#34

SOUTH DAKOTA

By Leon E. Esparza

1988

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

SOUTH DAKOTA

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OF THE
INTERIOR

Manuel Lujan, Jr.
Secretary

BUREAU OF
MINES

T S Ary
Director

1988

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COVER PHOTO:
The South Dakota Capitol Building in Pierre symbolizes the cooperative working relationship between the U.S. Bureau of Mines and the Mineral agencies of the State. (Photo is courtesy of the South Dakota Department of Tourism.)

Tables

Centerfold Map

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. Esparza[1]

In 1988, the value of South Dakota's nonfuel mineral production was about $285.7 million, an increase of 9% compared with the 1987 value. South Dakota ranked 33d nationally in the value of nonfuel mineral production, accounting for about 1% of the U.S. total. This marked the third consecutive year of significant increases in value. The growth, as in recent years, was attributed to increased production and attendant value of gold mined in Lawrence County. Gold, the State's leading commodity, accounted for 69% of the total value of nonfuel minerals produced in the State in 1988, followed by portland cement and crushed stone.

Precious metals exploration activity mirrored the growth in production. Twenty-three permits were issued to 14 companies for nonfuel minerals exploration in Butte, Custer, Lawrence, Meade, and Pennington Counties. All but one of these permits specified gold and silver as the target commodities. Six new life-of-mine permits were issued by the State, three of which were for pegmatite minerals and three for precious metals.

Minerals used in construction accounted for about 30% of the nonfuel mineral production value. In 1988, the value of nonresidential construction permits increased by more than 20% when compared with the 1987 value; the number of private and public residential units authorized increased by about 2.5%.[2] The value of State road contract awards dropped by nearly 3%, to $116 million.[3] According to the South Dakota Department of Labor, mining employment totaled about 2,760 jobs in 1988, a slight increase over 1987.

Mineral taxes in South Dakota are levied only on gold and silver production. Collections for the fiscal year ending June 30, 1988, totaled slightly more than $7.1 million, up about 58% from the previous fiscal year, according to the South Dakota Department of Revenue.

TRENDS AND DEVELOPMENTS

South Dakota voters rejected two antimining initiatives on November 8. The initiatives originally had been proposed by various local environmental groups; funding and support from local and national environmental groups spurred the drive. The first initiative called for large-scale open pit metal mines to be reclaimed to approximately their original contours upon completion of mining. The second initiative would have increased State severance taxes on sales of gold produced by open pit methods. Tax revenues were to be earmarked for a minesite cleanup fund, an unreclaimed lands fund, and regulation of the industry. There was industry-wide concern that if the South Dakota initiatives had passed, open pit sodium cyanide heap-leach operations in other States would become targets for similar actions.

TABLE 1

NONFUEL MINERAL PRODUCTION IN SOUTH DAKOTA[1]

Mineral		1986		1987		1988	
		Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:							
Masonry	thousand short tons	4	W	4	W	4	W
Portland	do.	635	W	519	W	490	W
Clays[2]	short tons	118,718	$375	W	W	W	W
Gem stones		NA	100	NA	$100	NA	$100
Gold (recoverable content of ores, etc.)	troy ounces	W	W	W	W	449,514	197,026
Gypsum	thousand short tons	31	268	W	W	W	W
Sand and gravel (construction)	do.	9,713	19,853	e9,600	e19,100	7,929	18,681
Silver (recoverable content of ores, etc.)	troy ounces	W	W	W	W	84,398	552
Stone:							
Crushed	thousand short tons	e3,600	e12,600	5,070	18,515	e5,500	e20,600
Dimension	short tons	e54,934	e18,399	50,718	18,209	e43,297	e16,472
Combined value of beryllium concentrates (1986–87), clays (bentonite 1986, common 1987–88), iron ore (1988), lime, mica (scrap), and values indicated by symbol W		XX	181,291	XX	206,968	XX	32,288
Total		**XX**	**232,886**	**XX**	**262,892**	**XX**	**285,719**

e 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] Excludes certain clays; kinds and values included with "Combined value" data.

REGULATORY ISSUES

The State Board of Minerals and Environment issued six life-of-mine permits in 1988. Two of these were issued to Bond Gold-Richmond Hill Inc. (formerly known as St. Joe Gold Corp.) and to The Golden Reward Mining Co. for new gold mining operations in Lawrence County. The other four permits went to operations in Custer County. These included one small, underground gold mine west of Custer held by Rhyolite Inc. of Gillette, WY, and three pegmatite minerals mining projects operated by two Custer-based companies. Mining Claims Management Co. operated one of these projects and North American Accounts Inc. operated the other two.

In November, a circuit court judge ruled that Consolidated Management Corp. (CMC) was illegally storing 285,000 short tons of incinerated sewage ash and that steps must taken to dispose of the ash. CMC had planned to construct a processing plant using "proprietary reactor technology" to extract gold and other products from the ash. The Metropolitan Waste Control Commission of St. Paul, MN, had paid CMC $9 million to haul the ash to a site near Edgemont, SD, beginning in 1986. CMC had claimed that the ash would be processed into fertilizer, paving materials, and $60 million worth of gold, and that the operation would create 300 new jobs. At yearend, the South Dakota Department of Water and Natural Resources was considering plans to spend at least part of CMC's $1.25 million bond on burying the ash.

