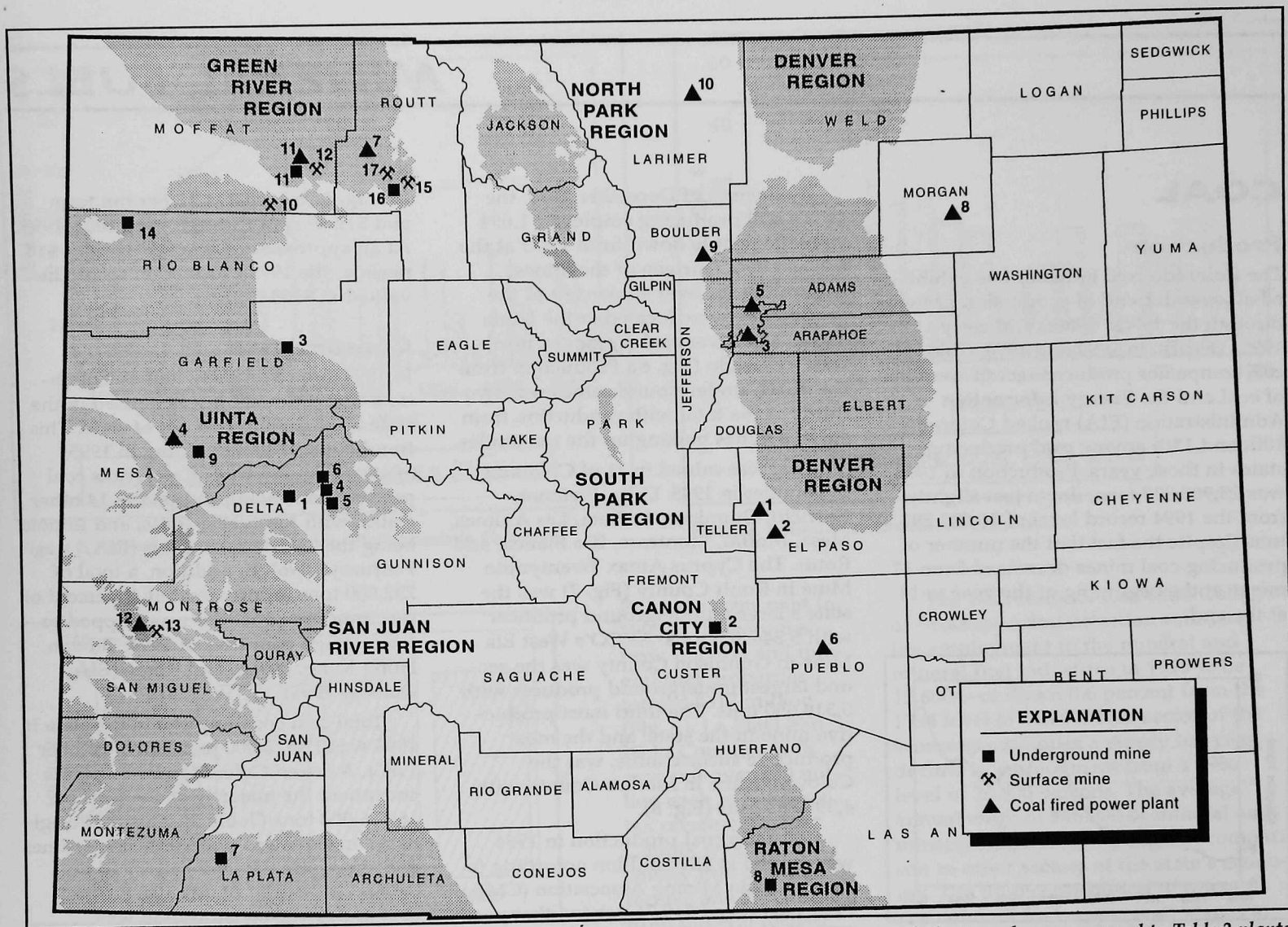
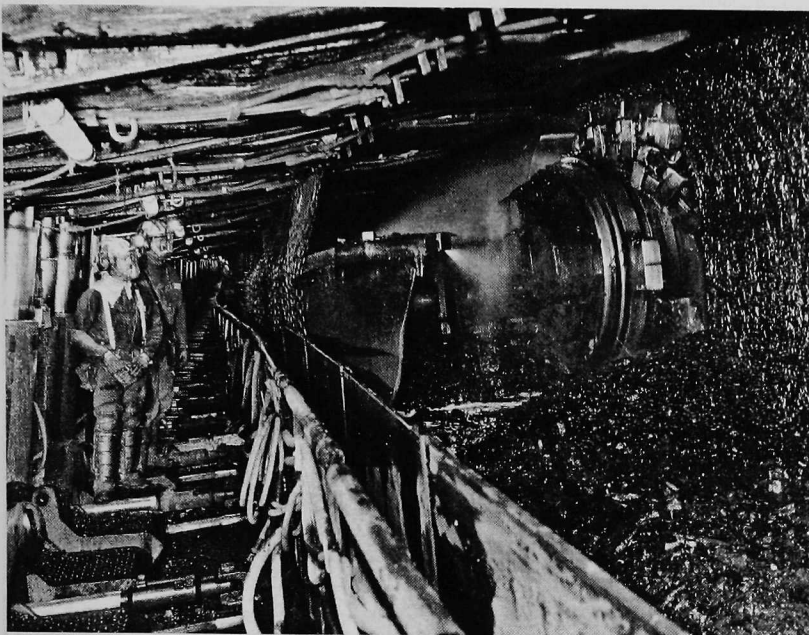


Figure 6. Coal mines and coal-fired power plants in 1995. Mine numbers correspond to Table 1 mines and plant numbers correspond to Table 2 plants.

**Table 1. Mines that produced coal in 1995. (Most BTU from 1996 Keystone Coal Industry Manual, production and number of miners from Colorado Division of Mines.)**

Mine No	County	Coal Region	Mine Name	Operator	Twp, Rge	Geologic Formation	Seam Names	Thickness (ft)	BTU Avg	Mine Type	Mining Method	Dec 1995 Miners	1995 Production (Tons)	Shipment Method
1	Delta	Uinta	Bowie Mine No.1	Bowie Resources, Ltd.	13S, 92W	Williams Fork	Upper D	10-20	11,400	U	Continuous	84	522,384	Rail
2	Fremont	Canon City	Southfield	Energy Fuels, Inc.	20S, 69W	Vermejo	Jack-O-Lantern Red Arrow	6 5.5	11,100	U	Continuous	46	302,233	Rail, truck
3	Garfield	Uinta	Eastside	Eastside Coal Co., Inc.	5S, 92W	Williams Fork	E	20-25	11,700	U	Conventional, continuous	0	375	Truck
4	Gunnison	Uinta	Bear No. 3	Bear Coal Co., Inc.	13S, 90W	Williams Fork	B	8-10	12,200	U	Continuous	49	468,002	Rail, truck
5	Gunnison	Uinta	West Elk	Mountain Coal Co. (ARCO)	14S, 90W	Williams Fork	B	14	11,700	U	Longwall, continuous	198	5,318,650	Rail
6	Gunnison	Uinta	Sanborn Creek	Pacific Basin Resources	12-13S, 90-91W	Williams Fork	B	18	12,375	U	Continuous	102	1,057,996	Rail
7	La Plata	San Juan River	King Coal	National King Coal, Inc.	35N, 11W	Menefee	Upper bed	5.5-6	13,100	U	Conventional	48	208,642	Truck
8	Las Animas	Raton Mesa	Golden Eagle	Basin Resources, Inc.	33S, 67W	Raton	Maxwell	4-7	12,684	U	Longwall, continuous	225	1,519,174	Rail
9	Mesa	Uinta	Roadside	Powderhorn Coal Co.	11S, 98W	Williams Fork	Cameo B	7-8	11,500	U	Continuous	67	589,064	Rail, truck, conveyer
10	Moffat	Uinta	Colowyo	Colowyo Coal Co. (Kennecott)	4N, 93W	Williams Fork	A-F, X, Y	(8 beds) 5.3-12.3	10,650	S	Dragline, truck	229	4,395,865	Rail
11	Moffat	Green River	Eagle No. 5	Cyprus Empire Corp.	5N, 91W	Williams Fork	F	10.5-11.5	10,500	U	Longwall, continuous	8	745,074	Rail
12	Moffat	Green River	Trapper	Trapper Mining, Inc.	6N, 90W	Williams Fork	G, H, I, Q, R	4.5, 5, 5, 11, 4	9,900	S	Dragline, scraper	110	2,024,186	Truck
13	Montrose	San Juan River	New Horizon	Western Fuels Assn.	46N, 15W	Dakota	Upper Dakota Lower Dakota	1 5-5.5	10,400	S	Shovel, truck	20	374,266	Truck
14	Rio Blanco	Uinta	Deserado	Western Fuels-Utah, Inc.	3N, 101W	Williams Fork	D	8-9	10,930	U	Longwall, conventional	114	760,255	Rail
15	Routt	Green River	Edna	Pittsburg & Midway Coal Co.	5N, 85W	Williams Fork	Wadge, Wolf Creek	5-11, 13.5	10,800	S	Dragline	0	24,088	Rail, truck
16	Routt	Green River	Foidel Creek	Twentymile Coal Co. (Cyprus Amax)	5N, 86W	Williams Fork	Wadge	9.5	11,200	U	Longwall, continuous	296	5,846,803	Rail
17	Routt	Green River	Seneca	Peabody Western Coal Co.	5N, 87W	Williams Fork	Wadge, Wolf Creek	9-10, 15.5-16	10,650	S	Dragline	98	1,743,782	Truck, rail
<b>Total</b>												<b>1,694</b>	<b>25,900,839</b>	

**Key: U—underground; S—surface.**




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*Figure 7. Longwall at Cyprus Amax Twentymile Mine. Photo by Bob Lynn, January, 1996. Courtesy of Cyprus Amax Coal Co.*

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commercial consumption was a mere 23,000 tons.

