USGS
science for a changing world

2012–2013 Minerals Yearbook

MICHIGAN [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

October 2016

MICHIGAN

LEGEND

- County boundary
- ★ Capital
- ● City
- 1 Crushed stone/sand and gravel district boundary

MINERAL SYMBOLS
(Principal producing areas)

Cem	Cement plant
Clay	Common clay
CS	Crushed stone
Cu	Copper plant
D-Sd	Dimension sandstone
FA	Ferroalloys
Fe	Iron ore
Gyp	Gypsum
IS	Industrial sand
K	Potash
Lime	Lime plant
Lime-c	Lime plant (captive)
MgCp	Magnesium compounds
Peat	Peat
Per	Perlite plant
S-ng	Sulfur (natural gas)
Salt	Salt
SG	Construction sand and gravel
Steel	Steel plant
TiMet	Titanium metal plant
⬭	Concentration of mineral operations

Source: Michigan Department of Environmental Quality, Office of the Geological Survey/U.S. Geological Survey (2012–13).

The Mineral Industry of Michigan

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Michigan Office of Oil, Gas and Minerals for collecting information on all nonfuel minerals.

In 2013, the value of the nonfuel mineral production[1] in the State of Michigan increased to $2.59 billion, 3.4% of the total U.S. nonfuel mineral production (excluding steel), ranking it ninth in the country. In 2012, the corresponding value was $2.13 billion, 2.8% of the Nation's total nonfuel mineral production, ranking it 11th among the 50 States. In 2013, on a per capita basis, nonfuel mineral production in Michigan had a value of $262 compared with the national average of $238. In 2012, the per capita value was $216 compared with the national average of $241.

The value of nonfuel mineral production in Michigan for the years 2006 through 2013 was as follows (in billions of dollars): $1.94 (2006), $1.97 (2007), $2.02 (2008), $1.76 (2009), $2.17 (2010), $2.45 (2011), $2.13 (2012), and $2.59 (2013).

In 2013, there were 2,105 employees in nonfuel mineral mines in Michigan and 1,239 in mills and preparation plants. In 2012, the corresponding numbers were 2,163 in nonfuel mineral mines and 1,257 in mills and preparation plants (U.S. Mine Safety and Health Administration, 2013, p. 11; 2014, p. 11). In 2013, the average annual wage in Michigan for all mining was $78,880 compared with $46,673 for all industries. In 2012, the corresponding figures were $78,831 and $46,223, respectively (National Mining Association, unpub. data, February 4, 2016).

In 2013 and 2012, on the basis of production quantity, Michigan was the leading State for the production of magnesium compounds out of 4 producing States, ranked second in the production of iron ore (shipped) out of 3 producing States, ranked third in the production of potash out of 3 producing States, and ranked fifth in the production of construction sand and gravel out of 50 producing States. In 2013, Michigan moved up from fifth in 2012 to fourth in the sales of peat out of 13 and 12 producing States, respectively. The State moved down to fifth in 2013 from fourth in 2012 in the production of portland cement out of 34 and 35 producing States, respectively.

In 2012 and 2013, the State also produced common clays, crushed stone, dimension stone, gypsum, industrial sand and gravel, lime, masonry cement, natural gemstones, and salt (table 1). Although not listed in table 1, Michigan also produced pig iron and (or) crude steel at Dearborn, Ecorse, Jackson, and Monroe.

[1]The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity. Excludes steel and other smelted or refined metals.

All USGS mineral production data published in this chapter are those available as of February 2016. Data in this report are rounded to three significant digits and percentages are calculated from unrounded data. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at http://minerals.usgs.gov/minerals.

Commodity Review

The following information has been extracted from U.S. Geological Survey (USGS) and other sources. Data from other sources may differ from USGS data, which are based on company responses to USGS surveys and estimation for nonrespondents. The USGS withheld some data to avoid disclosing company proprietary data.

Metals

Mineral industry activity with respect to metals was as follows:

There were only two active iron ore mines in Michigan in 2012–13, the Empire Mine and the Tilden Mine (Cliffs Natural Resources, Inc, Cleveland, Ohio). These were open pit mines located in Marquette County, producing iron ore for pellets for the steel industry. The Empire Mine was temporarily shut down in 2013 and slated for closure in 2014 (Tuck, 2015, p. 39.2).

