

THE MINERAL INDUSTRY OF SOUTH DAKOTA

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

In 1998, the preliminary estimated value¹ of nonfuel mineral production for South Dakota was \$269 million, according to the U.S. Geological Survey (USGS). This was about an 18% decrease from that of 1997,² and followed a 6.6% decrease from 1996 to 1997.

Gold remained South Dakota's leading nonfuel mineral by value, accounting for about 45% of the State's total nonfuel mineral production value. In 1998, declines in the values of gold and granite dimension stone accounted for most of State's decrease in value (table 1). Small decreases also occurred for crude gypsum, usable iron ore, and silver. Most other nonfuel minerals increased, led by a more than \$3 million increase in the combined values of portland and masonry cements. In 1997, relatively small to moderate gains in the values of construction sand and gravel, crushed stone, and portland cement were significantly less than the decreases in other commodities (mostly in gold), resulting in a net drop in value.

Based on USGS estimates of the quantities produced in the 50 States during 1998, South Dakota rose to fourth from fifth² in gold and remained fifth in mica and seventh in feldspar. Additionally, South Dakota was a leading State in the production of granite dimension stone.

The following narrative information was provided by the South Dakota Geological Survey (SDGS)³ of the State's Department of Environment and Natural Resources (DENR) (T.V. Durkin, E.H. Holm, and D.K. Burtts, DENR, accessed November 19, 1999, at URL <http://www.state.sd.us/denr/>

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

All 1998 USGS mineral production data published in this chapter are preliminary estimates as of February 1999 and are expected to change. For some mineral commodities (for example, construction sand and gravel, crushed stone, and portland cement), estimates are updated periodically. To obtain the most current information, please contact the appropriate USGS mineral commodity specialist. A telephone listing for the specialists may be retrieved over the Internet at <http://minerals.usgs.gov/minerals/contacts/comdir.html>; by using MINES FaxBack at (703) 648-4999 from a fax machine with a touch-tone handset (request Document #1000 for a telephone listing of all mineral commodity specialists); or by calling USGS information at (703) 648-4000 for the specialist's name and number. All Mineral Industry Surveys—mineral commodity, State, and country—also may be retrieved over the Internet at <http://minerals.usgs.gov/minerals/>; facsimile copies may be obtained from MINES FaxBack.

²Values, percentage calculations, and rankings for 1997 may vary from the *Minerals Yearbook, Area Reports: Domestic 1997, Volume II*, owing to the revision of preliminary 1997 to final 1997 data. Data for 1998 are preliminary and expected to change, while related rankings may also be subject to change.

³T.V. Durkin, E.H. Holm, and D.K. Burtts of the Minerals and Mining Program (MMP), South Dakota Department of Environment and Natural Resources, jointly authored the text of mineral industry information used in the remainder of this publication.

DES/Mining/1998sum.htm).⁴ There was a major decline in South Dakota gold production in 1998. The gold mines in the northern Black Hills produced more than 12,100 kilograms (about 390,000 troy ounces) of gold in 1998. This represented a 26% drop in the amount of gold produced the previous year, but because of lower gold prices this equated to a 34% drop in gross value. The average price of gold in 1998 was slightly above \$294 per troy ounce, yielding a gross value of about \$115 million for the State's gold mining industry. The State's mines were surface heap-leach operations with the exception of Homestake Mining Co., which had underground and opencut surface operations.

In early 1998, Homestake announced that it was temporarily shutting down the underground portion of its Homestake Mine to institute a new mining plan to help the company withstand low gold prices without permanently shutting down the mine. When operations resumed in April, the workforce was reduced from 850 to 380 employees and gold production decreased from about 12,400 kilograms (kg) in 1997 (8,100 kg from the underground operation and 4,300 kg from the opencut surface operation) to about 8,600 in 1998 (3,600 kg underground and 5,000 kg open cut). In September, Homestake completed mining in the Open Cut.