### **Productivity and Capacity**

The larger underground coal mines in the state have been increasing their production by using more efficient technology such as longwall mining (See mining methods, Table 1). The Twentymile Mine set a new *world* record for underground coal production in 1995. In December the mine produced 689,759 tons of coal using both longwall and continuous miner systems (Coal, March 1996). The West Elk Mine set a new *world* record for single longwall

production of 601,068 tons in 24 days in September. Productivity of longwall mines (COAL, January 1996) in Colorado in 1993 was the highest in the country at 5.92 tons per worker-hour versus 3.84 for continuous miners (EIA, March 1995). The five longwalls operating in Colorado during 1995 had panel widths ranging from 620 to 950 feet, panel lengths from 3,000 to 9,000 feet, and cutting heights from 84 to 144 inches (Table 3). Smaller underground mines in the state which use continuous miners or conventional mining are having a difficult time competing with the current low price for coal.

According to the EIA 1994 Coal Industry Annual, the productive capacity of Colorado mines in 1994 was 31,075,000 tons. Given the 1994 production of 26,033,591 tons that year,

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*Figure 8. Colowyo surface coal mine. Photo by Carol Tremain, September, 1993.*

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the capacity utilization of Colorado coal mines was about 84 percent in 1994.

## Resources and Reserves

Colorado's coal is some of the best in the world in terms of quality. Coal underlies 29,600 square miles or 28 percent of the state. Resources range from lignite in the Denver Basin to anthracite near Crested Butte, Gunnison County.

Over 70 percent of the coal mined in Colorado is bituminous in rank with the remainder subbituminous. Furthermore, all the coal being produced is low sulfur with less than 0.6 pounds of sulfur/mil-

**Table 3 . Longwalls seam, size, and overburden data. Information from COAL Magazine 1996 Longwall census, February 1996.**

Mine	Seam	Panel Width (ft)	Panel Lenth (ft)	Overrburden (ft)	Seam Height (in.)
Empire	E	750	7500	600-1200	126-138
Twentymile	Wadge	830	9000	1100	100
West Elk	B	950	9000	600-1400	276 (cut 144)
Deserado	D	820	3000	1600-2100	102
Golden Eagle	Maxwell	620	8900	600	96 (cut 84)

lion British Thermal Units (BTU). The average coal produced in Colorado contains 0.39 pounds of sulfur/ million BTU (CMA, 1996). Wyoming coal has a similar sulfur content with 0.44 pounds of sulfur/ million BTU. In comparison, Illinois and Ohio coal contain 2.34 and 2.89 pounds of sulfur, respectively, per million BTU (CMA, 1996). Colorado coal has the highest heat value among western

coals; BTUs of coal mined in 1995 ranged from 9,900 to 13,100. Although some Colorado coal is coking quality, the current production is being used as steam coal.

Colorado's demonstrated coal reserves are about 16.96 billion tons (EIA, 1993) making Colorado 8th among the states in demonstrated reserves. This is a 650 year supply at the 1994 mining rate (Sanderson and Orf, 1996). Furthermore, of the 16.96 billion ton total, 11.26 billion tons are low sulfur. However, about 10 percent of the underground reserves and 11 percent of the surface reserves are inaccessible (EIA October 1995). Recovery factors are about 88 percent for surface reserves and 58 percent for underground reserves for an average of 77 percent. Recoverable reserves from existing reserves under lease at reporting mines were 676 million tons in 1994. At the 1994 production rate, this gives Colorado a 26-year recoverable coal supply under lease. This low

**Table 2. Coal fired power plants in Colorado, 1995. (Consumption data from 1996 Keystone Coal Industry Manual.)**

Map No	Plant	Utility	Location	1994 Consumption
1	Drake	Colorado Springs	Colorado Springs	767,970
2	Nixon		Colorado Springs	623,090
3	Arapahoe	PSC of Colorado	Denver	750,100
4	Cameo		Cameo	271,190
5	Cherokee		Denver	2,050,800
6	Comanche		Pueblo	2,054,890
7	Hayden		Hayden	1,536,540
8	Pawnee		Brush	1,799,060
9	Valmont		Boulder	548,350
10	Rawhide	Platte River Power	Wellington	1,075,380
11	Craig	Tri-State G&T Assn., Inc.	Craig	4,683,360
12	Nucla		Nucla	375,450
<b>Total</b>				<b>16,536,000</b>

sulfur and high BTU coal should continue to be in demand from American and foreign electricity producers in the future.

## News and Developments

Several mines were commended for emphasizing safety and reducing environmental impact in 1995. Two surface mines operated without any lost time injuries in 1995; the Colowyo and New Horizon mines were recognized by the CMA and Colorado Division of Minerals and Geology for outstanding safety performance. The Twentymile, Eagle 5 and 9, Colowyo, Trapper, and New Horizon mines were given reclamation awards for environmental and reclamation achievements.

Overall trends in Colorado coal include the closure of smaller and less productive mines giving the state an upward trend in production and downward trend in employment. Several mines closed, downsized, or were idled for parts of the year.

The 50 year-old Pittsburgh and Midway Edna Mine in Routt County ceased production at the end of 1994 costing 28 jobs (Miller, 1995). The closing occurred after the lowering of SO<sub>2</sub> requirements by Public Service of Colorado, the Edna's chief customer (COAL, August 1995). The Edna is currently in reclamation.

About 160 employees at the Colowyo Coal Co. were laid off after. Kennecott

Energy acquired the Moffat County mine from W.R. Grace & Co. in late 1994 in a \$220 million transaction (Miller, 1995). The mine has present reserves of approximately 200 million tons (Coal, January 1995).

The Deserado Mine was idled from July to December. Then just 6 weeks after Western Fuels called back 150 miners, a mine fire caused a \$32 million loss of the longwall and other capital equipment. The mine has ordered a new continuous miner and longwall system and plans to resume mining (COAL, March 1996).

Basin Resources shut down the Golden Eagle Mine located 30 miles west of Trinidad, Colorado at the end of 1995 (Denver Post, December 31, 1995). The mine employed 220 people and was the area's largest employer. Seam pinchouts and roof problems were causing significant difficulties for the longwall operation resulting in a \$9.5 million loss in the first nine months of 1995 (Coal Outlook, January 8, 1996).

Cyprus Amax laid off 81 of 91 workers at the Empire Mine in Moffat County at the end of the year due to poor coal sales. As of November 1995, the company was considering whether to develop a higher quality seam at the mine (COAL, November 1995).

A proposed merger of the Southern Pacific and Union Pacific railroads is being reviewed by federal regulators. Much of Colorado's coal is shipped by

Southern Pacific while Powder River Basin coal, which dominates the western coal market, is shipped by Union Pacific and Burlington Northern.

## OIL AND GAS

### Production

In 1994, 15,384 wells produced oil, gas, or CO<sub>2</sub> in Colorado (Table 4). Crude production that year was 30.9 million barrels of oil (BO), CO<sub>2</sub> production was 307.4 billion cubic feet (BCF), gas production was 509.8 BCF (Fig. 9). Coalbed methane at 195.8 BCF was nearly 39 percent of the total gas production. The number of gas wells drilled in 1994 was 716 bringing the total producing gas well count to 14,308 and making Colorado number two in gas wells drilled in the producing states (Gas Daily, February 7, 1996). Marketed gas in 1994 was estimated at 446.6 BCF by the EIA. Consumption of natural gas in the state in 1994 was 275.8 BCF (EIA, November 1995).

La Plata County, home of the giant Ignacio Blanco Gas Field, and Weld County, home of Wattenberg Gas Field, were the leading natural gas producing counties in 1994 with 222.8 BCF and 140.8 BCF respectively. Rio Blanco County led in oil production in 1994 with 9,883,216 barrels of oil (BO) due to the presence of Colorado's one giant oil field, Rangely (Fig. 10).