Higher grade ores, with iron concentrations greater than 50%, have long been exhausted. Lean ores (25% to 30% iron) require beneficiating to reduce the silica components to control shipping and smelting costs. Taconite and jaspillite are the two most common lean ores currently mined and beneficiated.

In 2013, the U.S. Environmental Protection Agency issued a Federal implementation plan for one taconite facility in Michigan that required the installation and operation of continuous air monitoring systems and set nitrogen oxide (NOx) emission limits based on the best available retrofit technology. The final rule went into effect in 2014 (Tuck, 2015, p. 39.1).

Significant quantities of copper were mined in Michigan's Upper Peninsula during the second half of the 19th century and first half of the 20th century. Production, however, began to decline in the 1980s and eventually ceased in 1995. In 2002, Kennecott Exploration (a subsidiary of the London-based Rio Tinto Group) discovered a high-grade nickel-copper deposit near Marquette and began permitting and construction of the Eagle Mine and Humboldt mill. In February 2013, Rio Tinto changed focus and slowed construction of these facilities. In July 2013, Rio Tinto sold the ongoing mining project to Lundin Mining Corp. (Toronto, Ontario, Canada), which included the 80%-finished underground Eagle Mine west of Big Bay and the unfinished Humboldt mill 40 km southwest of Marquette for $318 million cash (Lundin Mining Corp., 2014). The mine was expected to be completed by late 2014 and begin production in the first quarter of 2015, reaching full production in mid-2015 (Kuck, 2016, p. 56.2).

Industrial Minerals

Mineral industry activity with respect to industrial minerals was as follows:

The area around Detroit has underground room-and-pillar mines that produce coarse rock salt for deicing purposes and other industrial uses. Solution mining of the salt is common deeper in the basin and is a basic raw material for several industries. The Salinas salt was obtained by solution mining operations, which also produced bromine, magnesium, and potassium for industrial chemicals, fertilizers, and food-grade salt.

Gypsum was mined in underground room-and-pillar mines near Grand Rapids and in open pit mines in the vicinity of the town of Alabaster near Lake Huron.

Michigan's crushed stone production was mainly limestone and dolomite for concrete aggregate, controlling shoreline erosion, industrial products, and pharmaceuticals. Most of the quarries are located near the Great Lakes shoreline owing to their shallow depth and ease of shipping. In 2013, there were 37 active crushed stone operations in the State with 36 quarries and 29 processing plants. In 2012, there were 38 active operations with 33 quarries and 27 processing plants.

Thick deposits of Pleistocene glacial sediments overlay much of the surface of Michigan, so unconsolidated layers of clay, gravel, and sand are mined locally. Much of the mined material is used for industrial purposes (such as foundry sand, glass, traction, and so forth) and construction. Many concrete plants are located at or near these gravel pits. In 2013, there were 323 active construction sand and gravel operations in Michigan, of which 19 were dredging operations. In 2012, the corresponding numbers were 333 active operations and 16 dredging operations.

References Cited

Gillespie, R., Harrison, W.B., III, and Grammer, G.M., 2008, Geology of Michigan and the Great Lakes: Kalamazoo, MI, Michigan Geological Repository for Research and Education, Western Michigan University, 37 p.

Kuck, P.H., 2016, Nickel [advance release], in Metals and minerals: U.S. Geological Survey Minerals Yearbook 2013, v. I, p. 51.1–51.31. (Accessed June 28, 2016, at http://minerals.usgs.gov/minerals/pubs/commodity/nickel/myb1-2013-nicke.pdf.)

Lundin Mining Corp., 2014, Eagle Mine site visit—May 15–16, 2014: Toronto, Ontario, Canada, Lundin Mining Corp., December, 52 p. (Accessed June 27, 2016, at http://www.lundinmining.com/i/pdf/2014-05-15_emsv_4arp4m.pdf.)

Tuck, C.A., 2015, Iron ore [advance release], in Metals and minerals: U.S. Geological Survey Minerals Yearbook 2013, v. I, p. 39.1–39.19. (Accessed May 26, 2016, at http://minerals.usgs.gov/minerals/pubs/commodity/iron_ore/myb1-2013-feore.pdf.)