EXPLORATION ACTIVITIES

Gold exploration in the Black Hills during 1988 escalated from the already feverish pace of the 2 previous years. Twenty-four exploration permits were issued to 13 companies. All but one of these permits were for gold; the other was for pegmatite minerals exploration by one company. Over the past 10 years, 145 State exploration permits identifying precious metals as a target have been held by 44 different companies. Most of this activity was in Lawrence County. In 1988, a total of 13,979 test holes was permitted for drilling.[4] Also permitted were 353 bulk sample pits, 3,800 small test pits, 21 trenches, and 69 miles of access roads. Sample targets included Precambrian iron formations, Cambrian Deadwood Formation, Mississippian Pahasapa (Madison) Limestone, Tertiary igneous intrusives, Quaternary alluvial placer deposits, and mine tailings.

Companies conducting minerals exploration included Beau Val Nevada Inc., Bond Gold-Richmond Hill Inc., Brohm Mining Corp., Compass Resources Ltd. (d.b.a. Oakmont Resources Inc.), Goldstake Explorations (SD) Inc., Homestake Mining Co., Minerva Exploration Inc., St. Joe Richmond Hill Inc., Mining Claims Management Co., Noranda Exploration Inc., Tera Mining Co., The Golden Reward Mining Co., and Wharf Resources (U.S.A.) Inc.

In addition to gold exploration near or adjacent to active or proposed mines, several old mining districts were explored. Beau Val drilled claims in the Keystone Mining District near Keystone, in the shadow of Mt. Rushmore. Exploration activity increased in the area around Rochford, about 15 miles south of Lead. Noranda received exploration permits for an area near Castle Peak, and Compass acquired permits for an area around Irish Gulch. Mining Claims Management Co. received permits to explore for pegmatite minerals east of Custer.

LEGISLATION AND GOVERNMENT PROGRAMS

Public debate continued on the Sioux Nation Black Hills Act, U.S. Senate bill 705 and House bill 1506, also known as the Bradley Bill. The bill's intent was to return 1.3 million acres, including almost all Federal land in western South Dakota, to the Sioux Indian Nation. At yearend, the bill was held in committee.

A new State law was implemented that gave counties with severed precious metals part of the minerals severance tax paid to the State. The law provided an allocation of 20% of the minerals severance tax paid by mining companies that began operations after January 1, 1981. Revenues would be used to fund road and school projects and other needs created by mining activities. A new law empowered the State Board of Minerals and Environment to amend fees, transfer mining permits, and amend the timetable for public hearings on mining applications. Also enacted was a State law exempting collection of State retail sales tax on sales of South Dakota-minted bullion pieces.

An allotment grant of $138,000 from the U.S. 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 Law 98-409. The purpose of the institute is to coordinate and administer training and research in mining, mineral resources, minerals development, and mineral processing. Ten graduate fellowships were supported by the allotment grant. Projects undertaken included one on the origin of Tertiary age ore-forming fluids in the northern Black Hills. This study determined that an important factor in exploration for epithermal gold deposits similar to those in the Northern Black Hills is the recognition and characterization of intrusive rocks as sources of the fluids and gold.

Another study addressed the physical and economic feasibility of highwall reduction of surface mines in the Black Hills. Various pit slope angles ranging from 35° to 70° were used to evaluate three pit plans. Another study sought to develop a ground water flow model for the Pahasapa aquifer near Terry Peak in

the northern Black Hills. A study was begun to characterize rocks of the Cambrian Deadwood Formation by shear strength and surface roughness of rock joints using fractal geometry.

The Mining and Mineral Resources Research Institute also provided technical assistance to the South Dakota Department of Water and Natural Resources in reviewing gold mine permit applications and other technical issues related to mining in South Dakota. For example, the technical content of The Golden Reward Mining Co. permit application was reviewed; the review included an on-site inspection of planned mine areas and submission of written comments. An on-site inspection of construction progress was made of the Brohm Mining Corp. Gilt Edge Mine. Associates of the institute also conducted a stability assessment of an area proposed by Homestake Mining Co. for a waste dump near the Homestake Mine.

In 1988, the Employer's Investment in South Dakota's Future, an investment fund created by the State legislature, provided $71,800 to research a high-temperature chlorination process to recover gold from scrap. Matching funds of $8,400 were provided by the Chlor-Pure Corp. of Rapid City. The study was done by the Center for Innovation, Technology, and Enterprise at the South Dakota School of Mines and Technology. The research indicated that gold scrap from Black Hills jewelry manufacturing can be easily refined using chlorine gas, and that gold, arsenic, and mercury can be removed from Whitewood Creek mine tailings by the same method.

REVIEW BY NONFUEL MINERAL COMMODITIES

Metals

Beryllium.—Pacer Corp. has historically reported production of beryllium as a coproduct of feldspar mining by its contract miners. Beryllium, feldspar, and mica occur in pegmatite deposits in the vicinity of Custer. In 1988, no beryllium production was reported because of a dearth of beryl associated with pegmatites mined during the year. This development, however, is not expected to be trend setting.

Gold and Silver.—The State ranked third of 14 States in gold production and hosted the second largest gold mine in the United States. Gold production in 1988 totaled almost 450,000 troy ounces valued at nearly $200 million, up significantly from 1987 production. Gold accounted for about 69% of the State's total nonfuel mineral production value. Silver, produced as a coproduct of gold mining, also posted production and value increases. Precious metals production increased because of increased efficiency, new heap-leach pads coming on-line, and one new mine beginning production. All of the active, major gold operations were located in the northern Black Hills of Lawrence County.