Other large-scale gold operations in South Dakota that produced gold in 1998 included the Wharf Mine, operated by Wharf Resources Ltd. and the Gilt Edge Mine, operated by Brohm Mining Corp. Wharf Resources production slightly increased to 3,250 kg in 1998 from 3,210 kg in 1997, and Brohm Mining's production went from 838 kg in 1997 to about 70 kg in 1998, owing to the closure of Gilt Edge and delays in commencing the mining of its Anchor Hill deposit. The Golden Reward Mine, owned by Goldcorp, Inc. and Dakota Mining Co., remained under temporary cessation and produced no gold. LAC Minerals (USA) Inc.'s Richmond Hill Mine is no longer producing gold and the mine was undergoing final reclamation.

In June 1998, the South Dakota Board of Minerals and Environment conditionally approved a permit application from Wharf Resources for its expansion project north and east of the present Wharf Mine, which has operated in South Dakota since 1982. During the next 10 years, Wharf will mine two new pits in phases, reclaiming one pit while mining another. The project involves about 250 hectares, of which more than 110 hectares will be affected by the operation and 136 hectares will be undisturbed. The company estimated that total production would be more than 19 million metric tons of ore with an average grade of 1.1 grams gold per ton, containing about 21,100 kg of gold. Ore from the expansion project will be processed at the existing facilities at the Wharf Mine. About 50 million tons of overburden and waste rock

⁴Production data in the following text are those reported by the SDGS, based on its own surveys and estimates. They may differ from some production figures reported to the USGS.

will be displaced/generated during the life of the project. The majority of the waste rock will be used as backfill, while some waste rock will be placed in a new waste depository that will partially cover a relic tailings area.

Nonmetallic Industrial Minerals

During the 1998 reporting period, 503 companies had active mine licenses in South Dakota. An operator must obtain a license to mine for sand, gravel, pegmatite minerals, rock used in the process of making cement or lime used in construction. There were also a total of 52 mine permits that covered the mining of other non-metallic minerals such as slate, bentonite, and dimension stone.

Sand and gravel was the major industrial mineral commodity; more than 13.7 million tons of production were reported. Sand and gravel is produced in nearly every county in South Dakota and is used mainly for road construction projects.

Sioux quartzite was the next largest industrial mineral commodity with about 2.55 million tons produced. It is quarried from four locations in southeastern South Dakota. Most of the quartzite is crushed and used in construction, whereas some of the larger blocks are used for rip-rap, railroad ballast, and occasionally for decorative purposes.

Pegmatite mining, mainly in the southern Black Hills, produced more than 15,500 tons of pegmatite minerals such as feldspar, mica, and rose quartz.

The South Dakota Cement Plant of Rapid City, Pennington County, reported mining almost 1.2 million tons of limestone, 188,000 tons of shale, 41,000 tons of gypsum, and 30,500 tons of sand.

More than 240,000 tons of granite was mined by Dakota Granite Co. and Cold Spring Granite Co. from quarries near Milbank, in Grant County in northeastern South Dakota. Due to its beauty and distinctive red color, the mahogany granite (much of it goes to international markets) is used primarily for floor tiles, monuments, and building construction. Waste granite was crushed and used in road construction. Total sales from 1998 production were \$40.4 million.

More than 36,000 tons of bentonite was mined in the western portion of the State.

Exploration

Five exploration permits were issued in 1998 to Luff Exploration Co., Homestake Mining Co., and three other individual and joint operators. Of 640 test holes that were permitted for drilling in Harding and Lawrence Counties, 600 were seismic shot holes drilled by Luff Exploration for oil and gas exploration in Harding County and 40 were permitted by Homestake Mining for all minerals excluding uranium in Lawrence County. Also in Lawrence County, 65 prospect pits and a bulk sample were permitted to two individual operators in a joint operation to conduct exploration for cassiterite, tantalite, scheelite, and placer gold. An exploration permit for amphibolite, gold, and quartz schist in Custer County was issued to two individuals involving the removal of waste rock previously stockpiled on a site and the removal of up to 4,500 tons of material from an underground drift as a bulk sample.

