

SOUTH DAKOTA

By Leon E. Esparza

1989

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

SOUTH DAKOTA



U.S.
DEPARTMENT
OF THE
INTERIOR

Manuel Lujan, Jr.
Secretary



BUREAU
OF
MINES

T S Ary
Director

April 1991

Contents

Regulatory Issues	1
Exploration Activities	2
Legislation and Government Programs	2
Review by Nonfuel Mineral Commodities	3
Metals	3
Gold and Silver	3
Iron Ore	7
Industrial Minerals	7
Cement	7
Feldspar and Mica	7
Sand and Gravel	7
Stone	7
Crushed	7
Dimension	7
Other Industrial Minerals	7

Tables

Table 1.—Nonfuel Mineral Production in South Dakota	1
Table 2.—South Dakota: Crushed Stone Sold or Used by Producers in 1989, by Use	7
Table 3.—South Dakota: Crushed Stone Sold or Used by Producers in 1989, by Use and District	8
Table 4.—Principal Producers	9

State Map

Principal Mineral-Producing
Localities in South Dakota

COVER PHOTO:

*The South Dakota
Capitol Building in
Pierre symbolizes the
cooperative working
relationship between the
Bureau of Mines and
the mineral agencies of
the State. (Photo is
courtesy of the South
Dakota Department of
Tourism.)*

*For comments or further information,
please contact
Twin Cities Regional Office of State
Activities
5629 Minnehaha Ave.
Minneapolis, MN 55417-3099
Telephone: (612) 725-4536;
FTS 789-4536*

THE MINERAL INDUSTRY OF SOUTH DAKOTA

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.

By Leon E. Esparza¹

In 1989, the value of South Dakota's nonfuel mineral production was about \$284 million, a slight decrease compared with the 1988 value. A 31% decrease in the value of crushed stone production offset increases recorded for other major commodities, including cement, gold, construction sand and gravel, and dimension stone. South Dakota ranked 32d in the value of nonfuel mineral production, accounting for about 1% of the U.S. total. Gold, the State's leading commodity, accounted for 70% of the total value of nonfuel minerals produced in the State in 1989, followed by portland cement and crushed stone.

Minerals used in construction accounted for about 30% of the nonfuel mineral production value. In 1989, the

value of nonresidential construction permits increased nearly 23% compared with the 1988 value; the number of private and public residential units authorized increased by about 8%.² The value of State road contract awards increased by slightly more than 5%, to \$122 million.³ According to the South Dakota Department of Labor, mining employment totaled 2,610 jobs in 1989, about 5% fewer than in 1988. Average hourly earnings for mine production workers was \$12.37 in 1989, a slight increase over the 1988 wage rate.

Mineral taxes in South Dakota are levied only on gold and silver production. Collections for the fiscal year ending June 30, 1989, totaled slightly more than \$8 million, up 14% from the previous fiscal year, according to the

South Dakota Department of Revenue, Severance Tax Unit.

REGULATORY ISSUES

The State Board of Minerals and Environment (SBME) issued two life-of-mine permits in 1989. One was to the South Dakota Cement Commission for a gypsum operation in Meade County. The other was for a small gold mine to be operated on the C & W No. 4 Claim in Pennington County by Mr. Franklin Wolbaum of Custer.

The South Dakota Department of Water and Natural Resources (DWNR) concluded deliberations reported in the 1988 South Dakota Minerals Yearbook

TABLE 1
NONFUEL MINERAL PRODUCTION IN SOUTH DAKOTA¹

Mineral	1987		1988		1989		
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	
Cement:							
Masonry	thousand short tons	4	W	4	W	W	
Portland	do.	519	W	490	W	W	
Gem stones		NA	\$100	NA	\$100	NA	\$150
Gold ²	kilograms	W	W	13,981	197,026	16,123	198,318
Lead ²	metric tons	—	—	—	—	4	3
Sand and gravel (construction)	thousand short tons	°9,600	°19,100	7,929	18,681	°6,400	°20,800
Silver ²	metric tons	W	W	3	552	4	705
Stone:							
Crushed	thousand short tons	5,070	18,515	°5,500	°20,600	3,833	14,303
Dimension	short tons	50,718	18,209	°43,297	°16,472	54,623	17,738
Combined value of beryllium concentrates (1987), clays (common), feldspar, gypsum, iron ore (1988-89), lime, mica (scrap), and values indicated by symbol W							
		XX	206,968	XX	32,288	XX	32,341
Total		XX	262,892	XX	285,719	XX	284,358

[°] Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

² Recoverable content of ores, etc.

chapter⁴ concerning disposal of incinerated sewage ash stored at Edgemont by Consolidated Management Corp. (CMC). Early in 1989, the DWNR decided to spend CMC's bond money to bury the ash. In November, a contractor for the State completed burial of the material. CMC initially planned to use "proprietary reactor technology" to extract gold and other products from the ash.

EXPLORATION ACTIVITIES

During 1989, gold exploration continued in the Black Hills but at significantly reduced levels from the feverish pace of recent years. According to the DWNR, 16 exploration permits were issued in 1989, down from 24 permits issued in 1988. Of the permits issued in 1989, 14 were for gold and 2 were for industrial minerals. Although most of the gold exploration was in Lawrence County, some also was in Custer and Pennington Counties. New exploration permits were issued to seven companies. A total of 1,858 test holes was permitted for drilled depths ranging from 60 to 12,000 feet. The State also permitted collection of 390 bulk samples and construction of 38 trenches and 18 miles of access road. Gold exploration targets included Precambrian iron formations, Cambrian Deadwood Formation, Mississippian Pahasapa (Madison) Limestone, and Tertiary igneous intrusive rocks.