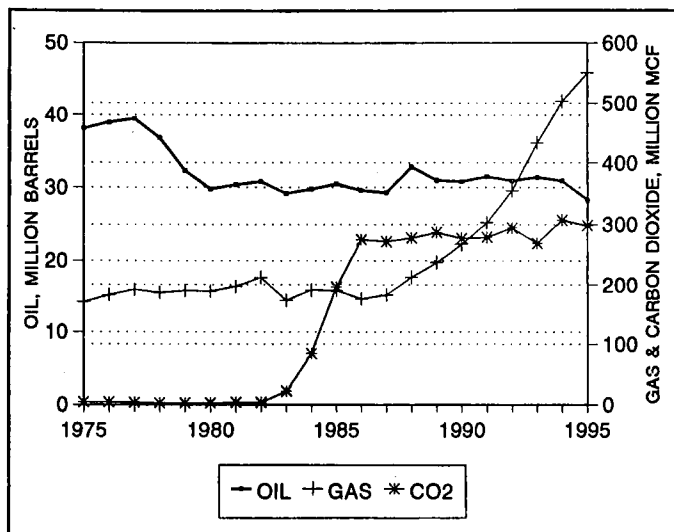


Figure 9. Colorado oil, gas, and carbon dioxide production 1975-1995. Note general rise in gas production and decline in oil production.

In 1995, production for the state was 28.3 million BO, 551 BCF natural gas, and 297.5 BCF CO<sub>2</sub>. In 1995 Colorado ranked 10th of all the states in daily crude and lease condensate production with 74,000 BO per day and 9th in daily

marketed gas production with 1.177 BCF per day (Oil & Gas Journal, January 29, 1996).

### Prices, Value, Costs

According to the Colorado Oil and Gas Conservation Commission (COGCC), the average wellhead price of gas in 1994 was \$1.41 per thousand cubic feet (MCF); the average oil price was \$14.98 per barrel, and the average CO<sub>2</sub> price was \$0.10 per MCF. The estimated value of oil produced in 1994 was \$484,433,322; gas was valued at \$859,624,752, and CO<sub>2</sub> at \$31,667,170 (COGCC, March 18, 1996).

In 1995, natural gas prices were down due to mild weather and high volumes in underground storage (Oil and Gas Journal, February 27, 1996). The 1995

natural gas price fell to \$0.96 per MCF; however, the oil price rose to \$16.38 per barrel; and the CO<sub>2</sub> price rose to \$0.14 per MCF (COGCC). This places the estimated value of 1995 production at \$1.034 billion.

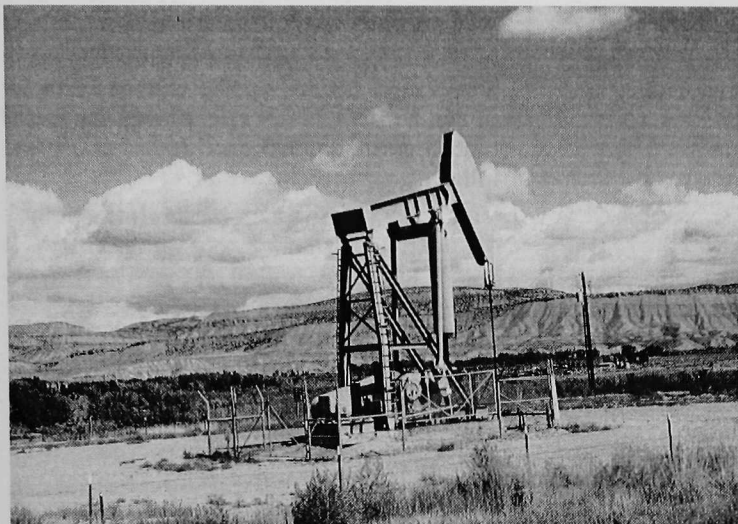
Of the 759 wells completed in 1995, 589 were gas wells, 29 were oil wells, and 108 (approximately 14 percent) were dry and abandoned. Average gas well depth in 1994 was 7,189 feet. Drilling costs for Colorado gas wells in 1994 averaged \$266,395 or \$37.06 per foot. This was up from \$26.74 per foot in 1993 (Oil & Gas Journal, March 11, 1996).

### Permits and Drilling

In 1995, 1,394 permits were processed by the COGCC (1,002 drilling and 392 recompletion); this compares to 2,398 in 1994 for a drop of 42 percent (COGCC, January 16, 1996). The two counties that led permit applications were Weld with 599 and Yuma with 168. Rig counts were down significantly in 1995 to an average of 14.9 from 29.9 in 1994 (Oil & Gas Journal, January 29, 1996).

Table 4. Production, prices, and well counts for 1994 and 1995. Production and well counts for 1994 and all prices are from the Colorado Oil and Gas Conservation Commission. Production data and well counts for 1995 are from Petroleum Information.

Year	Oil (Barrels)	Avg. Price Per Barrel	Gas (MCF)	Avg. Price Per MCF	Carbon Dioxide, (MCF)	Avg. Price Per MCF	Producing Wells
1994	30,914,556	14.98	509,817,037	1.41	307,448,258	0.10	15,384
1995	28,303,109	16.38	551,058,723	0.96	297,514,370	0.14	15,351



*Figure 10. Pumpjack on south flank of Rangely field. Photo by Carol Tremain, September, 1993.*

Lower gas prices led Wattenberg Field operators to curtail drilling activity in 1995 (COGCC, June 19, 1995). Nevertheless, Weld County led the state in completions in 1995 with approximately 400 wells completed or worked over; most of those wells were Niobrara, Codell, or J Sand gas wells in Wattenberg Field. Yuma was the next most active county with the completion of approximately 60 shallow Niobrara gas wells. The shallowest completions in 1995 were several Vermejo coalbed methane wells in Las Animas County at approximately 900 to 1,000 feet. The deepest completion was Basin Exploration's Federal 1-19 Entrada gas deep pool discovery well in Hiawatha Field, Moffat County, at 14,407 feet. Average well

depth for wells completed in 1995 was 6,640 feet.

Of the 759 wells completed in 1995, around 587 were development wells and 91 were exploratory wells. The

COGCC named several new fields in 1995 which are listed in Table 5. 1995 wildcat discoveries are listed in Table 6 and wildcat dry holes are listed in Table 7. These exploratory wells are shown in Figure 11.

Two significant dry holes completed in 1995 were the Lexam Dakota exploration tests in the San Luis Valley which were both plugged and abandoned; however, Lexam will continue to explore in the area next year (COGCC, November 20, 1995). Lexam originally found significant oil shows in previously undiscovered Cretaceous rocks while drilling for gold west of the Sangre de Cristo Mountains (AAPG Explorer, Kathy Shirley, July 1995, p. 1-9).

## Unconventional Resources

New coalbed methane completions dropped sharply in 1994 and 1995. Although drilling in the Raton Basin

*Table 5. New oil and gas fields in 1995.*

Field	County	Type	Location	Zone
Deep Pockets	Arapahoe	Oil	Sec. 27, T4S, R63W	J Sand
Elephant	Kiowa	Gas	Sec. 32, T17S, R50W	Morrow
Kokopelli	Arapahoe	Gas	Sec. 10, T4S, R63W	J Sand
Prosperity	Morgan	Gas	Sec. 30, T6N, R58W	D Sand
Rockies	Washington	Oil	Sec. 12, T1N, R53W	D Sand
Saddlebag	Las Animas	Gas	Sec. 36, T32S, R67W	Raton coal
Sand Hills	Moffat	Gas	Sec. 32, T12N, R91W	Lewis
Spanish Peaks	Las Animas	Gas	T33S, R65W	Vermejo coal

was up with 16 gas wells completed in Las Animas County, most of the sweet spots had already been drilled in the San Juan Basin's Fruitland Formation coalbed methane play. Only a dozen Fruitland coal gas wells were completed in 1995. Methane production from Amoco's two coalbed methane wells in the Burro Canyon Unit of the Raton Basin rose from 277 MCF per day to 831 MCF per day after seven months of production (Stevens et al., 1996).

In the area of enhanced coalbed methane recovery—Amoco increased coalbed methane production rates from 200 MCF per day to 1,400 MCF per day in a pilot nitrogen injection program in La Plata County (Murray, 1995). Amoco also has a methane enhanced recovery project underway in the Tiffany area, San Juan Basin, and in the Raton Basin. Meridian is attempting a CO<sub>2</sub> flood in the Allison Unit, San Juan Basin (Stevens et al., 1996).