Mine Reclamation

The pit impoundment at LAC Minerals' Richmond Hill Mine, designed to reclaim impacts from acid mine drainage (AMD) that occurred at the site in 1992, continued to perform well based on results of about 3 years of performance monitoring of the facility. In 1995, the reclaimed pit impoundment was fitted with numerous performance monitoring devices designed to track the long-term success of remedial measures. Results from gravity and barrel lysimeters, heat dissipation units, neutron probes, piezometers, pore gas (oxygen and CO₂) monitoring, temperature probes, water quality and aquatic monitoring, and cap settlement surveys, have indicated that the reclaimed site continues to perform well. Performance monitoring data continued to be collected at the site. Water quality data from some wells and surface sites continued to show impacts from AMD, reinforcing the need to monitor the results and trends at these and other monitoring stations in future sampling events (currently scheduled to occur indefinitely.) Performance monitoring data are on file at the DENR and are available to the public.

Although the DENR does not have an abandoned mine reclamation program, the agency worked with the U.S. Forest Service (USFS), the U.S. Bureau of Land Management (BLM), and the U.S. Environmental Protection Agency to begin the process of reclaiming two abandoned mine sites in the northern Black Hills. Funds from the Federal Government's Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) are being used to reclaim both mine sites: the Minnesota Ridge Mine located on USFS and private property and the Belle Eldridge Mine located on BLM land. Both of these mines are typified by draining mine tunnels, AMD consisting of elevated heavy metals and other contaminants, sulfide waste rock piles, eroding streamside tailings, dilapidated structures, and open shafts. According to DENR's inventory of known inactive and abandoned mines in South Dakota's Black Hills has identified approximately 900 historic mine sites; about 200 are located on Federal land (mostly USFS) and about 700 are on private land. More information on inactive and abandoned mines in the Black Hills can be found on the Internet at URL <http://www.state.sd.us/denr/DES/Mining/acidmine.htm>.

Environmental Issues

Enforcement.—The DENR issued a notice of violation (NOV) to Homestake Mining Co. in 1998. Homestake was issued one NOV and an order to correct the situation that led to a tailings release into Gold Run Creek. This NOV also covered a release in November 1997 when a slurry line to the underground mine plugged and allowed the slurry to back up and escape through a vent line onto adjacent soils and into Whitewood Creek. In the November 1997 release, it was estimated that less than 400 liters (L) of slurry entered the creek. Cyanide and heavy metals in the slurry killed about 65 brown trout. In May 1998, an estimated 40,000 L of tailings from Homestake's west sand plant, containing heavy metals and about 4.5 kg of cyanide, escaped containment and flowed into Gold Run Creek and Whitewood Creek. The discharge contributed to a fish kill downstream in the Deadwood area.

Homestake took immediate steps to mitigate the effects of the discharge. The company performed an immediate biological assessment on Whitewood Creek to assess the impact of the spill while simultaneously removing about 11 to 14 tons of tailings from Gold Run Creek. In a settlement agreement signed in December 1998, Homestake agreed to pay \$200,000 (a penalty of \$150,000 paid to the DENR's emergency response fund and \$50,000 paid to the city of Lead to separate stormwater flows from the Lead sewer system). As part of the settlement agreement, Homestake also agreed to conduct a thorough assessment to identify and correct any structural problems with its mill to ensure that future releases not occur. Homestake must also conduct biological studies of Whitewood Creek over the next 3 years to ensure these two releases did not have any long-term negative impact on Whitewood Creek.

Brohm Mining's Gilt Edge and Anchor Hill Projects.—Dakota Mining Corp., owner of Brohm Mining's Gilt Edge and Anchor Hill Mines, continued to experience financial and environmental difficulties throughout 1998. Acid mine drainage at the Gilt Edge Mine (operations curtailed in September 1997) continued to be a significant problem. In early January 1998, several environmental and citizens groups appealed the USFS November 1997 decision to allow Brohm to proceed with the Phase II expansion of the Anchor Hill project. In February 1998 the USFS withdrew approval citing deficiencies in the Environmental Impact Statement (EIS). Addressing the deficiencies and submitting a supplement to the EIS delayed the project. Unable to finance continuing operations at the site, Dakota Mining announced in May that it would abandon the mine site. The State Governor went to the State's eighth circuit court and obtained a temporary restraining order and a Preliminary Injunction preventing Dakota/Brohm from abandoning the mine. As of June 1999,