Companies with State exploration permits included Bond Gold-Richmond Hill Inc., a wholly owned subsidiary of Bond International Gold Inc.; Goldstake Explorations (SD) Inc.; Homestake Mining Co.; Noranda Exploration Inc. (in part through a joint venture with Crown Butte Mines Inc.); Oakmont Resources Inc.; South Dakota Cement Commission; and Wharf Resources (U.S.A.) Inc. Crown Butte announced in June that it had optioned two Noranda gold properties in the Rochford Mining District, about 17 miles south of Lead. In 1987, Noranda was reported to have identified geology and mineralization similar to that at the Homestake Mine at Lead. Crown Butte announced intentions to spend \$1.5 million to expand reserves reported to be 2.3 million short tons or 2.1 million metric tons (MMmt), grading 0.11 ounce of gold per ton or 3.77 grams

per metric ton (mt), 0.45 ounce of silver per short ton (15.43 grams per mt), and 0.72% copper.⁵

LEGISLATION AND GOVERNMENT PROGRAMS

In November, the Surface Mining Initiative Fund, a coalition of environmental activists, began circulating a petition seeking a November 1990 ballot initiative that would impose a 3,100-acre limit on surface mining in the Black Hills. Earlier in the year, the State Legislature passed, and the Governor signed into law, House Bill 1291, commonly known as the Centennial Environmental Act. Part of the act requires an industry-funded comprehensive environmental evaluation (CEE) when total affected lands under mining permits exceed 3,500 acres. Also enacted was a new law specifying certain lands unsuitable for mining. Originally identified as House Bill 1289, the law denies mining permits for lands that cannot be physically or economically reclaimed. Other provisions of the new law deny mining permits if water pollution cannot feasibly be prevented or if probable adverse socioeconomic impacts of a proposed mining operation outweigh its probable benefits.

The DWNR was involved heavily with mining-related oversight activities in 1989. As a result of the enactment of House Bill 1291, the department supervised the contractor selection and initiation of the CEE study of the Black Hills. Brown, Bortz and Coddington Inc. of Denver, CO, was selected as the contractor, and the report is scheduled for completion by December 1990. The study will address the social, economic, and environmental effects of large-scale gold mining in the Black Hills.

An allotment grant of \$138,000 from the Bureau of Mines was received by the Mining and Mineral Resources Research Institute at the South Dakota School of Mines and Technology in Rapid City, under provisions of Public Laws 98-409 and 100-483. The purpose of the institute is to coordinate and administer training and research in mining, mineral resources, minerals development, and mineral processing. Fourteen graduate fellowships were supported by the allotment grant.

Projects undertaken included an in-

vestigation of problems associated with the permitting process for new gold mines in South Dakota. The investigation's purpose was to provide technical assistance to South Dakota mining companies and the DWNR. Technical assistance included a study for Wharf Resources comparing sound-level intensity of routine mining operations with those of nonmining sounds in the surrounding inhabited area, including chain saws, jet airplanes flying overhead, traffic noises, and barking dogs. The study concluded that the sound levels emanating from the mine operations were generally of lower intensity than those normally found in an inhabited area.

Another study sought a method to recover efficiently, through the use of centrifugation, the heavy and finely divided mineral particles from light gangue minerals. Success in the research would benefit the mineral processing industry by reducing current losses due to insufficient technology available to recover consistently material finer than minus 325 mesh. The study demonstrated that finely divided heavy and hydrophobic particles could be separated by centrifugal force in a two immiscible liquids system. Further study will be needed to understand the mechanisms of the separation process and to identify important parameters affecting the efficient separation of mixtures of many different types of minerals.⁶

The Bureau of Mines conducted several research projects to improve mine safety and economics at the Homestake Mine. Research results should benefit other deep underground mining operations worldwide. A study to determine the effect of nearby underground mining operations on a major shaft access-way continued. Another project sought ways to safely and economically improve blasting procedures or designs to preserve the integrity of rock surrounding mine workings. A third project involved designing methods to improve underground fire warning alarm systems. Researchers on this project developed a compact, lightweight antenna and an ultra-low-frequency electromagnetic alarm system that allows communication of a mine emergency through short pulsating interruptions in underground lighting systems. The Bureau also began an appraisal of selected mineral resources in

the Black Hills National Forest to determine their potential for development. The commodities specifically targeted for study included beryllium, columbium-tantalum, feldspar, gold, lithium, mica, quartz, silver, and tin. The study was scheduled for completion by late 1990.

REVIEW BY NONFUEL MINERAL COMMODITIES

Metals

Gold and Silver.—The State ranked fourth of 14 States in gold production value and hosted the second largest gold mine in the United States. Production in 1989 totaled 16,123 kilograms (kg) (518,371 troy ounces), valued at \$198.3 million, which was a 15% increase in production but a less than 1% increase in value compared with 1988 figures. Gold accounted for 70% of the State's nonfuel mineral production value. The South Dakota Mining Association, of which all the States's major gold producers are members, reported 1989 gold production of 558,600 troy ounces (17,400 kg) at an average cash cost per ounce produced of \$274.46.⁷ This cash cost did not include startup capital, exploration, administrative overhead, and certain unspecified taxes.⁸ Average gold price was \$382.58 per ounce. Silver, produced as a coproduct of gold mining, increased significantly in both quantity and value. Precious metals production continued to increase, as in recent years, because of improved efficiency and the full-scale startup of two operations. All of the active major gold operations were in the northern Black Hills of Lawrence County within about a 7-mile radius of Lead, and most produced silver as a coproduct.