Homestake Mining Co. was the State's largest gold producer. According to the Homestake 1988 annual report, gold production from the Homestake and Open Cut Mines at Lead totaled nearly 390,200 ounces, a 20% increase over 1987 output. Gold metal yields from the Homestake and the Open Cut were 343,987 and 46,175 ounces, respectively. Production was at its highest level since 1972. Improved mine scheduling, higher grade ore blocks, and strict grade control led to a 17% increase in the grade of underground ore to 0.187 ounce of gold per ton. Overall grade of ore milled increased 15% to 0.168 ounce per ton. Unit costs at the Open Cut were decreased through higher ore production and slightly reduced waste stripping. Total tons of milled ore increased 5% owing to a new gravity separation circuit that was installed in 1987. Its first full year of operation was completed in 1988.

Ore reserves at the Homestake Mine were nearly 18.6 million short tons at 0.218 ounce of gold per ton. Ore reserves at the Open Cut totaled about 6.6 million tons at 0.120 ounce per ton. Total gold reserves were about 4.8 million troy ounces. Exploration for new reserves at the Open Cut and in deep levels of the Homestake essentially replaced gold produced in 1988. Average full production costs declined to $314 per ounce of gold in 1988, a decrease of $33 per ounce from costs reported in 1987. Homestake also produced silver as a coproduct of gold mining.

Construction of a $6 million ventilation cooling system on the 6,950-foot level of the underground mine was completed and commissioned. This project was expected to reduce ambient temperatures in the lower portions of the mine and thus increase productivity.

Construction of a 50-foot lift on the Grizzly Gulch tailings dam was begun, with an expected cost of about $17 million. Completion of the 350-foot-high dam in 1989 was expected to add 11 years of storage capacity. The addition will raise the dam's total capacity by 9,300 acre feet, to a total of about 21,000 acre feet. This was the second of three planned lift expansions. The original 250-foot-high zoned earth- and rock-filled dam, completed in 1977, was designed to accommodate three additional raises. The first raise was completed in 1982.

Wharf Resources (U.S.A.) Inc.'s operations at its Foley Ridge project were expanded in 1988. The open pit and sodium cyanide heap-leach operation is located north of Terry Peak in Lawrence County. Heap leach methods extract precious metals from ore by spraying a diluted solution of sodium cyanide over crushed rock heaped on an impervious pad; the metal dissolved by the solution is then recovered. At midyear, construction on a major expansion to increase ore treatment capacity from 1.3 million tons to 2.3 million tons per year was begun. Wharf estimated that $7.2 million would be

spent for a new crushing circuit and an addition to the gold treatment plant. At yearend, the gold plant expansion was essentially complete and construction completion on the crushing plant was expected in early 1989. In late summer, construction on a fourth heap-leach pad was completed. Gold production for the year was 59,500 ounces, an increase of 29% over that of 1987.[5] Total ore production was about 1.5 million tons at an average grade of 0.046 ounce of gold per ton. The increase was attributed to mild winter weather, enhanced performance of the winter heap-leach system, more efficient leach pad spraying methods, and improved gold recovery from the more finely crushed ore placed on the pads in 1987, which resulted in faster leach rates. Cash operating costs in 1988 were $178 per ounce of gold, a decrease of 6% from 1987 costs. Gold reserves totaled about 904,000 ounces, down almost 7% from those reported in 1987. Average cash cost of sales per ounce of gold was $183, down about 3% from that reported in 1987. Wharf also recovered silver as a coproduct. In early November, the boards of directors for Dickenson Mines Ltd. and Wharf Resources Ltd. decided, due to market conditions, to postpone indefinitely the proposed arrangement announced in late July, under which shares of Dickenson and the common shares of Wharf were to be exchanged for shares of a new company, Dickenson Mines, Inc.

Brohm Mining Corp., a wholly owned subsidiary of MinVen Gold Corp., poured the first doré button on October 6 from its Gilt Edge operation, 5 miles southeast of Lead. MinVen was formed in early August by the amalgamation of Brohm Resources Inc. and MFC Mining Finance Corp. Construction on the $17.5 million open pit mine, sodium cyanide heap-leach pads, and Merrill-Crowe recovery plant began in late March. Annual gold production was expected to be 45,000 ounces of gold. In 1988, ore production totaled about 548,000 tons, grading 0.035 ounce of gold per ton and yielding 6,666 ounces of gold and 8,072 ounces of silver.[6] Cash operating costs were estimated to be $240 per ounce of gold.[7] Brohm began a 2-year, $11.8 million development program to increase ore reserves at the Gilt Edge and to evaluate the feasibility of a major project expansion. In 1988, $3.6 million was spent on 160,000 feet of development drilling. Drilling results brought total proven and probable ore reserves to about 54 million tons, grading 0.041 ounce of gold per ton and containing about 2.2 million ounces of gold.[8] Based on these results and metallurgical tests, MinVen commissioned Bechtel Engineering Inc. of San Francisco to conduct an engineering study for a 6.0-million-ton-per-year mining and milling facility at Gilt Edge. A preliminary estimate of the capital cost for the expansion was $100 million. This estimate included $18 million for mining equipment, $62 million for a gravity separation and cyanide leaching mill, and $20 million for a tailings dam. The expanded project would produce about 200,000 ounces of gold per year beginning in mid-1992.[9]