U.S. Mine Safety and Health Administration, [2013], Mine injury and worktime, quarterly, January–December 2012, Final, closeout edition, 33 p. (Accessed February 4, 2016, at http://arlweb.msha.gov/Stats/Part50/WQ/MasterFiles/MIWQ%20Master_20125.pdf.)

U.S. Mine Safety and Health Administration, [2014], Mine injury and worktime, quarterly, January–December 2013, Final, closeout edition, 34 p. (Accessed February 4, 2016, at http://arlweb.msha.gov/Stats/Part50/WQ/MasterFiles/MIWQ%20Master_20135.pdf.)

Walton, Nicole, 2014, Empire Mine saved from closing in 2014: Marquette, MI, WNMU (Northern Michigan University Public Radio), February 27. (Accessed May 26, 2016, at http://wnmufm.org/post/empire-mine-saved-closing-2014#stream/0.)

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN MICHIGAN[1, 2]

(Thousand metric tons and thousand dollars)

Mineral	2011		2012		2013	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement:						
Masonry	61	8,300 e	73	9,540 e	61	8,500 e
Portland	3,480	353,000 e	3,890	346,000 e	3,860	370,000 e
Clays, common	312	1,280	W	W	W	W
Gemstones, natural	NA	2	NA	2	NA	2
Gypsum, crude	345	2,670	322	2,250	368	3,040
Iron ore, usable shipped	13,200	W	10,800 e	W	10,500 e	W
Lime	518	56,500	526	62,300	524	64,700
Peat	3	27	W	W	W	W
Sand and gravel:						
Construction	32,100 r	179,000 r	31,600	173,000	34,300	197,000
Industrial	1,830	67,500	1,450	59,100	1,230	49,000
Stone, crushed	22,700 r	137,000 r	24,900 r	168,000 r	26,700	193,000
Combined values of magnesium compounds, potash, salt stone (dimension), and values indicated by symbol W	XX	1,650,000	XX	1,310,000	XX	1,710,000
Total	XX	2,450,000 r	XX	2,130,000	XX	2,590,000

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "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 no more than three significant digits; may not add to totals shown.

TABLE 2
MICHIGAN: CRUSHED STONE SOLD OR USED IN THE UNITED STATES, BY TYPE[1]

Type	2012 Number of quarries	2012 Quantity (thousand metric tons)	2012 Value (thousands)	2012 Unit value	2013 Number of quarries	2013 Quantity (thousand metric tons)	2013 Value (thousands)	2013 Unit value
Limestone[2]	29	24,300	$165,000	$6.79	30	25,800	$187,000	$7.26
Dolomite	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Calcareous marl	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Traprock	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Miscellaneous stone	5	618	3,610	5.84	6	857	5,180	6.04
Total or average	XX	24,900	168,000	6.77	XX	26,700	193,000	7.22

XX Not applicable. -- Zero.

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

[2]Includes limestone-dolomite reported with no distinction between the two kinds of stone.

[3]Withheld to avoid disclosing company proprietary data; included with "Limestone."

[4]Withheld to avoid disclosing company proprietary data; included with "Miscellaneous stone."

TABLE 3
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS BY USE[1]