South Dakota's five major gold producers in 1989 had nearly \$5.7 million invested in reclamation bonding with the State. The total area permitted for disturbance was 2,482 acres, with 1,874 acres disturbed and 190 acres reclaimed during the year. The gold producers had 1,816 employees, for a total annual payroll of nearly \$55 million and an average hourly wage, including benefits, of \$17.26. The average annual salary for mining-related jobs was \$33,683. The industry's supply pur-

chases totaled approximately \$67 million. Taxes paid by the gold producers totaled nearly \$7.6 million for State severance taxes, almost \$4 million in State sales taxes, and \$3 million for property taxes.⁹

Homestake Mining Co. was the State's largest gold producer. According to the Homestake 1989 annual report,¹⁰ gold production from the Homestake and Open Cut Mines at Lead totaled 381,788 ounces (11,875 kg), a 2% decrease from the 16-year record production reported in 1988. Open Cut gold production totaled 68,539 ounces (2,132 kg) from 997,050 short tons of ore mined.¹¹ Overall recovery rate was about 95%. Homestake also reported 4.4 short tons (4 mt) of lead production.

Ore reserves for the Homestake underground mine totaled about 19.8 million short tons grading 0.229 ounce of gold per short ton (7.85 grams per mt), containing about 4.5 million ounces (140,000 kg) of gold, and at the Open Cut about 9.0 million short tons grading 0.122 ounce of gold per short ton (4.18 grams per mt) containing about 1.1 million ounces (34,200 kg) of gold. Total ore reserves for the Lead operations as of yearend 1989 were about 28.8 million short tons, with a weighted average grade of 0.196 ounce of gold per short ton (6.72 grams per mt) and containing about 5.6 million ounces (174,200 kg) of gold. Full production costs at the Lead operations in 1989 totaled \$322 per ounce, an increase of \$8 per ounce over the previous year. In 1989, exploration expenditures in South Dakota totaled \$3.8 million.¹² Homestake's environmental operating expenses totaled nearly \$2.6 million, or \$6.76 per ounce of gold produced at the Lead operations.¹³

In 1989, Homestake continued exploration from platforms on the 8,000-foot, the deepest, level of the underground mine. Drilling targets included downplunge extensions of historically productive ledges and new ore ledges below the 8,000-foot level. Exploration successfully identified new ore bodies on the 15-ledge structure within the mine.

Underground mining in 1989 was mostly between the 1,400-foot and 7,850-foot levels, with about 25% of all underground production coming from below the 6,800-foot level. The Homestake mill has an annual production

capacity of about 2.5 million short tons (2.3 MMmt). Some of the mine tailings were used as backfill in mine operations, and the remainder was deposited in the Grizzly Gulch tailings impoundment. In 1989, an additional lift for the impoundment, begun in 1987, was completed. The new lift was expected to extend the impoundment life until 2003. Construction of a carbon strip regeneration plant was completed and the carbon adsorption facility enlarged to process tailings decant water that could allow annual recovery of an additional 7,000 ounces (218 kg). Additionally, a regrind mill circuit was commissioned in 1989 to process tailings from the gravity circuit and was expected to yield another 4,000 ounces (124 kg) annually.

In August, Homestake announced a planned \$30 million expansion of its Open Cut project. The expansion area would include a 26-acre tract mostly south and west of the current open pit and within part of the city of Lead. Also included would be a 92-acre waste disposal area near Central City, north of the current open pit. About 170 private and commercial structures within Lead could be relocated. The expansion would not begin until 1997, assuming all required county and State permitting requirements were completed. The Open Cut mine life would be extended about 5 years, to 2005, and at least an additional 375,000 ounces (11,664 kg) of gold would be added to its yield.

In May, Homestake was named "Business of the Century" by the Industry and Commerce Association of South Dakota. Homestake, formed in 1876 and employing nearly 1,300 South Dakotans, received the award for impacting the State's economy more than any other century-old business.

Wharf Resources increased gold production by 29%, to a record 77,000 ounces (2,395 kg) in 1989 compared with 1988 production.¹⁴ Production increased as a result of completing construction of a new \$4 million crushing and treating plant in late 1988. Wharf operated its open pit and cyanide heap-leach project all year and employed 147 people. The operation was north of Terry Peak in the Bald Mountain Mining District of Lawrence County, about 5 miles west of Lead. On-load and offload heap-leach methods extract precious metals from ore by spraying a