the company has complied with the restraining order and injunction. In July, the USFS issued a new Record of Decision (ROD) approving the expansion of the Anchor Hill Mine. In September, an organization called Earthlaw filed an appeal of the ROD on behalf of several parties, but in October, the Forest Service denied the Earthlaw appeal. At year end, Dakota was pursuing financing for the Anchor Hill Project and finalizing plans for the mine's operation and reclamation.

In the process of shutting down the Gilt Edge Mine, no reclamation work was completed. The water treatment plant continued to periodically treat acidic water collected at the mine and Brohm periodically continued to evaporate acidic water held in two pits at the Gilt Edge. The treatment and evaporation system could not keep up with inflows from precipitation. The amount of AMD water stored in the pits decreased to about 260 L at the end of 1997, and then increased to about 360 L at the end of 1998. The water treatment plant, which uses sodium hydroxide as a reagent, was effective at removing much of the metals and raising the pH in the AMD water prior to discharge, but the concentrations of parameters such as sulfate, total dissolved solids, sodium, and conductivity remained very high in the discharge.

Nitrate Treatment.—Bacteria have been used for nitrate-reduction in mine waters prior to discharge at two denitrification plants at the Wharf Mine and in a pond system at the Golden Reward Mine. The biotechnology has been successful at reducing nitrate concentrations. Various levels of nitrate reduction can be achieved, depending on site specifics. Some additional concerns that were raised in 1998 over potential impacts to human health and the environment from microorganisms involved in the process were being investigated by the companies and the DENR.

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN SOUTH DAKOTA 1/ 2/

(Thousand metric tons and thousand dollars unless otherwise specified)

Mineral	1996		1997 r/		1998 p/	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay: Common	147	W	182	W	185	W
Gemstones	NA	98	NA	98	NA	98
Gold 3/ kilograms	W	W	W	W	12,700	121,000
Gvpsum. crude	W	W	51	469	56	399
Sand and gravel: Construction	8,750	27,700	10,200	34,100	9,840	34,100
Silver 3/ metric tons	5	849 r/	4	694	4	656
Stone: Crushed	5,640	28,700	5,900	30,200	6,000	30,600
Combined values of cement, feldspar, iron ore (usable), lime, mica (crude), stone (dimension granite), and values indicated by symbol W	XX	293,000 r/	XX	263,000	XX	82,400
Total	XX	351,000 r/	XX	328,000	XX	269,000

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

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

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Recoverable content of ores, etc.

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

Kind	1996				1997			
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value
Limestone	4	2,850	\$11,500	\$4.05	4	3,110	\$11,900	\$3.82
Granite	1	1	7	7.00	1	1	13	13.00
Quartzite	7	2,790	17,200	6.16	9	2,790	18,300	6.55
Total	XX	5,640	28,700	5.09	XX	5,900	30,200	5.11

XX Not applicable.

1/ Data are rounded to three significant digits, except unit value; may not add to totals shown.

TABLE 3
SOUTH DAKOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS
IN 1997, BY USE 1/ 2/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Coarse aggregate (+1 1/2 inch):			
Riprap and jetty stone	57	\$351	\$6.16
Filter stone	170	965	5.68
Coarse aggregate, graded:			
Concrete aggregate, coarse	577	3,570	6.19
Bituminous aggregate, coarse	162	694	4.28
Bituminous surface-treatment aggregate	170	1,000	5.89
Railroad ballast	101	581	5.75
Other graded coarse aggregate	8	52	6.50
Fine aggregate (-3/8 inch) 3/	398	1,730	4.36
Coarse and fine aggregates:			
Graded roadbase or subbase	449	1,850	4.12
Crusher run or fill or waste	77	230	2.99
Other construction materials 4/	22	105	4.77
Chemical and metallurgical:			
Cement manufacture	1,130	1,680	1.49
Lime manufacture	W	W	4.52
Glass manufacture	W	W	20.65
Unspecified: 5/			
Actual	W	W	7.39
Estimated	732	4,380	5.99
Total	5,900	30,200	5.11

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

1/ Includes limestone, quartzite, and granite.