At yearend, Brohm awaited approval from the South Dakota Department of Water and Natural Resources to resume production following repair of a leak in a cell in the heap-leach pad's primary liner. Brohm uses an on-off load, heap-leach system. The system was shut down in late October when a leak occurred along cold seams where the liner changed from asphalt to high-density polyethylene. Solutions did not escape the secondary liner; they were pumped to storage ponds that are part of a state-of-the-art leak collection recovery system. Total cost of the repairs was estimated to be about $120,000.[10] In March, the State Board of Minerals and Environment granted Brohm an amendment to its mining permit. The amendment allowed Brohm 65 additional acres for a heap-leach pad site and an enlargement of proposed open pits at the current operation.

Bond Gold-Richmond Hill Inc., a wholly owned subsidiary of Bond International Gold Inc. and formerly known as St. Joe Gold Corp., began mine and plant construction on its Richmond Hill project in early spring. The $11 million open pit mine and sodium cyanide heap-leach operation received its mining permit in late January from the State Board of Minerals and Environment. The mining permit is for the Richmond Hill area about 5 miles northwest of Lead and includes the Richmond Hill and Turnaround deposits. The project was expected to have a mine life of about 10 years. Ore reserves were reported to be 3.9 million tons, grading 0.053 ounce of gold per ton. Gold metal reserves were stated to be 357,000 ounces.[11] Gold recovery was expected to be about 78% using carbon absorption. Annual production was expected to be 43,000 ounces, with operating costs at about $200 per ounce.[12] Gold production, which began in December, totaled about 1,000 ounces for 1988.[13]

Bond Gold's ore body is hosted within an elongated Tertiary breccia pipe and stockwork fractures emplaced in Precambrian metamorphic rocks. Part of the deposit is reportedly underlain by an as yet unevaluated auriferous sulfide zone.

The Golden Reward Mining Co. began operations at its Golden Reward Mine in July. The company is a joint venture with equal shares held by Coin Lake Gold Mines, Moruya Gold Mines of North America Inc., and MinVen Gold Corp., which acquired its interest in late December from the Denver-based Ventures Trident Limited Partnership. Construction began on the open pit mine, sodium cyanide heap-leach pads, and Merrill-Crowe recovery plant. Upon completion, total capital cost, excluding working capital, was anticipated to be $35.3 million.[14] Production was expected by the third quarter of 1989. The 772-acre project area had company-reported proven and

probable ore reserves of 18.8 million tons, containing 824,000 ounces of gold and about 3.77 million ounces of silver at a cutoff grade of 0.0175 ounce of gold per ton.[15] Annual ore production of 2.0 million tons, yielding 60,000 ounces of gold, was expected over a 6-year mine life. Gold recovery was expected to be 70%.

The Golden Reward Mine plan indicated reclamation concurrent with the mining of seven pits to be mined, in turn, to depths ranging from about 100 to 300 feet, and to be backfilled when feasible. Ore is to be crushed in a 10,000-ton-per-day mill, then loaded by conveyor and mobile stacker onto the leach pad. A mobile side bucket reclaimer and conveyor system will offload spent ore. The use of the conveyor and mobile stacker reclaimer system was to be a first for gold heap-leach operations. The intent was to keep heavy equipment off the heaps, which would protect the impermeable leach pad liners from punctures and subsequent leaking. Operating costs, including royalties and severance taxes, were expected to average $204 per ounce over the mine life.[16]

As an investment and goodwill gesture, the company bought $1.2 million worth of stock in the Black Hills Chairlift Co., which operates the Terry Peak ski facility, the largest in the central United States. The mine operation is adjacent to, and highly visible from, the ski facilities. Golden Reward previously bought land on part of the mountain, in part for the mine site and in part as an investment. Money from the stock purchase was used for a new lodge and snowmaking equipment.

The Whitewood Creek joint venture involving Whitewood Development Corp. and Goldstake Explorations (SD) Inc. was formed in October. The venture was to be managed by Whitewood Development Corp., a wholly owned subsidiary of Homestake Mining Co. Goldstake is a wholly owned subsidiary of Goldstake Explorations Inc., Toronto, Canada. Each of the partners had equal shares. Goldstake's previous partner, Strawberry Hill Mining Co., received a 20% interest of Goldstake's share in the venture. The partners evaluated relict mine tailings along an 18-mile stretch of Whitewood Creek, from its confluence with the Belle Fourche River southward to an area just north of the town of Whitewood. The area includes parts of Butte, Meade, and Lawrence Counties. The tailings occur at the surface and have a weighted average thickness of 4.8 feet. The material was carried downstream from mines and stamp mills that operated in the northern Black Hills from 1876 to the early 1900's. According to the Whitewood joint venture, the area has over 10.4 million tons of tailings, containing over 500,000 ounces of gold. The area is listed as a U.S. Environmental Protection Agency (EPA) Superfund site eligible for remediation under provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The tailings reportedly contain an average of 2,500 parts per million (ppm) total arsenic, primarily in an iron arsenate form with trace amounts of cadmium and mercury. An environmental baseline assessment and economic feasibility study for a potential mining project were underway at yearend. An initial decision by the EPA on proposed optional remedies under CERCLA guidelines was anticipated by November 1989 and expected to become final in the early part of 1990.