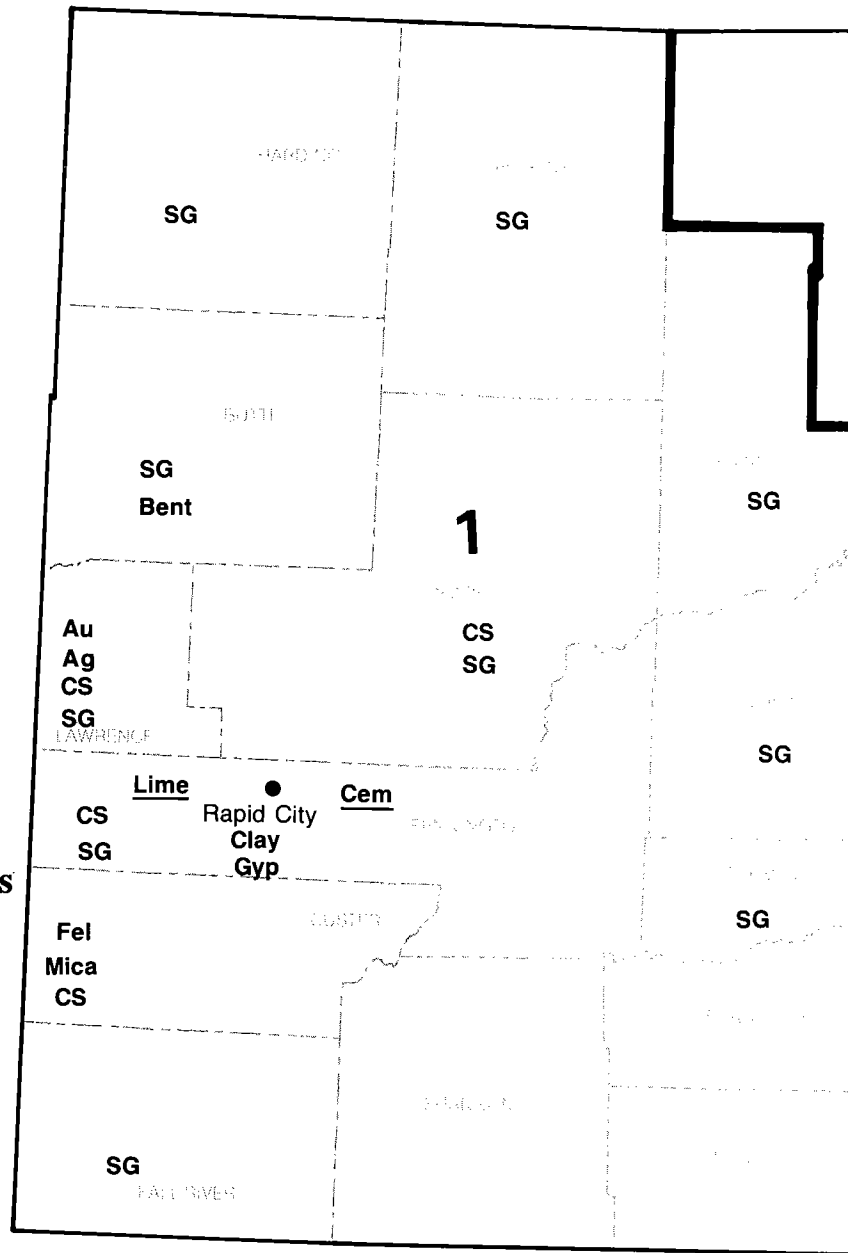
LEGEND

- State boundary
- - - County boundary
- ⊕ Capital
- City
- Crushed stone/sand & gravel districts