Two horizontal wells were completed in 1995. The Howell Petroleum Slanovich 25-14 (Sec. 25, T19S, R70W) was completed as a dry hole after being drilled to a measured depth of 4,729 feet in the Pierre Shale west of Florence Field, Fremont County. The Meridian Oil Clough 31-23H was completed as a Corcoran Sandstone gas well in Rulison Field, Garfield County. The well had a measured depth of 11,501 feet, a true vertical depth of 8,489 feet, and an initial potential of 2,753 MCF per day and 34 barrels of water.

## Employment

According to the Colorado Department of Labor and Employment, average 1994 Colorado employment in the petroleum sector (including exploration, drilling, and services) was 9,905 with an average annual wage of \$46,686. Although final figures will not be available until August, employment apparently declined in 1995, with first quarter employment at 9,132, second quarter 8,501, and third quarter, 8,811.

## Reserves

Proven crude oil reserves at December 31, 1994, were 271 million BO, down from 284 million BO at the end of 1993 (EIA, October 1995). Dry natural gas reserves in 1994 were up to 6,753 BCF in 1994 from 6,722 BCF at the end of 1993. These reserve totals put Colorado in eighth place among the 50 states (excluding offshore) in both crude and dry natural gas reserves.

## News and Developments

A number of mergers, purchases, and reorganizations affecting the Colorado petroleum sector were announced in 1995.

- ◆ The merger of Public Service of Colorado with Southwestern Public Service Co. was approved by shareholders. The merged companies will provide electricity and natural gas to four million consumers in a five state area (Hart's, April 1996).

- ◆ KN Energy Inc. merged K.N. Production into Tom Brown to form Wildhorse L.L.C., a new gas services firm (Hart's, April 1996).
- ◆ Texaco Exploration and Production Inc. consolidated its Denver and Bakersfield divisions. The new unit is headquartered in Bakersfield and about 35 Denver employees will be relocated (Hart's, February 1996).
- ◆ Snyder laid off about 80 people in November 1995, reducing their work force from 500 to 320 (Schwab, November 16, 1995). In addition, Snyder Oil Corp. and Gerrity Oil & Gas Corp. combined assets and operations in Wattenberg Field into a new public company, Patina Oil & Gas Company. The new company will operate 3,500 wells (Oil & Gas Journal, January 22, 1996).
- ◆ Plains Petroleum and Barrett Resources Corp. merged in July 1995 combining interests in more than 2,000 producing oil and gas wells (Day, July 16, 1995).
- ◆ The Gas Research Institute (GRI) reduced its 1996 budget by about 20 percent forcing cuts in staff and restructuring of research, development, and commercialization activities. GRI revenue, derived from gas transportation surcharges, was down due to discounting in the gas industry (Oil & Gas Journal, February 26, 1996).

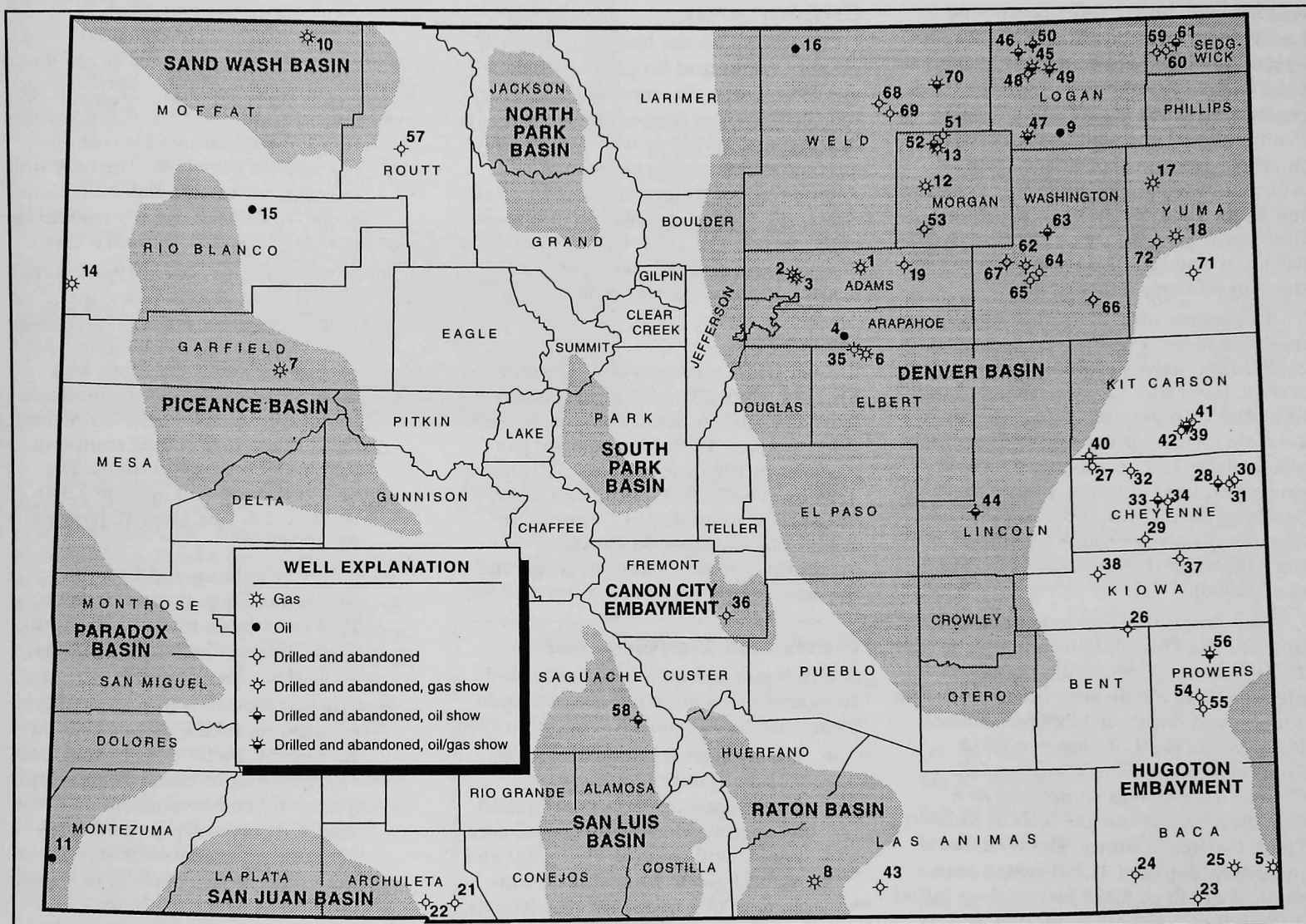


Figure 11. Map of significant wildcats completed in 1995.

**Table 6. Significant wildcat discovery wells completed in Colorado in 1995. Data from Petroleum Information and COGCC.**

Well	County	QtrQtr Sec, Twp, Rge	Field	Well Name	Completion Date	Total Depth (ft)	Formation at Total Depth	Producing Zone	Producing Interval (ft)	Initial Potential	
1	Adams	SWSW 29, 1S, 62W	Cougar	HS Resources HSR-Barclay No. 13-29	9/20/95	7415	J Sand	J Sand	7289-7298	57 MCFD	7 BWPD
2	Adams	SWNE 10, 2S, 66W	Holster	HS Resources HSR-Cunningham No. 7-10	4/18/95	8462	Skull Creek	J Sand	8294-8338	42 BCPD	102 MCFD 24 BWPD
3	Adams	NWSW 11, 2S, 66W	Holster	HS Resources HSR-Van Schaak No. 12-11	9/16/95	8400	J Sand	J Sand	8272-8307	7 BCPD	123 MCFD 7 BWPD
4	Arapahoe	SESW 17, 5S, 63W	Ferret	North American Resources Murphy No. 24-17	5/25/95	8150	J Sand	J Sand	7995-8038	25 BOPD	420 MCFD
5	Baca	NWNW 16, 33S, 41W	Greenwood	Sharon Resources State No. 1-16	4/6/95	4800	Morrow	Topeka	2941-3071	373 MCFD	
6	Elbert	SESW 9, 6S, 62W	Deadeye	HS Resources HSR-Whitehead No. 14-9	9/15/95	7585		D Sand	7282-7405	17 BCPD	690 MCFD 2 BWPD
7	Garfield	NESE 10, 7S, 93W	Mam Creek	Snyder Oil Parker Ranch No. 10-9	8/7/95	8294		Mesaverde	6539-7871	3,391 MCFD	
8	Las Animas	NESW 21, 33S, 65W	Spanish Peak	Evergreen Operating Grosso No. 23-21	6/19/95	1005	Trinidad	Raton / Vermejo	465-555	36 MCFD	138 BWPD
9	Logan	NWSW 10, 6N, 52W	Moose	Cyanostar Energy Colorado No. 4-10	3/1/95	4649	J Sand	D Sand	4517-4524	20 BOPD	
10	Moffat	SWNE 32, 12N, 91W	Sand Hills	BTA Oil Producers JV-P Fourmile A No. 1	7/27/95	4447	Lewis	Lewis	4202-4238	24 BCPD	4,031 MCFD 3 BWPD
11	Montezuma	SWSE 3, 34N, 20W	Little Ute	Petrocorp Inc. Sleeping Ute No. 3	3/31/95	6097	Akah	Ismay	5826-5840	49 BOPD	40 MCFD 2 BWPD
12	Morgan	NWSE 34, 4N, 59W	Canal	Schneider Rosella E Shorty No. 1	5/22/95	6200	J Sand	D Sand	6008-6026	872 MCFD	
13	Morgan	NENW 30, 6N, 58W	Prosperity	Maximum Energy Enersource No. 1	3/12/95	6196	J Sand	D Sand	6094-6098	6 BCPD	350 MCFD 2 BWPD
14	Rio Blanco	SWSE 31, 2S, 103W	Park Mountain	Mitchell Energy P M Federal No. 1-31-2-103	9/11/95	8500		Dakota	7824-7930	657 MCFD	
15	Rio Blanco	NWSE 4, 2N, 94W	Wilson Creek	Texaco Expl & Producing Wilson Creek No. 69	7/20/95	5800	Niobrara	Niobrara	4005-5129	100 BOPD	58 MCFD
16	Weld	SWNW 24, 11N, 66W	Wildcat	Antelope Producing Lind No. 24-1	7/1/95	9600	Dakota	J Sand			
17	Yuma	SESW 33, 4N, 47W	Buffalo Grass	J-W Operating Franson No. 9-33	3/10/95	2943	Smoky Hill	Niobrara	2747-2763	699 MCFD	
18	Yuma	SWNW 27, 1N, 46W	Unnamed	J-W Operating Gardner No. 1-27	6/15/95	2630	Smoky Hill	Niobrara	2438-2482	228 MCFD	