2/ Data are rounded to three significant digits, except unit value; may not add to totals shown.

3/ Includes screening (undesignated) and stone sand (bituminous mix or seal).

4/ Includes unpaved road surfacing.

5/ Includes reported and estimated production without a breakdown by end use.

TABLE 4
SOUTH DAKOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1997,
BY USE AND DISTRICT 1/ 2/

(Thousand metric tons and thousand dollars)

Use	District 1		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+1 1/2 inch) 3/	W	W	--	--	W	W
Coarse aggregate, graded 4/	W	W	--	--	W	W
Fine aggregate (-3/8 inch) 5/	W	W	--	--	W	W
Coarse and fine aggregate 6/	W	W	--	--	W	W
Other construction materials	1,010	4,740	--	--	1,190	6,390
Chemical and metallurgical 7/	1,370	(8/)	--	--	--	--
Unspecified: 9/						
Actual	--	--	578	3,320	(8/)	(8/)
Estimated	732	4,380	--	--	--	--
Total	3,110	11,900	578	3,320	2,210	14,900

W Withheld to avoid disclosing company proprietary data; included with "Other construction materials."

1/ No crushed stone was produced in District 2.

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Includes filter stone and riprap and jetty stone.

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

5/ Includes stone sand (bituminous mix or seal), and screening (undesignated).

6/ Includes graded road base or subbase, unpaved road surfacing, crusher run (select material or fill), and coarse and fine aggregates.

7/ Includes cement manufacture, glass manufacture, and lime manufacture.

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

9/ Includes reported and estimated production without a breakdown by end use.

TABLE 5
SOUTH DAKOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1997,
BY MAJOR USE CATEGORY 1/

Use	Quantity (thousand metric tons)	Value (thousands)	Value per ton
Concrete aggregate (including concrete sand) 2/	1,250	\$6,050	\$4.85
Plaster and gunite sands	50	310	6.20
Asphaltic concrete aggregates and other bituminous mixtures	607	2,440	4.02
Road base and coverings 3/	2,810	8,310	2.96
Fill	966	2,300	2.39
Snow and ice control	51	162	3.18
Other miscellaneous uses 4/	26	189	7.27
Unspecified: 5/			
Actual	715	3,020	4.22
Estimated	3,700	11,300	3.07
Total or average	10,200	34,100	3.36

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes concrete products.

3/ Includes road and other stabilization (cement and lime).

4/ Includes filtration and roofing granules.

5/ Includes reported and estimated production without a breakdown by end use.

TABLE 6
SOUTH DAKOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1997,
BY USE AND DISTRICT 1/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2	
	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products 2/	--	--	--	--
Asphaltic concrete aggregates and road base materials 3/	548	1,160	1,030	2,740
Fill	W	W	W	W
Snow and ice control	W	W	W	W
Other miscellaneous uses 4/	--	--	--	--
Unspecified: 5/				
Actual	W	W	W	W
Estimated	869	2,370	666	1,930
Total	1,720	4,920	1,940	5,310
	District 3		District 4	
	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products 2/	22	114	1,040	4,980
Asphaltic concrete aggregates and road base materials 3/	629	1,610	1,210	5,260
Fill	305	786	560	1,290
Snow and ice control	W	W	24	45
Other miscellaneous uses 4/	--	--	26	189
Unspecified: 5/				
Actual	W	W	485	2,430
Estimated	1,210	4,220	948	2,820
Total	2,220	6,890	4,290	17,000

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

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes plaster and gunite sands.

3/ Includes road and other stabilization (cement and lime).

4/ Includes filtration and roofing granules.

5/ Includes reported and estimated production without a breakdown by end use.