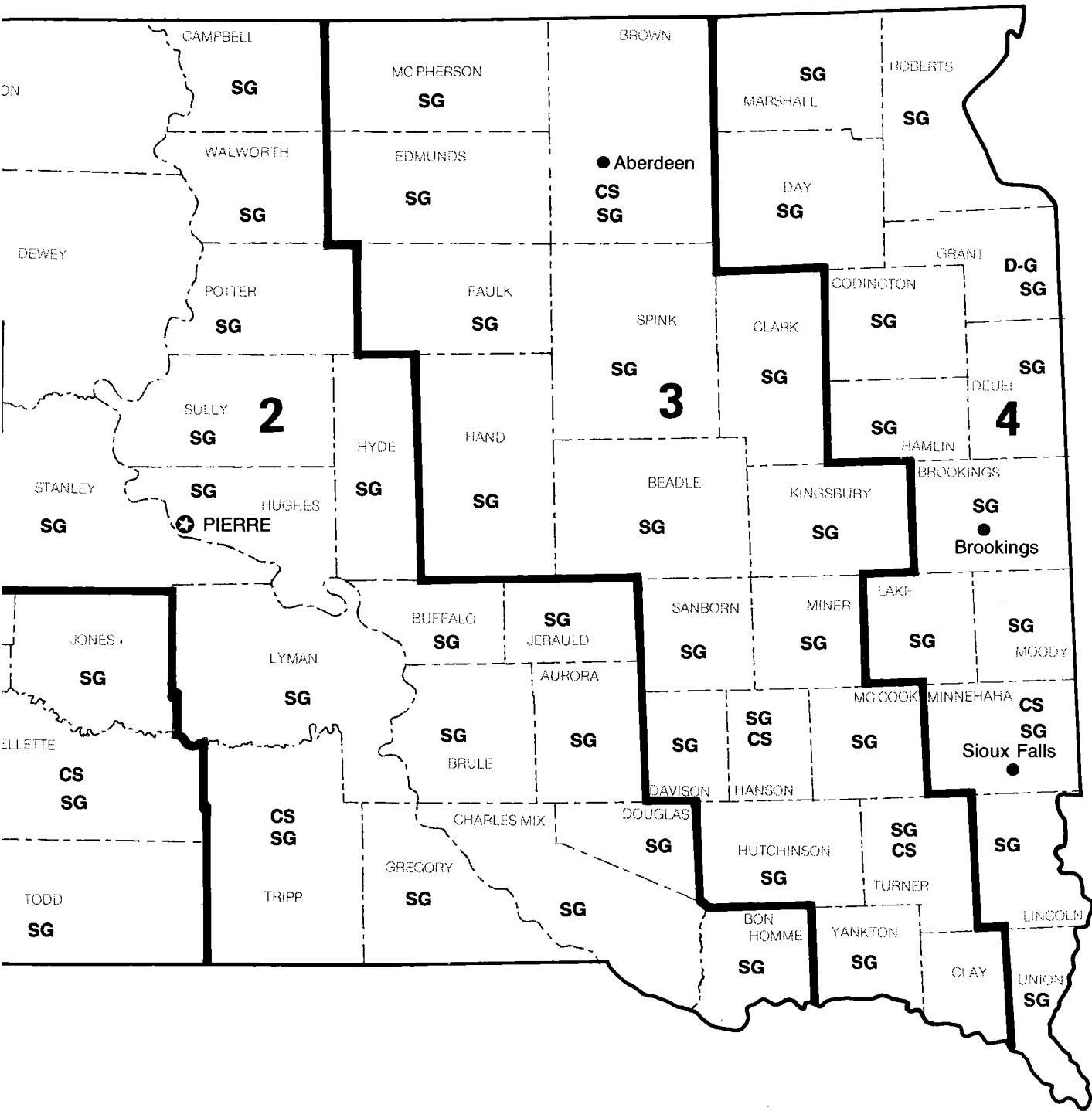
MINERAL SYMBOLS

- Ag** Silver
- Au** Gold
- Bent** Bentonite
- Cem** Cement plant
- Clay** Clay
- CS** Crushed Stone
- D-G** Dimension Granite
- Fel** Feldspar
- Gyp** Gypsum
- Lime** Lime plant
- Mica** Mica
- SG** Sand and Gravel

Principal Mineral-Producing Localities



AKOTA



diluted solution of sodium cyanide over crushed ore heaped on an impervious pad; the metals dissolved by the solution are then recovered. Operating capacity was 2.3 million short tons of ore per year, but this was expected to be gradually increased by 1991 to 3.1 million short tons. Total ore mined in 1989 was about 2.2 million short tons, at a grade of 0.043 ounce of gold per short ton (1.47 grams per mt). The average direct production cost of sales per ounce of gold in 1989 was \$180, down slightly from 1988.¹⁵ Proven and probable ore reserves increased to 26.9 million short tons, at a minable grade of 0.035 ounce of gold per short ton (1.19 grams per mt) for about 936,000 ounces (29,110 kg) of gold.¹⁶ The reserve was based on a 1.42:1 waste-to-ore ratio at \$400 per ounce of gold and a cutoff grade of 0.0155 ounce of gold per ton.¹⁷ Wharf was a runner-up in the open pit category for the prestigious Sentinels of Safety Award competition cosponsored by the Mine Safety and Health Administration and the American Mining Congress. Eligibility for the award required at least 30,000 injury-free work hours. Wharf received a certificate of award from the South Dakota Water and Wastewater Association and the DWR for its management of a public water system.

Brohm Mining Corp., a wholly owned subsidiary of MinVen Gold Corp. produced gold from its Gilt Edge open pit mine and sodium cyanide heap-leach operation at lower than expected levels for much of 1989, its first full year of production. The low production rate was due to an ongoing repair of cell liners on the heap-leach pads. Repair work was hampered by adverse winter weather. In late October 1988, the company determined that the rate of seepage of processing solution through the upper layer of the leach pad into the leak detection system exceeded the amount allowed under the mine's various operating permits, although no leakage occurred into the surrounding environment. Repairs and testing carried over into 1989.

In March, Brohm submitted a plan to the U.S. Forest Service that, if approved, could quadruple the size of its Gilt Edge operation. The proposed \$100 million expansion would allow the company to mine sulfide gold deposits adjacent to, and deeper than, the oxide gold ore

bodies presently being mined. Announcement of the proposal encountered immediate negative responses from mining opponents because part of the expansion would, for the first time in the Black Hills, involve public lands. Also at issue was the mine operation's need for water resources made scarce in recent years because of drought, and general public concerns about land reclamation and potential damage to recreation areas and wildlife habitat. The company proposed to convert its sodium cyanide heap-leach gold recovery system to a vat-leach system and to construct a 22,000-square-foot milling facility. Employment would triple to 300 jobs. Brohm envisioned having the operation on-line by late 1991.

Production at the Gilt Edge in 1989 totaled 17,161 ounces (534 kg) of gold and 11,862 ounces (369 kg) of silver.¹⁸ MinVen reported that 701,364 short tons of ore were processed, with an average grade of 0.036 ounce of gold per short ton (1.23 grams per mt). Movable proven and probable ore reserves at an average grade of 0.041 ounce of gold per short ton (1.40 grams per mt) were reported by MinVen to be nearly 53.5 million short tons containing almost 2.2 million ounces (68,430 kg) of gold.¹⁹ The on-load and offload sodium cyanide heap-leach operation averaged a 98-day cycle time from pad loading to unloading, with an approximate 67% rate of gold recovery. Cash cost per ounce of gold produced was \$407.