Minerva Exploration Inc., a subsidiary of Naneco Resources Ltd. of Calgary, Alberta, unsuccessfully sought a water permit for its proposed Johnson Gulch surface gold mine west of Lead. In December, the South Dakota Water Management Board, in an unprecedented action, ordered Minerva to provide detailed plans for the operation before granting the permit. The Board indicated that it would reconsider the application in March 1989 if Minerva completed its final mine plan. Historically, the board had been required only to decide on water availability, impacts on other users, and whether the proposed use was in the public interest; review of detailed mine and reclamation plans had been a responsibility of the South Dakota Department of Water and Natural Resources.

Minerva had sought to drill three wells, each about 1,000 feet deep, to supply the mine and mill with water at a maximum pump rate of 150 gallons per minute. According to Naneco, the deposit had ore reserves, at a cutoff grade of 0.010 ounce of gold per ton, of about 6.5 million tons, with an average grade of 0.04 ounce of gold per ton for a metal content of 260,000 ounces.[17] The ore occurs in flat-lying silicified limestone breccia that averages 16 feet in thickness at depths from 0 to about 45 feet. Naneco indicated an annual production rate of 1 million tons for up to 10 years. Construction of the surface mine and vat leach recovery plant was expected to cost $12 million. The mine site would be near the rim of Spearfish Canyon, a scenic area popular with local citizens and tourists.

Rhyolite Inc. received a life-of-mine permit for its D&R Claim No. 3 from the South Dakota Department of Water and Natural Resources in late April for a proposed small underground gold operation. The permit application indicated a planned mine life of 10 years with an annual production rate of up to 5,000 tons. At yearend, development had not begun.

Iron Ore.—Pete Lien & Sons Inc. entered a 5-year contract with the South Dakota Cement Commission to produce a small amount of iron ore for use in cement manufacturing. According to the contract bid specification delivery schedule, the bidder was to provide the equivalent of 8,000 tons of elemental iron each year for 5 consecutive years beginning in 1988. Iron ore was surface mined from a small deposit near Nemo.

Industrial Minerals

Cement.—In 1988, sales and attendant value of the State's second leading commodity, portland cement, fell for