**Key: BOPD—barrels of oil per day; BCPD—barrels of condensate per day; MCFD—thousand cubic feet of gas per day; BWPD—barrels of water per day.**

**Table 7. Significant wildcat dry holes completed in 1995. Data from Petroleum Information and COGCC.**

Well	Show	County	QtrQtr Sec, Twp, Rge	Field	Well Name	Completion Date	Total Depth	Formation at Total Depth
19		Adams	SENE 29, 1S, 60W	Wildcat	HS Resources HSR-Smiley M Q No. 8-29	5/19/95	6582	Skull Creek
20		Arapahoe	NWSE 3, 4S, 57W	Wildcat	Edward Mike Davis UPRC-Linnebur No. 33-3	1/14/95	5453	J Sand
21		Archuleta	SENW 28, 33N, 2E	Wildcat	Murphy H Baxter Navajo Peak No. 1	8/29/95	3900	Precambrian
22		Archuleta	SENW 25, 33N, 1W	Wildcat	True Oil Bayles No. 22-25	8/02/95	2525	
23		Baca	SWNE 31, 34S, 45W	Wildcat	D & J Oil Kohler No. 1-31	11/12/95	4430	Mississippian
24		Baca	SWNW 24, 33S, 49W	Wildcat	Paroo Petroleum Sycamore No. 24-E1	5/5/95	4090	Arbuckle
25	G	Baca	SENW 12, 33S, 44W	Wildcat	Sharon Resources Doke-Lohrey No. 1-12	7/9/95	5383	Morrow
26		Bent	NWNW 1, 21S, 49W	Wildcat	Murfur Drilling McClave-State No. 1-1	9/12/95	5400	Mississippian
27		Cheyenne	SESW 7, 12S, 50W	Speaker	Union Pacific Resources House 24-7 No. 1	9/5/95	6800	Mississippian
28	O	Cheyenne	SESW 15, 13S, 44W	Wildcat	Dunne Equities Etal Hanavan No. 2	3/8/95	5510	Warsaw
29		Cheyenne	SWNE 14, 16S, 48W	Wildcat	Dunne Equities Bullock No. 1-14	3/23/95	5330	Warsaw
30		Cheyenne	SWNE 17, 13S, 43W	Wildcat	Union Pacific Resources Elasmos 32-17 No. 1	7/26/95	5560	Spergen
31		Cheyenne	SWSE 18, 13S, 43W	Wildcat	Union Pacific Resources Casner 34-18 No. 2	3/19/95	5445	Keys
32		Cheyenne	SENE 19, 12S, 48W	Wildcat	Anschutz Corporation Farside No. 8-19	1/26/95	6500	Mississippian
33	O	Cheyenne	NWNW 10, 14S, 47W	Wildcat	Dunne Equities Steel No. 1-10	4/15/95	5490	Spergen
34		Cheyenne	CW2SW 12, 14S, 47W	Wildcat	Dunne Equities So Mt Pearl No. 1-12	5/9/95	5510	Spergen
35	G	Elbert	SENW, 1, 6S, 63W	Wildcat	HS Resources HSR-Miller No. 6-1	5/1/95	7856	Skull Creek
36		Fremont	SESW 25, 19S, 70W	Wildcat	Howell Petroleum Slanovich 25-14 No. 2	2/9/95	4729	Pierre
37		Kiowa	SWSW 15, 17S, 46W	Wildcat	Union Pacific Resources Pawnee 14-15 No. 2	2/25/95	5138	Spergen
38		Kiowa	SWNE 5, 18S, 50W	Wildcat	Mull Drilling Mull UPRC-Aldrich No. 2	2/12/95	5700	Spergen
39	O&G	Kit Carson	NWSW 21, 10S, 45W	Beeson	Anschutz Corporation Booth No. 12-21	6/29/95	5640	Spergen
40		Kit Carson	NENW 36, 11S, 51W	Speaker	Union Pacific Resources Highpoint State 21-36 No. 1	6/23/95	6865	Spergen
41		Kit Carson	SENE 21, 10S, 45W	Wildcat	Anschutz Corporation Beeson No. 8-21	6/10/95	5700	Morrow
42		Kit Carson	NENW 29, 10S, 45W	Wildcat	Anschutz Corporation Davis No. 3-29	7/19/95	5630	Spergen
43		Las Animas	NWSE 35, 33S, 62W	Wildcat	El Paso Gas Marketing Carlos Sandoval No. 12	6/11/95	1550	Greenhorn
44	O	Lincoln	SENW 19, 14S, 56W	Wildcat	Mesa Operating Smith Cattle No. 1-19	2/28/95	8300	Spergen
45	O&G	Logan	NESW 30, 10N, 53W	Garnet	Western Operating Koester No. A-1	10/20/95	5064	J Sand
46		Logan	NENW 4, 10N, 54W	Nabar	Western Operating et al Vincent No. 1	6/20/95	5330	J Sand

Table 7. Continued.

Well	Show	County	QtrQtr Sec, Twp, Rge	Field	Well Name	Completion Date	Total Depth	Formation at Total Depth
47		Logan	SESE 11, 6N, 54W	Sodbuster	Western Operating Van Deweghe No. 1	8/8/95	4953	Skull Creek
48		Logan	SENE 36, 10N, 54W	Wildcat	Peterson Energy Mgmt State No. 8-36	10/8/95	5040	J Sand
49	O&G	Logan	SWSE 36, 10N, 53W	Wildcat	Crown Petroleum Crown Petroleum State No. 1	10/15/95	5156	Lakota
50	O	Logan	SENE 29, 11N, 53W	Wildcat	Winslow Resources Loos No. 1	6/28/95	5250	Skull Creek
51		Morgan	SENE 9, 6N, 58W	Cole	Maximum Energy Wulf No. 1	2/1/95	6453	D Sand
52	O	Morgan	SWSW 19, 6N, 58W	Nacho	Maximum Energy Enersource No. 2	3/9/95	6270	J Sand
53		Morgan	SWSE 33, 2N, 59W	Wildcat	Barnes Petroleum Rosener No. 3	6/10/95	9860	Paleozoic
54		Prowers	NWNW 21, 24S, 45W	Wildcat	Walter V Berry Cogburn No. 1-21	6/2/95	5203	Keys
55		Prowers	NENE 9, 25S, 45W	Wildcat	Walter V Berry Hoffman No. 1-9	1/27/95	5170	Mississippian
56	O&G	Prowers	SENE 13, 22S, 45W	Wildcat	Walter V Berry Holden No. 1	9/15/95	4990	Keys
57		Routt	NWSE 20, 6N, 86W	Wildcat	Sindbad Partnership Tow Creek State No. 20-1	9/7/95	5850	Niobrara
58	O	Saguache	SWNW 15, 42N, 12E	Unnamed	Lexam Explorations Baca No. 1	9/26/95	4322	Precambrian
59		Sedgwick	NESW 16, 10N, 47W	Wildcat	Peterson Energy Mgmt State of Colorado No. 16-11-1	11/21/95	3990	J Sand
60		Sedgwick	NWNE 14, 10N, 47W	Wildcat	White Eagle Energy Eagle View State No. 1-B	4/17/95	6575	Granite
61	O	Sedgwick	NENE 4, 10N, 46W	Wildcat	Western Operating Munson No. 4-1	2/22/95	5410	Wolfcamp
62	G	Washington	NESW 1, 1S, 55W	Rago	Western Operating Stegosaurus No. 23-1	4/13/95	4973	J Sand
63	O	Washington	SWSW 12, 1N, 53W	Rockies	Arthur T Skaer Churchill No. 2	9/24/95	4900	J Sand
64		Washington	NESW 16, 2S, 53W	Wildcat	Heartland Oil & Gas State of Colorado No. 2	6/21/95	4824	J Sand
65		Washington	NWSW 30, 2S, 53W	Wildcat	Heartland Oil & Gas Pachner No. 1BH	6/26/95	4895	J Sand
66		Washington	NESW 32, 3S, 50W	Wildcat	Peterson Energy Mgmt Lippelmann No. 32-1	1/20/95	4000	J Sand
67		Washington	NWSW 26, 1S, 55W	Woodrow E	Patrick A Doheny Sharp No. 1	6/30/95	4860	J Sand
68		Weld	NWSE 18, 8N, 61W	Seven Cross	Polfam Exploration Sievers No. 33-18	7/11/95	7400	J Sand
69		Weld	NENE 3, 7N, 61W	Wildcat	HS Resources HSR-Bradt/Susie Q No. 1-3	3/8/95	7300	J Sand
70	O&G	Weld	SE 19, 9N, 58W	Wildcat	Walsh Production Best Chance No. 1-19	4/22/95	6679	J Sand
71		Yuma	SENE 28, 2S, 45W	Wildcat	J-W Operating Sigmon No. 1-28	3/17/95	2423	Smoky Hill
72		Yuma	NWSE 3, 1S, 47W	Wildcat	J-W Operating Nelson No. 1-3	9/15/95	2784	Smoky Hill