Use	2012			2013		
	Quantity (thousand metric tons)	Value (thousands)	Unit value	Quantity (thousand metric tons)	Value (thousands)	Unit value
Construction:						
Coarse aggregate (+1½ inch):						
Macadam	22	$383	$17.43	W	W	W
Riprap and jetty stone	89	1,440	16.22	77	$1,150	$15.03
Filter stone	16	172	10.76	W	W	W
Unspecified coarse aggregate	--	--	--	W	W	W
Coarse aggregate, graded:						
Concrete aggregate, coarse	2,240	20,100	8.96	540	5,430	10.04
Bituminous aggregate, coarse	193	2,080	10.75	17	122	7.09
Railroad ballast	W	W	W	W	W	W
Unspecified graded coarse aggregate	--	--	--	W	W	W
Fine aggregate (-⅜ inch):						
Stone sand, concrete	W	W	W	9	43	4.96
Stone sand, bituminous mix or seal	164	1,100	6.71	W	W	W
Screening, undesignated	280	1,770	6.31	163	1,740	10.69
Unspecified fine aggregate	--	--	--	W	W	W
Coarse and fine aggregates:						
Graded road base or subbase	2,510	16,000	6.35	903	5,970	6.60
Unpaved road surface	1	8	8.15	167	2,010	12.06
Terrazzo and exposed aggregate	W	W	W	--	--	--
Crusher run or fill or waste	W	W	W	14	98	7.02
Unspecified coarse and fine aggregates	10	79	7.91	1,130	9,850	8.71
Agricultural:						
Agricultural Limestone	287	4,040	14.06	550	9,070	16.48
Poultry grit and mineral food	--	--	--	W	W	W
Unspecified and other agricultural uses	58	220	3.80	90	339	3.76
Chemical and metallurgical:						
Cement manufacture	4,310	11,300	2.63	W	W	W
Lime manufacture	W	W	W	W	W	W
Flux stone	218	1,440	6.61	W	W	W
Sulfur oxide removal	W	W	W	W	W	W
Special:						
Whiting or whiting substitute	--	--	--	W	W	W
Other fillers or extenders	W	W	W	--	--	--
Other miscellaneous uses and specified uses not listed						
Unspecified:[2]						
Reported	836	3,540	4.23	4,350	34,100	7.84
Estimated	10,200	68,600	6.72	3,510	23,200	6.61
Total or average	24,900	168,000	6.77	26,700	193,000	7.22

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.
[2]Reported and estimated production without a breakdown by end use.

TABLE 4
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2012, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch)[2]	W	W	W	W	W	W
Coarse aggregate, graded[3]	W	W	W	W	W	W
Fine aggregate (-⅜ inch)[4]	W	W	W	W	W	W
Coarse and fine aggregates[5]	W	W	W	W	W	W
Other construction materials	--	--	--	--	--	--
Agricultural[6]	1	36	W	W	W	W
Chemical and metallurgical[7]	W	W	W	W	--	--
Special[8]	--	--	W	W	--	--
Other miscellaneous uses and specified uses not listed	--	--	--	--	--	--
Unspecified:[9]						
Reported	--	--	--	--	836	3,540
Estimated	6,260	47,100	1,430	7,550	2,540	14,000
Total	7,770	57,500	10,300	64,100	6,790	46,900

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes macadam, riprap and jetty stone, and filter stone.
[3]Includes concrete aggregate (coarse), bituminous aggregate (coarse), and railroad ballast.
[4]Includes stone sand (concrete), stone sand (bituminous mix or seal), and screening (undesignated).
[5]Includes graded road base or subbase, unpaved road surface, terrazzo and exposed aggregate, crusher run, and unspecified coarse and fine aggregates.
[6]Includes agricultural limestone and other agricultural uses.
[7]Includes cement manufacture, lime manufacture, flux stone, and sulfur oxide removal.
[8]Includes other fillers or extenders.
[9]Reported and estimated production without a breakdown by end use.

TABLE 5
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2013, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch)[2]	W	W	188	727	W	W
Coarse aggregate, graded[3]	W	W	W	W	W	W
Fine aggregate (-⅜ inch)[4]	W	W	W	W	W	W
Coarse and fine aggregates[5]	1,110	8,910	1,020	8,370	W	W
Other construction materials	--	--	--	--	--	--
Agricultural[6]	W	W	W	W	W	W
Chemical and metallurgical[7]	W	W	W	W	--	--
Special[8]	--	--	W	W	--	--
Other miscellaneous uses and specified uses not listed	--	--	--	--	--	--
Unspecified:[9]						
Reported	(10)	(10)	--	--	4,350	34,100
Estimated	--	--	1,320	8,730	2,190	14,500
Total	8,340	72,100	11,400	69,400	6,920	51,100

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes macadam, riprap and jetty stone, and filter stone.
[3]Includes concrete aggregate (coarse), bituminous aggregate (coarse), and railroad ballast.
[4]Includes stone sand (concrete), stone sand (bituminous mix or seal), and screening (undesignated).
[5]Includes graded road base or subbase, unpaved road surface, terrazzo and exposed aggregate, crusher run, and unspecified coarse and fine aggregates.
[6]Includes agricultural limestone and other agricultural uses.
[7]Includes cement manufacture, lime manufacture, flux stone, and sulfur oxide removal.
[8]Includes other fillers or extenders.
[9]Reported and estimated production without a breakdown by end use.
[10]Less than ½ unit.