SOUTH

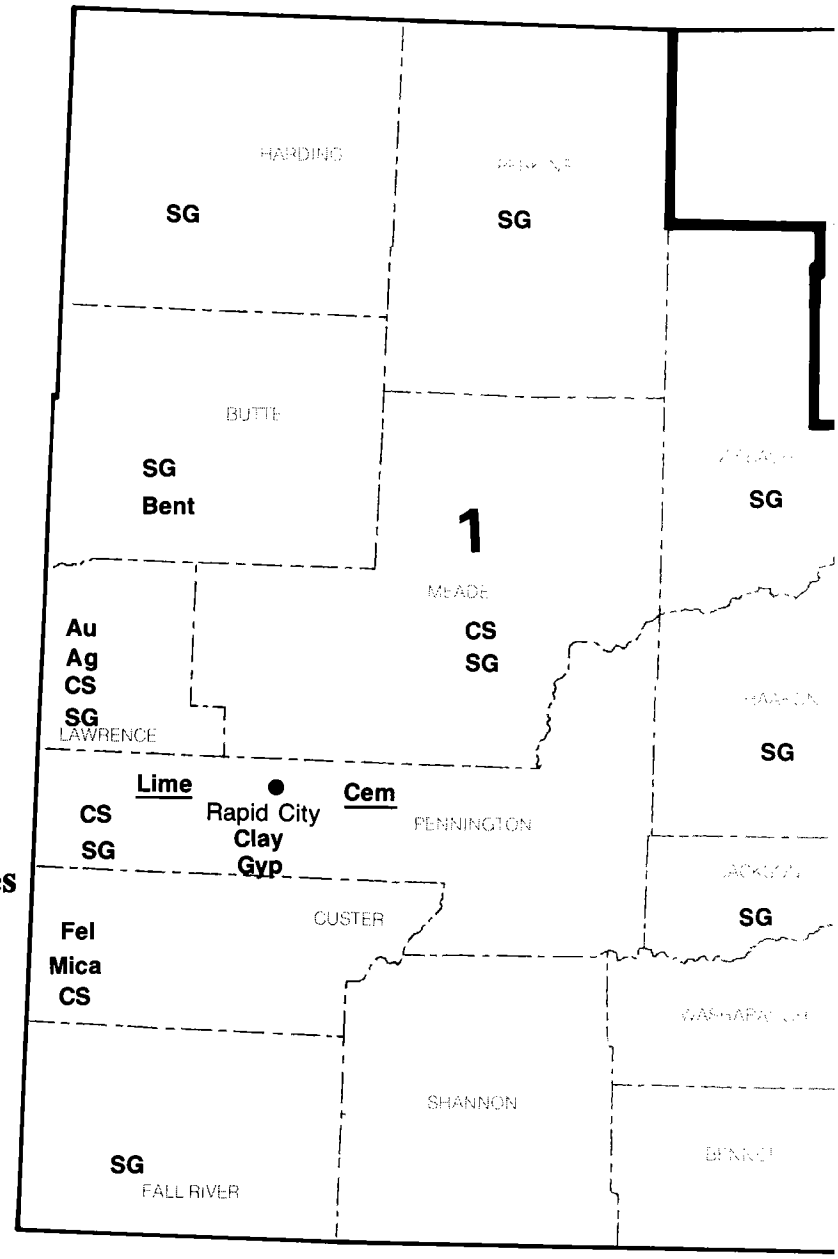
LEGEND

- 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



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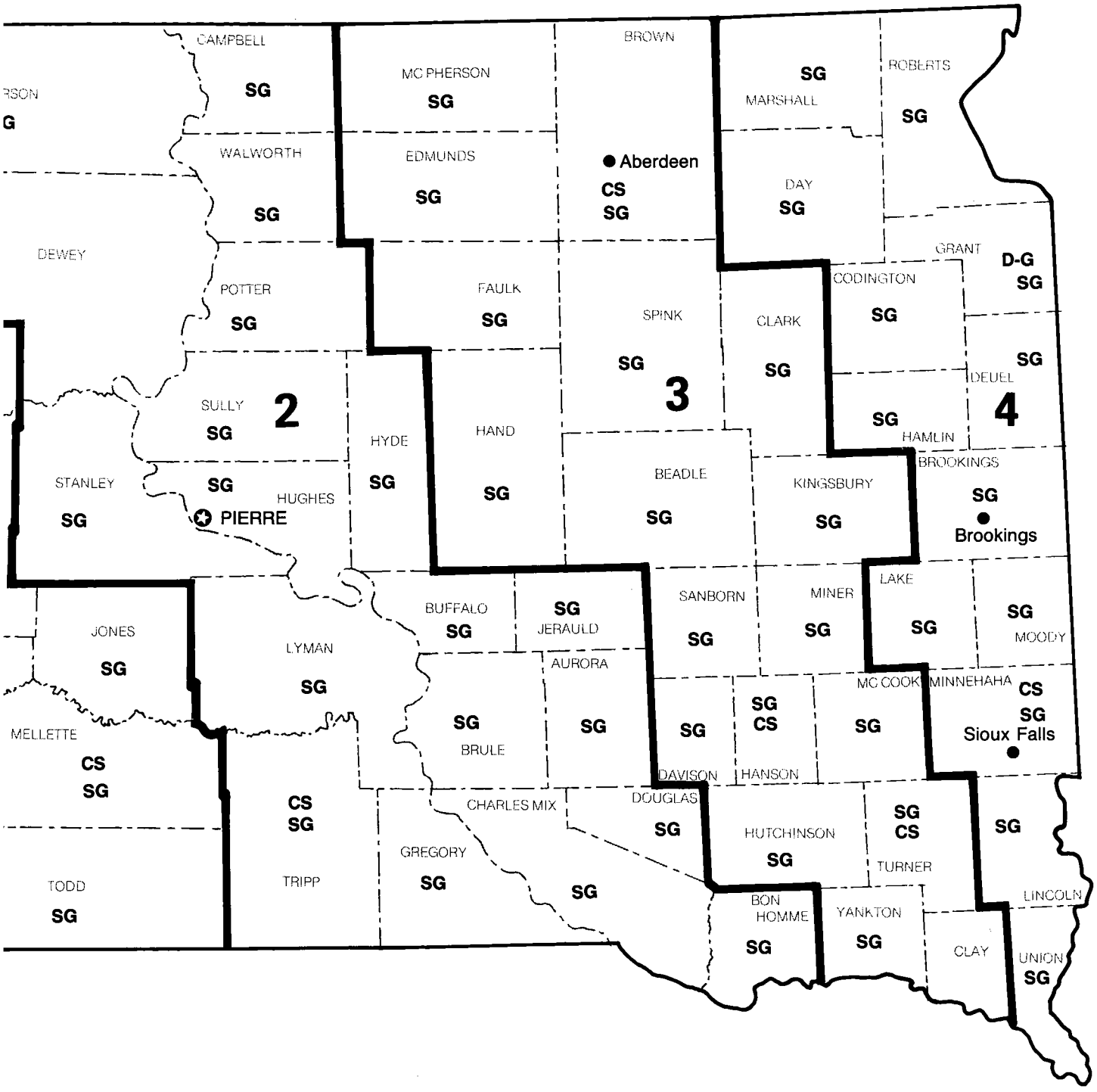
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HAMLIN
BROOKINGS
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STANLEY
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HUGHES
PIERRE
BEADLE
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KINGSBURY
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Brookings
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LYMAN
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MC COOK
MINNEHAHA
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Sioux Falls
MELLETTE
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DAVISON
HANSON
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CHARLES MIX
DOUGLAS
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HUTCHINSON
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TURNER
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TODD
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TRIPP
GREGORY
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BON
HOMME
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YANKTON
SG
LINCOLN
CLAY
UNION
SG

the third consecutive year. The 6% decline was mostly because of reduced sales to ready-mixed concrete operations, which experienced decreased sales in some marketing regions, in part because of reduced road construction or building construction. Masonry cement sales and attendant value fell nearly 8% in 1988, resuming the declines reported in 4 of the previous 5 years. Total clinker sales in 1988 were 588,000 short tons.[18] About 54% of the finished portland cement was sold to ready-mixed concrete companies, 22% to highway contractors, 8% to other contractors, and 16% to various other consumers. The State's only cement plant, at Rapid City, is owned by the State of South Dakota and governed by a seven-person commission, appointed by the Governor. A high percentage of the plant's earnings is remitted to the State's general fund each year. The plant employed about 230 people and operated around the clock all year. The plant uses both the wet- and dry-kiln processes and has a clinker production capacity of 965,000 tons. The finished product is marketed under the name Dakotah Brand in South Dakota, in six adjacent States, and in Colorado.