Key: G—Gas show; O—Oil show

- ♦ Petroleum Information and Dwight's Energydata announced an agreement to form a new company in October 1995.

## **Pipelines**

Mid America Pipeline Co. is planning a 10 inch diameter, 383 mile products line from Weld County, Colorado to Ellsworth County, Kansas; completion is projected for December 1996. TransColorado Gas Transmission is awaiting approval from the Federal Energy Regulatory Commission of a 24 inch diameter, 22 mile gas pipeline; completion is scheduled for 1996 (Williamson, 1996). The 292 mile, 22-24 inch diameter

TransColorado Gas Transmission pipeline between Meeker, Colorado and Blanco, New Mexico (initial capacity 3 MMCF of gas per day) should be on line in the fall of 1996 (Hart's, September 1995). KN Energy plans to buy Amoco's 850 mile crude oil pipeline connecting Riverton, Wyoming to Kansas City and convert it to a gas line by 1997 (Gas Daily, January 31, 1996).

## **URANIUM**

Underground development work took place at Cotter Corporation's Schwartzwalder Mine in Jefferson County during

1995. A spiral decline is being taken from the 1900 level down to the 2200 level. Minal reserves are being blocked out by one underground core drill which has been operating since May 1995. Cotter Corporation plans to have the mine back in production by mid-1996. The price of uranium oxide has risen over the past year in part due to restriction penalties placed on Commonwealth of Independent States (CIS) uranium oxide. In March 1995 the NUEXCO price was \$7.25 per pound. By March 1996 the price with the CIS penalty had more than doubled to \$15.40 for domestic uranium.

## METALS

### Molybdenum

During 1994 improving economies in the Far East and Europe and depleted stockpiles caused an increase in demand for molybdenum. In January of 1995 the free market price for molybdcic oxide had risen to \$16-18 per pound. As a result of the price increase, Cyprus Amax Minerals Company, the sole producer in Colorado, began a program to increase production at the Henderson Mine, Clear Creek County and reopened the dormant Climax Mine in Lake County.

In 1993 the Climax Mine was reported to have minable ore reserves of 136 million tons at a grade of 0.22 percent Mo. At its zenith of production in 1980 the Climax Mine produced over 150 million tons of ore.

Open pit mining at the Climax Mine commenced in April at a daily rate of 30,000 to 40,000 tons of ore and waste. The mine employed 90 Cyprus Amax staff employees in the mill and plant. The company hired 50 contract miners from Montana to conduct the mining operations. Unfortunately, the price of molybdcic oxide declined from its

January high to \$5.75 in July prompting Cyprus-Amax officials to close the mine after only four months of operation. The price for molybdcic oxide continued its decline through the year, decreasing to \$4.89 in September and \$4.78 in December.

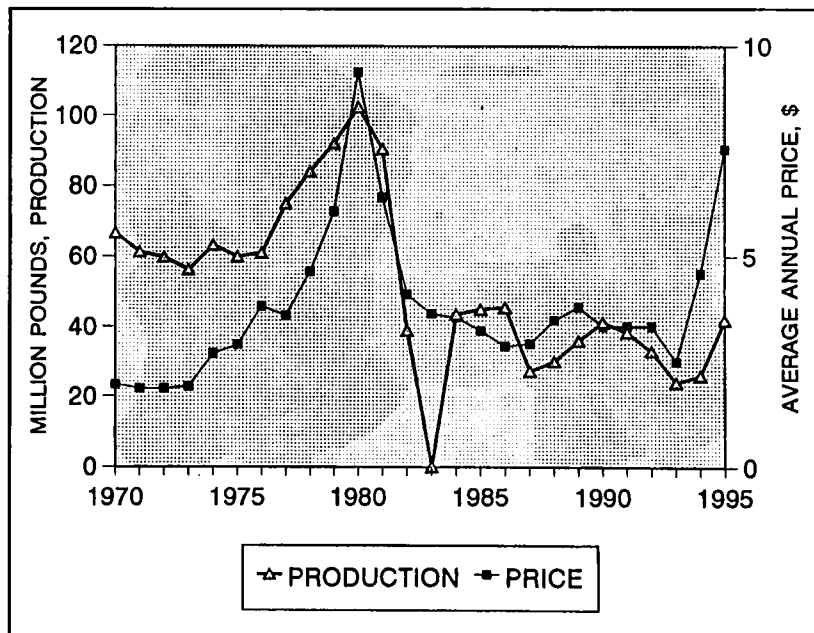
Molybdenum production at Cyprus Amax's Henderson Mine in 1994 was 26.5 million pounds. Production for 1995

from both the Henderson and Climax Mines was 42 million pounds at an estimated value of \$316 million (Fig.12). If the global economy continues to improve, 1996 production will probably stabilize at slightly below that level.

### Gold and Silver

Gold production in Colorado increased approximately 14 percent from 145,000

*Figure 12.  
Colorado  
molybdenum  
production.*



ounces in 1994 to an estimated 165,000 ounces in 1995 (Fig. 13). There are two main gold producers in the state, the San Luis Gold Mine which has attained its planned production level, and the Cresson Mine in the Cripple Creek district. Gold is also produced as a by-product of base metal mining at the Black Cloud Mine in the Leadville district.

Production of gold in 1995 at Battle Mountain's San Luis Gold Mine in Costilla County was 70,000 ounces, down slightly from 73,000 ounces in 1994. The San Luis deposit (also known as El Plomo) contained about 12,149,000 tons of ore at 0.04 ounce per ton gold

prior to the commencement of mining in 1991. Current minable reserves will sustain the mining operation until mid-1997 when the ore will be exhausted. The mine and mill are operating at their planned capacity with a staff of 93 employees. The total operating cost in 1995 was the same as 1994, \$317 per ounce. Battle Mountain forecasts a 1996 production of 70,000 ounces.

The Cripple Creek and Victor Gold Mining Company, a joint venture partnership between Pikes Peak Mining Company (a subsidiary of Independence Mining Company) and Golden Cycle Gold Corporation, produced 76,589 ounces of gold and 26,429

ounces of silver from the Cresson Mine in 1995. Mining at the Cresson open pit began in December 1994 after a seven month construction period and an investment of \$100 million. In 1995, 7,155,400 tons of ore at a grade of 0.033 ounce of gold per ton and 11,140,300 tons of waste were mined.

In 1996 the Cresson Mine is projected to operate at full capacity producing 163,000 ounces of gold from 8,500,000 tons of ore at a grade of 0.027 ounce per ton. The current mine plan will allow for an annual production of 160,000 ounces of gold over the next seven years. The Cresson Mine has a 1994 proven and probable reserve of 73 million tons at a grade of 0.03 ounce of gold per ton for a total of 2.2 million ounces. There is an additional 1.4 million ounces of gold at the mine that have been classified as a resource. The deposit has an overall strip ratio of 1.7:1 and a leach pad recovery of 71 percent. District wide reserves total approximately 97 million tons at 0.027 ounces of gold per ton.