Bond Gold-Richmond Hill Inc. (BIG) began mine production at its Richmond Hill project in December 1988. The open pit mine and sodium cyanide heap-leach operation produced 44,603 troy ounces (1,387 kg) of gold in 1989²⁰ from 1.1 million short tons of ore, with an average grade of 0.040 ounce of gold per short ton (1.36 grams per mt). The company reported proven and probable ore reserves at a cutoff grade of 0.015 ounce per short ton (0.51 grams per mt) of gold of about 2.8 million short tons, at an average grade of 0.050 ounce of gold per short ton (1.71 grams per mt), for a total of 136,000 ounces (4,230 kg) of gold.²¹

In May, BIG battled a weather-related water runoff problem that caused red oxidized fine sediments from the mine site and vicinity to discolor waters feeding into scenic Spearfish Canyon and Bridal Veil Falls. The

problem was quickly and voluntarily remedied by the company. In September, LAC Minerals Ltd., of Toronto, Ontario, Canada, acquired a 65% interest in BIG for \$373.8 million.

Golden Reward Mining Co. began production at its surface Golden Reward Mine and on-load and offload sodium cyanide heap-leach, Merrill-Crowe zinc precipitation operation in October. The company poured its first doré bar on December 14, 1989. The operation is 3 miles southwest of Lead. Production for 1989 totaled 129 ounces (4.0 kg) of gold and 412 ounces (12.8 kg) of silver. Estimated operating costs for mining and processing, exclusive of royalties and severance taxes, were \$178 per ounce of gold.²² The company reported minable ore reserves of about 13.1 million short tons grading 0.042 ounce of gold per short ton (1.44 grams per mt), at a cutoff grade of 0.015 ounces (0.51 grams). A more detailed description of the operation was provided in the 1988 South Dakota Minerals Yearbook chapter.²³

The Whitewood Creek joint venture involving Whitewood Creek Development Corp., a subsidiary of Homestake, and Goldstake Explorations (SD) Inc. continued its wait at yearend for a U.S. Environmental Protection Agency (EPA) decision on proposed optional remedies for cleanup of Whitewood Creek. Under guidelines of the Comprehensive Environmental Response, Compensation, and Liability Act, the EPA could allow the joint venture to recover gold from relict mine tailings along an 18-mile stretch of Whitewood Creek. The tailings occur in Butte, Meade, and Lawrence Counties along the Whitewood Creek from just north of the town of Whitewood northward to the confluence of the creek and the Belle Fourche River.

Minerva Exploration Inc., a subsidiary of Naneco Resources Ltd. of Calgary, Alberta, Canada, continued its efforts to secure State approval to begin surface mining operations at its Johnson Gulch project west of Lead. In July, the SBME decided it would not grant transfer of a mining permit to Minerva for the property previously held by Homestake. Minerva acquired the property from Homestake in 1986 with the understanding from the DWR that the permit would also be transferred. Homestake acquired the permit in 1984 and posted a \$661,800

reclamation bond but never mined the property. In April, Homestake was granted return of the bond by the SBME, as no land had been disturbed, with the understanding that the permit would remain active. When Minerva sought a permit transfer in July, SBME members voted that, because mining previously had not occurred and the bond was returned, there was no permit to transfer. At yearend, the issue was under court litigation.

Iron Ore.—Pete Lien & Sons Inc. intermittently produced iron ore from its mining property near Nemo. The material was sold for use in cement production at the South Dakota Cement Plant in Rapid City.

Industrial Minerals

Cement.—The South Dakota cement plant set a sales record in 1989, reversing a 3-year decline. Total sales for the year were reported by the company to have been about 677,000 short tons.²⁴ The sales increase resulted from taking advantage of spot shortages in some West Coast markets and increased road construction activity in Minnesota and North Dakota. The plant was the State's only cement operation and was owned by the State of South Dakota and governed by a seven-person commission appointed by the Governor. A large percentage of the plant's earnings have been remitted to the State's general fund each year.

Feldspar and Mica.—Contract miners for Pacer Corp. continued to produce feldspar and mica from small pegmatite deposits, mostly near Custer in the southern Black Hills. Producers included Good Faith Mining Co., Pacer Corp., and Rose Quartz Enterprises, all of Custer, and Dakota Gold & Quartz Co. of Rapid City. In 1989, feldspar production and value decreased about 13% and 31%, respectively, compared with 1988 figures. During the same period, scrap mica decreased about 14% in quantity and value. South Dakota ranked second of seven producing States.

Sand and Gravel.—Construction sand and gravel production is surveyed by the

Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988. Construction sand and gravel production was estimated to have decreased 19%; however, value was estimated to have increased 11%.

Stone.—Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

Crushed.—Crushed stone was produced from 13 quarries in 7 counties by 13 operators. Production and value in 1989 decreased about 30% and 31%, respectively, compared with estimates for 1988. Counties leading in production were Minnehaha, Pennington, and Hanson. Leading uses for crushed stone were in concrete aggregate, cement manufacturing, railroad ballast, and lime manufacturing. Unit values for all crushed stone ranged from \$6.50 per short ton for terrazzo and exposed aggregate to \$1.38

per ton for cement manufacturing. Average unit value was \$3.73. The leading uses for crushed limestone and dolomite were in cement manufacturing, concrete aggregate, and lime manufacturing. Unit values for limestone and dolomite averaged \$2.87, but ranged from \$4.78 per ton for riprap and jetty stone to \$1.38 for cement manufacturing.

Dimension.—South Dakota ranked ninth of 34 States in dimension stone production. Grant County hosted five granite dimension stone operations, all near Milbank. Production and value of dimension stone increased 26% and 8%, respectively, in 1989. In May, Dakota Granite Co. commissioned its new 14-foot-diameter slab-cutting saw, believed to be the world's largest.