In 1988, $1.8 million was appropriated for various capital improvements for the plant. One improvement was designed to control fugitive dust from cement loading onto railroad cars, at a cost of at least $400,000.

Feldspar and Mica.—Feldspar and mica were mined from numerous pegmatite deposits in the vicinity of Custer by miners under contract with Pacer Corp. of Custer, SD. In 1988, feldspar production and value increased about 42% as compared with 1987 figures. In the same period, scrap mica production and value increased about 7% and 10%, respectively. Based on quantity produced, South Dakota ranked sixth of six feldspar-producing States and second of seven mica-producing States. Feldspar is used as a flux in glass and ceramics manufacturing. Mica is used in manufacturing gypsum wallboard, cement, paint, roofing materials, rubber products, and as an oil-well drilling mud additive.

Not included in the Bureau of Mines production totals was output from Mining Claims Management Co. (MCMC) and North American Accounts Inc. (NAAI). NAAI produced small amounts of pegmatite deposits from its Sheryl and Whale claims near Custer. Scrap mica reportedly was shipped to Franklin Minerals Corp., Hartwell, GA. Ore was processed by NAAI at its 12-ton-per-day mill. The mill's jaw crushers, roll crushers, and single and double deck screens reduced the mica to a +⅛-inch size, averaging about 4% biotite, which was removed using magnetic separation.[19]

MCMC had limited production from its Arcade and Scott pegmatite mines in Custer County. Total production was less than 100 tons of hand-cobbed specimen-grade beryl, feldspar, mica, and rose quartz. Production was sold to collectors. In December, MCMC was sold to Good Faith Mining Co. of Custer at an undisclosed price. However, the former management of MCMC retained the Arcade Mine and reported plans to continue and eventually expand operations for commercial-grade feldspar[20] and rose quartz for applications ranging from landscape material to gem stones.

Gem Stones.—The value of gem stones collected during 1988 was estimated to have remained the same as that of 1987 and represented material collected by rockhounds, mineral collectors, and other hobbyists. Gem stones common to the State include various euhedral, coarse-grained, and cryptocrystalline varieties of quartz, including rose quartz and numerous multicolored varieties of agate, chalcedony, jasper, and petrified wood. Gem stones commonly associated with metamorphic rocks in the Black Hills area or nearby placer deposits are staurolite and garnet, includ-

TABLE 2

SOUTH DAKOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1988, BY MAJOR USE CATEGORY

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregates (including concrete sand)	804	$2,874	$3.57
Plaster and gunite sands	W	W	4.67
Concrete products (blocks, bricks, pipe, decorative, etc.)	W	W	3.25
Asphaltic concrete aggregates and other bituminous mixtures	524	2,024	3.86
Road base and coverings[1]	2,823	5,867	2.08
Fill	191	219	1.15
Snow and ice control	9	17	1.89
Other	118	367	3.11
Unspecified:[2]			
Actual	1,556	3,753	2.41
Estimated	1,904	3,561	1.87
Total or average	**7,929**	**[3]18,681**	**2.36**

W Withheld to avoid disclosing individual company proprietary data; included with "Other."
[1] Includes road and other stabilization (cement and lime).
[2] Includes production reported without a breakdown by end use and estimates for nonrespondents.
[3] Data do not add to total shown because of independent rounding.

TABLE 3

SOUTH DAKOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED BY PRODUCERS IN 1988, 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
Concrete aggregates and concrete products[1]	297	1,256	114	382	235	715	168	560
Asphaltic concrete aggregates and other bituminous mixtures	112	870	37	77	227	665	148	412
Road base and coverings[2]	490	1,156	869	1,910	629	1,282	835	1,518
Fill	(3)	(3)	W	W	W	W	144	151
Snow and ice control	—	—	W	W	W	W	8	15
Other miscellaneous	42	99	21	54	70	209	23	36
Other unspecified[4]	174	253	1,003	1,302	492	1,756	1,791	4,003
Total[5]	**1,115**	**3,635**	**2,044**	**3,726**	**1,652**	**4,626**	**3,117**	**6,695**

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."
[1] Includes sand and gravel for plaster and gunite sands.
[2] Includes sand and gravel for road and other stabilization (cement and lime).
[3] Less than 1/2 unit.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5] Data may not add to totals shown because of independent rounding.

ing almandite, andradite, grossularite, pyrope, and spessartite.

***Sand and Gravel* (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains actual data for 1986 and 1988 and estimates for 1987. South Dakota construction sand and gravel statistics are compiled by geographical districts as depicted in the centerfold map. Table 3 presents end-use data for the State's four districts.

Construction sand and gravel was the State's fourth leading nonfuel mineral commodity. In 1988, production declined 17% in quantity and 2% in value. Leading counties were Codington, Corson, and Minnehaha.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains estimates for 1986 and 1988 and actual data for 1987.

Crushed.—Crushed stone production and value were estimated to have increased 8% and 11%, respectively, in 1988.