The Cripple Creek and Victor Gold Mining Company conducts an aggressive exploration program in the district. Because of the tremendous amount of geological, geophysical, and geochemical data on the district the exploration staff uses a unique GIS-based data system to conduct favourability analysis for selection of drill targets. In 1995, 71,000 feet of reverse circulation and core drilling were completed. This year

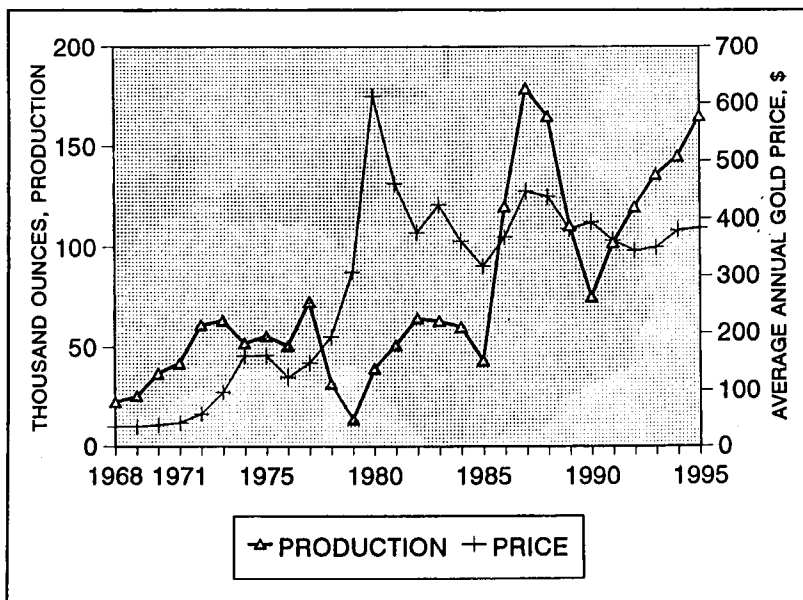


Figure 13.  
Colorado gold  
production.

the company plans 267,000 feet of exploration drilling. The focus of the exploration program remains on shallow, bulk-minable mineralization; however, there will be some deep drill hopes targeted on the high grade mineralization that made the Cripple Creek district the third largest producing gold district in the United States with over 21 million ounces of production since its discovery in 1891.

Sunshine Mining Company entered into a lease agreement in 1994 on the presently-closed Revenue-Virginus Mine in the Sneffels district near Ouray, Colorado. Over 14.5 million ounces of silver were produced between 1876 to 1913 from narrow, high-grade, tetrahedrite veins hosted in a series of Tertiary volcanic rocks. The company began a reserve delineation program with seven surface and underground drillholes during 1994. In 1995 the company drilled an additional nine core drillholes on the property. Silver is found in association with the tetrahedrite, a complex copper-antimony sulfide, which can be successfully treated using Sunshine's patented hydro-metallurgical process. Proven and probable reserves at the Virginus Mine are 410,000 tons of ore containing approximately 5 million ounces of silver.

Projections for 1996 indicate that gold production will be about 250,000 ounces, a new modern record for Colorado. The last time such gold production levels were obtained was in the late

1930s just prior to the cessation of gold mining activities during World War II.

## Base Metals

The Black Cloud Mine near Leadville is the state's sole significant base metal producer. The mine has a capacity of 900 tons per day and operates from two underground shafts. The mine produced about 220,000 tons of ore during 1995. Development activities in 1995 included the deepening of the Irene Shaft an additional 250 feet down to the 2000 level. Staffing at the mine will remain at 135 to 150 employees as long as metal prices do not fluctuate significantly.

The orebody is a complex massive sulfide replacement deposit in the Mississippian Leadville Limestone. The ore grade is 3 percent lead, 8.5 percent

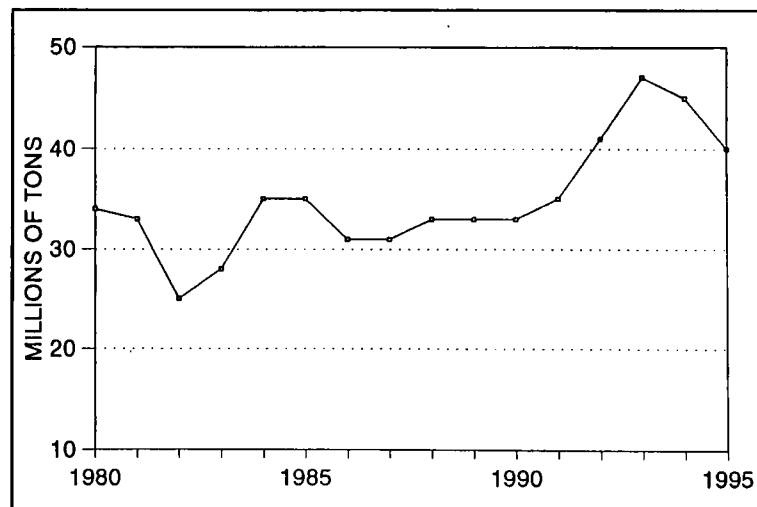
zinc, 2 ounces per ton silver, and 0.06 ounces per ton gold.

# CONSTRUCTION MATERIALS AND INDUSTRIAL MINERALS

## Sand, Gravel, and Aggregate

The sand, gravel, and aggregate industry produced approximately 40 million tons of sand, gravel, and aggregate in 1995, down from the high of 47 million tons in 1993 (Fig. 14). The value of the 1995 production is estimated to be \$157 million. The decrease in production is due to the completion of the Denver International Airport and a slowdown in

*Figure 14. Colorado sand, gravel, and aggregate production*



new home and commercial construction. Production in 1996 is projected to remain around 40 million tons.

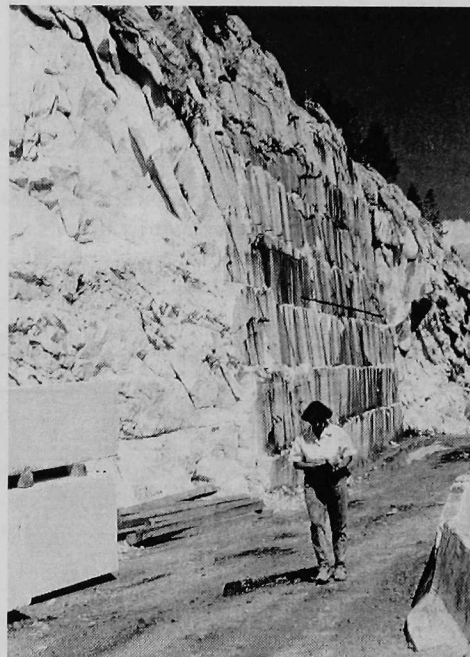
Colorado Silica Sand Inc. of Colorado Springs produces approximately 200,000 tons a year of specialty sand that is used for fracturing of oil and gas wells, filter media for water purification plants, gravel packs around water wells, and other applications where roundness, permeability, and strength are important parameters. About 50 percent of the production is shipped overseas, primarily Canada, South America, and Europe. The sand comes from several quarries of a Quaternary eolian sand located in the Colorado Springs area. The sand deposits are fine- to coarse-grained, well rounded, and have a thickness of about 20 feet.

Other construction and industrial minerals produced in the state during 1995 include peat, bentonite clay, common clay, and kaolin.

### Dimension Stone

The Colorado Yule Marble Company is mining white marble from the historic Yule Marble Quarry near Marble, Colorado. In 1995 the company produced 4,400 tons of salable marble primarily as 15 to 20 ton blocks (Fig. 15). Approximately 20 percent of the production was sent overseas, primarily to Italy, Japan, and Indonesia, where it is fabricated into consumer products. The demand for stone floor tiles within

the United States is increasing as the price disparity between ceramic and stone tiles diminishes. The Colorado Yule Marble Company has purchased a new production saw and plans to add a third shift in 1996 in order to approximately double production to satisfy the increased demand for high quality marble tiles.



*Figure 15. Blocks of Yule Marble awaiting shipment to Glenwood Springs partly visible on left of photo. Yule Marble Quarry, near Marble, Gunnison County. Photo by J. Cappa, 1994.*

The Crystal Valley Mining Company is conducting limited development work on their alabaster and black marble deposit in Pitkin County. The deposit is hosted by the Pennsylvanian Belden Formation. The black marble is noted for its hardness and multicolored veinlets. The project which is located on federal land has received the necessary permits from state and federal authorities, but is still in the process of obtaining a permit from Pitkin County.

### Gem Minerals

Colorado Diamond Co., a subsidiary of Redaurum Red Lakes Mines Ltd. of Toronto, announced a 300,000 ton per year trial mining program on their Kelsey Lake kimberlite prospect in the State Line district of Larimer County. The Kelsey Lake Mine will be North America's first commercial diamond producer since the turn of the century. Open pit mining at Kelsey Lake began in late 1995; but, the processing plant commenced operations in May, 1996. The mine and processing plant will be upgraded to 1 million tons a year production after the two year trial mining program. The diamonds produced at the Kelsey Lake Mine will be marketed as Colorado™ Diamonds and Kelsey Lake™ Diamonds.