Other Industrial Minerals.—Common clay and shale increased in production and value about 29% and 22%, respectively, during 1989. Crude gypsum decreased about 9%, and value decreased about 10%. All of the gypsum was used in cement manufacturing by the State's plant at Rapid City. Hydrated lime and quicklime production and value decreased 8% and 7%, respectively.

TABLE 2
SOUTH DAKOTA: CRUSHED STONE¹ SOLD OR USED BY PRODUCERS
IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch): Riprap and jetty stone	75	336
Coarse aggregate, graded:		
Concrete and bituminous aggregate (coarse)	598	2,864
Bituminous surface-treatment aggregate	99	506
Fine aggregate (- 3/8 inch): Stone sand, concrete and bituminous mix or seal	166	515
Coarse and fine aggregate:		
Graded road base or subbase	186	701
Crusher run or fill or waste	13	39
Other construction materials ²	307	1,278
Other miscellaneous uses ³	1,064	2,023
Unspecified: ⁴		
Actual	773	4,258
Estimated	552	1,783
Total	3,833	14,303

¹Includes limestone, quartzite, sandstone, and miscellaneous stone.

²Includes stone used in railroad ballast, screenings (fine), unpaved road surfacing, and terrazzo and exposed aggregate.

³Includes stone used in cement manufacture, lime manufacture, and abrasives.

⁴Includes production reported without a breakdown by end use and estimates for nonrespondents.

¹ State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

² U.S. Department of Commerce written communication.

³ Highway and Heavy Construction. Market Update: Battle Lines Form Over Gridlock, Gas Tax. V. 132, No. 3, Mar. 1989, p. 34.

⁴ Esparza, L. E. South Dakota. Ch. in BuMines Minerals Yearbook 1988, v. II, p. 448.

⁵ The Northern Miner. Crown Butte Options Noranda Properties. V. 75, No. 16, June 26, 1989, p. 13.

⁶ South Dakota Mining and Mineral Resources Research Institute. Annual Status and Final Report 1989. South Dakota School of Mines and Technology, Rapid City, SD. 81 pp.

⁷ Internationally, gold price quotes use ounces and dollars as units of measure.

⁸ South Dakota Mining Association (Sioux Falls, SD), 1990 Industry Status Report. 5 pp.

⁹ Work cited in footnote 8.

¹⁰ Homestake Mining Co. (San Francisco, CA). 1989 Annual Report to Stockholders. 40 pp.

¹¹ Homestake Gold Mine Employee Newsletter. V. 9, No. 1, Feb. 1990, p. 1.

¹² Homestake Mining Co. (San Francisco, CA). 1989 Form 10-K Report. 38 pp.

¹³ Work cited in footnote 12.

¹⁴ Wharf Resources Ltd. (Toronto, Ontario, Canada). 1989 Annual Report to Stockholders. 24 pp.

¹⁵ Work cited in footnote 14.

¹⁶ Dickenson Mines Ltd. (Toronto, Ontario, Canada).

Annual Report to Stockholders, p. 11.

¹⁷ Dickenson Mines Ltd. (Toronto, Ontario, Canada). 1989 Form 10-K Report, p. 11.

¹⁸ MinVen Gold Corp. (Lakewood, CO). 1989 Annual Report to Stockholders, pp. 4-5.

¹⁹ Work cited in footnote 18.

²⁰ LAC Minerals Ltd. (Toronto, Ontario, Canada). 1989 Annual Report to Stockholders, p. 27.

²¹ Bond International Gold Inc. (Denver, CO). Financial Report, July 1-Dec. 31, 1989, pp. 6-7.

²² MinVen Gold Corp. (Lakewood, CO). 1989 Form 10-K Report, 120 pp.

²³ Esparza, L. E. South Dakota. Ch. in BuMines Minerals Yearbook 1988, v. II, pp. 450-451.

²⁴ The Rapid City Journal. Cement Plant Sets Record. Jan. 19, 1990, p. A6.

TABLE 3

SOUTH DAKOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989, BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:								
Coarse aggregate (+ 1 1/2 inch) ¹	(²)	(²)	—	—	W	W	W	W
Coarse aggregate, graded ³	(²)	(²)	—	—	W	W	W	W
Fine aggregate (- 3/8 inch) ⁴	(²)	(²)	—	—	W	W	W	W
Coarse and fine aggregates ⁵	(²)	(²)	—	—	W	W	W	W
Other construction aggregates	676	2,776	—	—	—	—	—	—
Chemical and metallurgical ⁶	(⁷)	(⁷)	—	—	—	—	—	—
Special ⁸	—	—	—	—	—	—	W	W
Other miscellaneous	1,049	1,985	—	—	—	—	—	—
Unspecified:								
Actual ⁹	—	—	—	—	—	—	W	W
Estimated ¹⁰	552	1,783	—	—	—	—	—	—
Total	¹¹ 2,276	6,544	—	—	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

¹ Includes riprap and jetty stone and filter stone.

² Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

³ Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface treatment aggregate, and railroad ballast.

⁴ Includes stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate (screening-undesigned).

⁵ Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

⁶ Includes crushed stone for cement manufacture and lime manufacture.

⁷ Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

⁸ Includes crushed stone for abrasives.

⁹ Includes production reported without a breakdown by end use.

¹⁰ Includes estimates for nonrespondents.

¹¹ Data do not add to total shown because of independent rounding.