Dimension.—South Dakota ranked 10th of 35 States in dimension stone production. Grant County hosted five granite dimension stone operations, all east of Milbank, in 1988. Production was mostly of the variety locally referred to as mahogany granite, a burgundy- and black-colored, coarsely crystallined granite that crops out or lies near the surface. Cut and polished slabs or rough-cut slabs were hauled by truck to finishing plants, then shipped to various domestic and international markets. Large volumes were sold to Japan and Italy for use as building stone veneers. Another large use is in manufacturing monuments. Part of Cold Spring Granite Co.'s South Dakota production was used in manufacturing granite floor tile at its Cold Spring, MN, plant. At yearend, Dakota Granite Co. was finalizing plans to begin manufacturing granite floor tile at its Milbank plant by mid-1989.

Other Industrial Minerals.—Common clay and shale increased in production and value about 23% and 38%, respectively, during 1988. Crude gypsum production, used by the Cement Commission plant at Rapid City in the manufacture of cement, decreased almost 3%, and value increased nearly 19%. Output and value of hydrated lime and quicklime increased 27% and 22%, respectively. High-purity, highly refined natural quartz for use in the manufacture of semiconductors and specialty glass was produced by Min-Tech Corp. of Custer.

[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] U.S. Department of Commerce, Bureau of the Census. Private communication, 1989; available upon re-

quest from L.E. Esparza, BuMines, Minneapolis, MN.

[3] Highway and Heavy Construction. Market Update: On the Road Again. V. 130, No. 6, June 1987, p. 36.

———. Highways: New State Revenue Cushions Falling General Aid. V. 131, No. 6, June 1988, p. 34.

[4] Mining Engineering. State Activities 1988—South Dakota. V. 41, No. 5, May 1989, pp. 316–317.

[5] Wharf Resources Ltd. (Toronto, Canada). 1988 Annual Report to Stockholders. 20 pp.

[6] MinVen Gold Corp. (Denver, CO). 1988 Annual Report to Stockholders. 40 pp.

[7] Western Mining Activity Report. V. 2, No. 11, Nov. 1988, p. 4.

[8] Work cited in footnote 6.

[9] Ibid.

[10] Ibid.

[11] Engineering and Mining Journal. Richmond Hill Gold Mine Opens. V. 190, No. 1, Jan. 1989, p. 13.

[12] Work cited in footnote 11.

[13] Bond International Gold Inc. (Denver, CO). Second Quarter Report, Dec. 31, 1988, 12 pp.

[14] Work cited in footnote 6.

[15] The Mining Record. Final License Received For Golden Reward Mining Project. V. 99, No. 28, July 13, 1988, p. 5.

[16] Work cited in footnote 6.

[17] Naneco Resources Ltd. Private communication, 1989; available upon request from L. E. Esparza, BuMines, Minneapolis, MN.

[18] The Rapid City Journal. Cement Plant OKs $487,000 for Two Projects. July 22, 1989, p. A8.

[19] Stratton, Vernon (North American Accounts Inc.). Private communications, 1989; available upon request from L. E. Esparza, BuMines, Minneapolis, MN.

[20] Ventling, Larry (Mining Claims Management Co.). Private communications, 1989; available upon request from L. E. Esparza, BuMines, Minneapolis, MN.

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	Box 360 Rapid City, SD 57709	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 under development	Lawrence.
Brohm Mining Corp., a division of MinVen Gold Corp.[1]	Box 485 Deadwood, SD 57732	Open pit and leach pads	Do.
Golden Reward Mining Co.	Box 888 Lead, SD 57754	Open pit and leach pads under development	Do.
Homestake Mining Co.[1]	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.	Box 440 Rapid City, SD 57709	Plant	Pennington.
Mica:			
Pacer Corp.	Box 912 Custer, SD 57730	Mine and dry-grinding plant	Custer.
Sand and gravel (construction):			
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 Street Rutland, ND 58067	do.	Marshall.

See footnote at end of table.

TABLE 4—Continued

PRINCIPAL PRODUCERS

Commodity and company	Address	Type of activity	County
Stone (1987):			
Crushed:			
Limestone:			
Pete Lien & Sons Inc.	Box 440 Rapid City, SD 57709	Quarries and plants	Custer and Pennington.
Northwestern Engineering Co. (Hills Materials Co.)	Box 2320 Rapid City, SD 57709	do.	Pennington.
South Dakota Cement Commission	Box 360 Rapid City, SD 57709	Quarry and plant	Do.
Sandstone-quartzite:			
Concrete Materials Co.	Box 809 Sioux Falls, SD 57101	do.	Minnehaha.
L. G. Everist Inc.	Box 829 Sioux Falls, SD 57101	do.	Do.
Spencer Quarries Inc.	Box 25 Spencer, SD 57374	do.	Hanson.
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.

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

U.S. Department of the Interior
Bureau of Land Management
Thomas Lonnie, Deputy State Director for Mineral Resources
Box 36800
Billings, MT 59107

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

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

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

STATE

South Dakota Geological Survey
Merlin J. Tipton, State Geologist
Science Center
University of South Dakota
Vermillion, SD 57069

South Dakota Department of Water and Natural Resources
Floyd Matthew, Secretary
523 East Capitol
Joe Foss Building
Pierre, SD 57501

South Dakota School of Mines and Technology
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