TABLE 6
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2012,
BY MAJOR USE CATEGORY[1]

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	3,120	$18,700	$5.99
Plaster and gunite sands	129	482	3.74
Concrete products (blocks, bricks, pipe, decorative, and so forth)	4	38	9.50
Asphaltic concrete aggregates and other bituminous mixtures	2,080	14,300	6.88
Road base and coverings	5,260	28,900	5.49
Road and other stabilization (cement)	51	341	6.69
Road and other stabilization (lime)	194	1,680	8.66
Fill	2,180	6,420	2.94
Snow and ice control	171	684	4.00
Railroad ballast	30	265	8.83
Other miscellaneous uses[2]	333	2,220	6.67
Unspecified:[3]			
Reported	4,170	24,700	5.92
Estimated	13,900	74,900	5.39
Total or average	31,600	173,000	5.47

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes filtration.
[3]Reported and estimated production without a breakdown by end use.

TABLE 7
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2013,
BY MAJOR USE CATEGORY[1]

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	1,910	$12,500	$6.54
Plaster and gunite sands	63	178	2.83
Concrete products (blocks, bricks, pipe, decorative, and so forth)	55	372	6.76
Asphaltic concrete aggregates and other bituminous mixtures	1,510	9,310	6.18
Road base and coverings	3,780	17,500	4.62
Road and other stabilization (cement)	28	171	6.11
Road and other stabilization (lime)	182	1,930	10.62
Fill	2,580	7,090	2.75
Snow and ice control	220	823	3.74
Railroad ballast	22	250	11.36
Other miscellaneous uses[2]	137	1,190	8.68
Unspecified:[3]			
Reported	5,250	31,200	5.95
Estimated	18,600	115,000	6.16
Total or average	34,300	197,000	5.74

[1]Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.
[2]Includes filtration.
[3]Reported and estimated production without a breakdown by end use.

TABLE 8
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2012, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (including concrete sand)	280	2,150	375	1,970	2,470	14,600
Concrete products (blocks, bricks, pipe, decorative, and so forth)[2]	5	46	1	6	127	468
Asphaltic concrete aggregates and other bituminous mixtures	351	2,420	209	1,420	1,530	10,400
Road base and coverings	2,170	11,800	853	4,260	2,230	12,800
Road and other stabilization (cement and lime)	27	180	49	293	169	1,550
Fill	72	256	143	317	1,960	5,850
Other miscellaneous uses[3]	65	391	142	676	328	2,110
Unspecified:[4]						
Reported	15	181	64	397	4,090	24,100
Estimated	559	3,120	3,110	17,300	10,300	54,400
Total	3,550	20,500	4,940	26,700	23,200	126,000

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes plaster and gunite sands.
[3]Includes filtration, railroad ballast, and snow and ice control.
[4]Reported and estimated production without a breakdown by end use.

TABLE 9
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2013, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (including concrete sand)	241	2,860	342	2,020	1,330	7,610
Concrete products (blocks, bricks, pipe, decorative, and so forth)[2]	9	129	1	6	108	415
Asphaltic concrete aggregates and other bituminous mixtures	112	693	283	2,000	1,110	6,620
Road base and coverings	1,480	5,930	847	3,230	1,450	8,310
Road and other stabilization (cement and lime)	--	--	7	28	203	2,080
Fill	86	237	146	405	2,350	6,450
Other miscellaneous uses[3]	63	482	98	497	219	1,280
Unspecified:[4]						
Reported	53	140	5	60	5,190	31,000
Estimated	798	5,150	4,660	29,300	13,100	80,100
Total	2,850	15,600	6,390	37,500	25,100	144,000

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes plaster and gunite sands.
[3]Includes filtration, railroad ballast, and snow and ice control.
[4]Reported and estimated production without a breakdown by end use.