TABLE 4
PRINCIPAL PRODUCERS

Commodity and company	Address	Type of activity	County
Cement:			
South Dakota Cement Commission	Box 360 Rapid City, SD 57709	Plant	Pennington.
Clays:			
South Dakota Cement Commission	do.	Open pit mine	Do.
Feldspar:			
Pacer Corp.	Box 912 Custer, SD 57730	Open pit mines and dry-grinding plant	Custer.
Gold:			
Bond Gold-Richmond Hill Inc., a subsidiary of Bond International Gold Inc. ¹	601 West Main St. Lead, SD 57754	Open pit and leach pads	Lawrence.
Brohm Mining Corp., a division of MinVen Gold Corp. ¹	Box 485 Deadwood, SD 57732	do.	Do.
Golden Reward Mining Co. ¹	Box 888 Lead, SD 57754	do.	Do.
Homestake Mining Co. ^{1 2}	Box 875 Lead, SD 57754	Underground mine and open pit, cyanidation mill, gravity separation, refinery	Do.
Wharf Resources (U.S.A.) Inc.	Box 897 Lead, SD 57754	Open pit and leach pads	Do.
Gypsum:			
South Dakota Cement Commission	Box 360 Rapid City, SD 57709	Open pit mine	Pennington.
Iron ore:			
Pete Lien & Sons Inc.	Box 440 Rapid City, SD 57709	do.	Lawrence.
Lime:			
Pete Lien & Sons Inc.	do.	Plant	Pennington.
Mica:			
Pacer Corp.	Box 912 Custer, SD 57730	Mine and dry-grinding plant	Custer.
Sand and gravel (construction, 1988):			
Bob Bak Construction Co.	Box 256 White River, SD 57579	Pits and plant	Corson.
Birdsall Sand & Gravel Co.	Box 767 Rapid City, SD 57709	Pits and plants	Fall River, Pennington, Sully.
Brownlee Construction Co.	Route 3 Watertown, SD 57201	do.	Codington.
Tom Luke Construction Co.	Box 169 Kimball, SD 57355	do.	Brule and Sanborn.
Bernard Mahrer Construction Inc.	Main St. Rutland, ND 58067	do.	Marshall.

See footnotes at end of table.

TABLE 4—Continued
PRINCIPAL PRODUCERS

Commodity and company	Address	Type of activity	County
Stone:			
Crushed:			
Limestone:			
Pete Lien & Sons Inc.	Box 440 Rapid City, SD 57709	Quarry and plant	Pennington.
Northwestern Engineering Co. (Hills Materials Co.)	Box 2320 Rapid City, SD 57709	Quarries and plants	Do.
South Dakota Cement Commission	Box 360 Rapid City, SD 57709	Quarry and plant	Do.
Sandstone-quartzite:			
L. G. Everist Inc.	Box 829 Sioux Falls, SD 57101	do.	Minnehaha.
Spencer Quarries Inc.	Box 25 Spencer, SD 57374	do.	Hanson.
Sweetman Construction Co.	Box 809 Sioux Falls, SD 57101	do.	Minnehaha.
Dimension, granite:			
Cold Spring Granite Co.	202 South 3d Ave. Cold Spring, MN 56320	Quarries and plant	Grant.
Dakota Granite Co.	Box 1351 Milbank, SD 57252	do.	Do.

¹ Also silver.

² Also lead.

MINERAL-RELATED GOVERNMENT AGENCIES

FEDERAL

U.S. Department of the Interior
Bureau of Mines
Leon E. Esparza, State Mineral Officer
Twin Cities Regional Office of State
Activities
5629 Minnehaha Ave.
Minneapolis, MN 55417-3099
Telephone: (612) 725-4536

U.S. Department of the Interior
Bureau of Land Management
Thomas Lonnie, Deputy State Director
for Mineral Resources
Box 36800
Billings, MT 59107
Telephone: (406) 255-2805

U.S. Department of Labor
Mine Safety and Health Administration
Vernon R. Gomez, District Manager
Rocky Mountain District Office
Metal and Nonmetal Mine Safety and
Health
Box 25367, Denver Federal Center
Denver, CO 80225-0367
Telephone: (303) 236-2794

U.S. Forest Service
Region I (Custer National Forest)
Minerals and Geology
Charles E. Wassinger, Director
Box 7669
Missoula, MT 59807
Telephone: (406) 329-3595

U.S. Forest Service
Region II (Black Hills National Forest)
Minerals and Geology
Charles Hendricks, Director
Box 25127
Lakewood, CO 80225
Telephone: (303) 236-9467

STATE

South Dakota Cement Commission
Gary Pechota, President
Box 360
Rapid City, SD 57701
Telephone: (605) 342-4252

South Dakota Department of Water
and Natural Resources
Robert Roberts, Secretary
523 East Capitol
Joe Foss Bldg.
Pierre, SD 57501
Telephone: (605) 773-3151

South Dakota Geological Survey
Merlin J. Tipton, State Geologist
Science Center
University of South Dakota
Vermillion, SD 57069
Telephone: (605) 677-5227

South Dakota School of Mines and
Technology
William Hughes, Vice President
501 East St. Joseph St.
Rapid City, SD 57701-3995
Telephone: (605) 394-2256

South Dakota School of Mines and
Technology
Zbigniew Hladysz, Director
Mining and Mineral Resources
Research Institute
501 East St. Joseph St.
Rapid City, SD 57701-3995
Telephone: (605) 394-1971