Over 60 percent of the diamonds recovered in previous years bulk sampling programs are of gem quality including a 14.2 carat, white diamond,

the largest ever discovered in the State Line district and the eighth largest found in North America (Frontispiece). The Kelsey Lake prospect consists of eight kimberlite pipes; however, the trial mining program will be focussed on the two largest pipes which have a surface area of about 12 acres and contain about 19 million tons of ore down to 330 feet depth. The processing plant will be capable of producing 200 tons per hour of gravity concentrates by using only a water slurry in four rotating pans, each about 14 feet in diameter. The concentrates are mixed with water and passed over a vibrating table coated with grease. Because of their hydrophobic character, the diamonds stick to the grease as the other heavy minerals float away to the tailings pond. Initial diamond recoveries are estimated to be up to 25,000 carats per year.

Anvil Resources Ltd. has acquired kimberlite prospects in the Chicken Park area of the State Line district. Earlier prospecting in this area yielded 306 diamonds including a 2.5 carat industrial grade diamond. The estimated grade of the Chicken Park kimberlites is 6.7 carats per 100 metric tonnes. The company was reportedly drilling the property in August, 1995.

The Sweet Home Mine, an old silver prospect, in Park County was reopened as a rhodochrosite gem mine in 1991. Over the past five years the mine has produced several world class examples of cherry red rhodochrosite crystals

including one thought to be the largest in the world. Some of the larger crystals set in a quartz and sulfide mineral matrix have commanded prices in the hundreds of thousand dollars.

## Gypsum

Gypsum production in 1995 at the Eagle Gypsum Mine, Eagle County operated at its nameplate capacity of 400,000 tons, the same as in 1994. The gypsum ore is mined from an open pit mine using pavement profiler machines that cut a trench 12 feet wide by 0.5 foot deep (Fig. 16). The gypsum is manufactured into

wallboard and other products at the plant in Gypsum. Approximately 50 percent of the wallboard produced at the plant goes to the Colorado construction industry and the remainder is marketed throughout the USA.

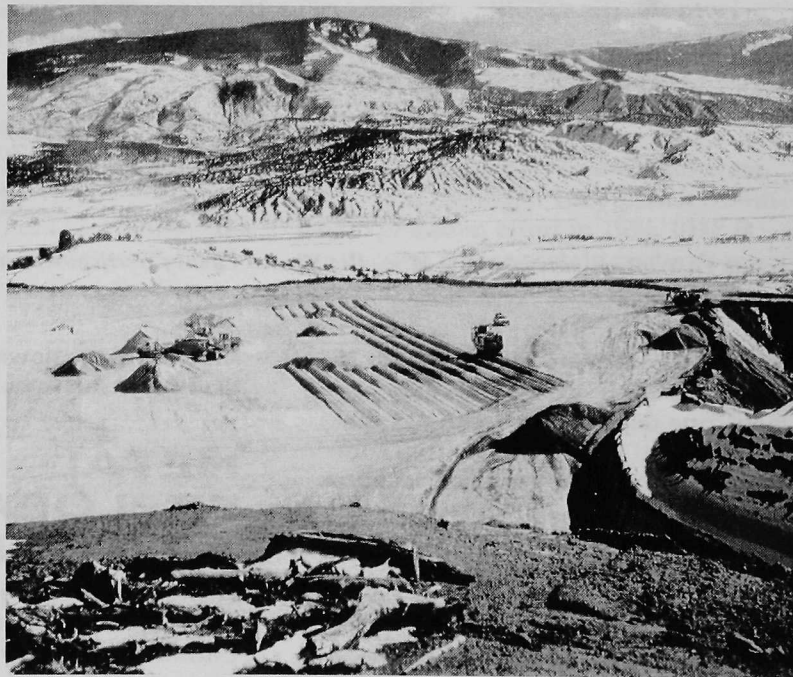
## Sodium Minerals

The White River Nahcolite Company produced approximately 50 percent of the plant's nameplate capacity of 125,000 tons a year of nahcolite,  $\text{NaHCO}_3$ , at their solution mine in the Piceance Basin, Rio Blanco County. The company produces both food and industrial grade

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*Figure 16. Eagle Gypsum mine, north of Gypsum, Eagle County. Note pavement profiler cutting furrows in gypsum bed. Loading facilities just to the left of photo center. Photo by J. Cappa, 1996.*

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*Figure 17. White River Nahcolite Mine, Rio Blanco County. Vertical recovery well at solution cavity number 4.*

sodium bicarbonate from the 20 to 25 foot-thick "Boies Bed", a Tertiary age lacustrine deposit at a depth of 2,000 feet. Current production is from solution cavity number 4 which has a projected yield of 125,000 tons at a well spacing of 3,000 feet (Fig 17). Recent permit changes have allowed the company to reopen solution mining operations at solution cavity number 1. The solution cavities formed a different

shape, which allows greater recoveries, than projected in early design plans.

## **METAL EXPLORATION ACTIVITIES**

Hendricks Minerals Canada Ltd. optioned the Cross Mine property in the Caribou district, Boulder County to

Echo Bay Mines during 1995. The Cross Mine is thought to be a stockwork vein gold deposit associated with the contact of a Tertiary age quartz monzonite intrusive and surrounding Precambrian rocks. Preliminary reserve calculations by Hendricks Minerals indicate 1.1 million tons at a grade of 0.08 ounce per ton including a high grade zone of 387,000 tons at a grade of 0.21 ounces per ton. Echo Bay completed a mapping and sampling program and drilled nine core holes totaling 11,000 feet on the property in 1995. Seven holes were drilled from surface and two were drilled from underground stations. Echo Bay was testing a new model for gold and silver mineralization at the Cross Mine; however, the gold and silver grades did not meet expectations and the property was returned to Hendricks Minerals.

Sunshine Mining continued its gold and base metal exploration program in the Uncompahgre mining district near Ouray. The exploration program consisted of nine core holes in a skarn zone in the Upper Jurassic Pony Express Limestone Member. After evaluation of the drilling results Sunshine terminated its lease and returned the property to the owner.

Royal Gold Inc. of Denver has entered into an agreement with Union Pacific Minerals Inc. to conduct exploration for precious metal and gemstone deposits in Colorado and Wyoming on Union Pacific lands. During 1995 Royal

sediment samples yielded positive results for kimberlite minerals. At least five anomalous drainage basins without known kimberlite rocks have been defined by the sampling. Continued exploration in 1996 will consist of more detailed sampling in anomalous drainages and follow-up geological exploration.

Summo Corporation, a partnership consisting of Denver-based St. Mary Minerals Inc., MLP Associates, and other investors, completed 25 exploration drillholes on the Cashin copper prospect in Montrose County during 1995. The best drill holes intersected 160 feet of 1.18 percent copper. A total of 77 drill holes have been completed on the project to date. The tabular-shaped orebody is hosted by the Triassic Wingate Sandstone, is about 150 feet thick, and consists of two layers—an upper oxide zone consisting primarily of malachite and azurite and a lower chalcocite (sulfide) zone. The preliminary drill-indicated reserve is 13 million tons at a grade of

0.5 percent copper for a total of approximately 130 million pounds of copper. Metallurgical tests confirm that the ore is amenable to a solution extraction-electrowinning process. Projected average recoveries are 80 percent for both ore types. Column leach testing of bulk oxide and sulfide samples and collecting of environmental baseline data is planned for 1996.

The Powderhorn district in Gunnison County is estimated to contain approximately 500 million tons of titanium ore. Most of the titanium resource is in perovskite, a mineral that presents unique processing problems. Teck Resources has been conducting an evaluation program on the Powderhorn titanium resource since 1990. No work other than continued market evaluation took place in 1995. In 1996 Teck plans to conduct metallurgical testing on the ore and is likely to undertake a pre-feasibility study.

Royalstar Resources Ltd. completed a Phase 1 bulk sampling program from their Sloan 2 pipe test adit at the Sloan

kimberlite prospect in the State Line district in 1994. Plans for 1995 included an additional 700 feet of drifting and cross-cutting below high grade zones indicated by surface sampling; however, legal complications concerning the mineral lease forced Royalstar to suspend further exploration efforts on the Sloan kimberlite.

American Alkali Company, formerly Natrona Resources Inc., of Glenwood Springs has provisional plans to conduct drilling for environmental baseline information this spring on their proposed soda ash and sodium bicarbonate plant and solution mine site in the Piceance Basin, Rio Blanco County.

Phelps Dodge is actively looking at precious and base metal opportunities in Colorado. They have conducted an exploration drilling program on an undisclosed prospect in the southwestern part of the state. They plan a continued exploration effort in 1996. BHP is conducting a base metals exploration program in undisclosed areas.