



BUREAU OF MINES ★ UNITED STATES DEPARTMENT OF THE INTERIOR
IN COOPERATION WITH
MISSOURI DEPARTMENT OF NATURAL RESOURCES

MINERALS IN THE ECONOMY OF MISSOURI

This current report has been prepared by the Bureau of Mines, U.S. Department of the Interior, to—

1. Provide the latest available data and information on the mineral industry of Missouri.
2. Invite comment, revisions, or additional information on the subject.

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MINERALS IN THE ECONOMY OF MISSOURI

INTRODUCTION

Missouri (area 68,995 square miles, population 4.7 million) is an important agricultural and mining State; however, 70 percent of its population live in urban areas with the two principal metropolitan areas, St. Louis--St. Louis County and Kansas City--Jackson County, accounting for approximately 50 percent. The 1977 preliminary value of mineral production amounted to over \$880 million with metals accounting for nearly 50 percent; nonmetals or industrial minerals, 43 percent; and mineral fuels, chiefly coal, 8 percent. About 600 sites were operated by the mining industry, which employed nearly 9,500 persons and had a payroll of over \$225 million.

Nationally, Missouri ranked 21st in total mineral production among the 50 States and is in the top 10 in nonfuel mineral production. The State leads the Nation in the production of lead and refractory clays and ranks second in barite and zinc, third in lime, fourth in stone, and fifth in cement. Comparison of the 1976 and 1977 preliminary production and value is shown in table 1.

GENERAL MINERAL SITUATION

With the exception of iron ore, the Missouri mineral industry was generally in fair to good condition during 1977. The value of mineral production, \$883 million, was nearly a 13-percent increase over that of 1976, and for the 16th consecutive year the total value was an alltime high. Values for each of the 3 mineral commodity groups--metals, nonmetals, and mineral fuels--showed significant increases over 1976 levels, and of the 14 mineral commodities for which production could be reported, only 4, iron ore, natural gas, stone, and zinc, showed declines. Unit values dropped for five commodities, barite, copper, iron ore, natural gas, and zinc, and increased for all the others with the largest percentages registered by lead (33 percent), clay (24 percent), and lime (22 percent).

Lead was the leading mineral commodity in terms of revenue (35 percent of the State's total value) followed by cement, stone, coal, lime, zinc, iron ore, sand and gravel, clays, copper, and silver. Largest tonnages of marketable minerals were for stone, sand and gravel, coal, and cement.

The value of the nonfuel mineral production in Missouri was approximately \$175 per capita compared with a national average of \$83; the value per square mile amounted to \$11,800 compared with a national average of \$4,800.

Metallic Minerals

The State's 1977 metal production exclusive of iron ore was valued at \$390 million, an increase of 22 percent over the 1976 level. Missouri continued as the major lead-mining State supplying approximately 82 percent of the Nation's mine production of lead. The 500,000 tons produced continued at the 1976 level but was 62,000 tons below the 1974 record high. The 1977 lead value of \$307 million is a record high and reflects an increase in lead price from 28 cents to 33 cents per pound during the year.

TABLE 1. - Mineral production in Missouri¹

Mineral	1976		1977 ^P	
	Quantity	Value, thousand dollars	Quantity	Value, thousand dollars
Barite.....thousand short tons..	124	3,860	148	3,694
Cement:				
Masonry.....do.....	76	2,718	80	3,042
Portland.....do.....	4,353	142,976	4,736	164,862
Clays.....do.....	2,133	14,915	2,352	20,390
Coal (bituminous).....do.....	6,075	56,934	6,626	69,507
Copper (recoverable content of ores, etc.)....short tons..	11,050	15,382	11,737	15,681
Iron ore (usable).....thousand long tons, gross weight..	2,133	W	1,585	W
Lead (recoverable content of ores, etc.).....short tons..	500,991	231,458	500,255	307,157
Lime.....thousand short tons..	1,731	49,907	1,748	61,393
Natural gas.....million cubic feet..	29	10	15	5
Petroleum (crude).....thousand 42-gallon barrels..	61	W	73	W
Sand and gravel.....thousand short tons..	15,375	26,550	15,400	27,600
Silver (recoverable content of ores, etc.).thousand troy ounces	2,277	9,905	2,363	10,916
Stone.....thousand short tons..	47,546	98,327	45,466	96,526
Zinc (recoverable content of ores, etc.).....short tons..	83,530	61,812	81,690	56,203
Value of items that cannot be disclosed: Asphalt (native), phosphate rock, and values indicated by symbol W.....	XX	70,406	XX	46,359
Total.....	XX	785,160	XX	883,463

^P Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

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

TABLE 2. - Missouri's role in U.S. mineral supply in 1977

Major commodity	Production	Share of U.S. output, percent	Rank in Nation	Reserves
Lead (recoverable content of ores, etc.)....short tons..	500,255	84	1	Moderate.
Fire clay.....thousand short tons..	124	29	1	Do.
Zinc (recoverable content of ores, etc.)....short tons..	81,690	18	2	Do.
ω Barite.....thousand short tons..	124	9	2	Do.
Lime.....do.....	1,748	8	3	Large.
Portland cement.....do.....	4,736	6	5	Do.
Iron ore (usable)....thousand long tons, gross weight..	1,585	3	5	Moderate.
Silver (recoverable).....thousand troy ounces..	2,363	6	6	Do.
Stone.....thousand short tons..	45,466	5	7	Large.

Copper, silver, and zinc are byproducts of lead mining in Missouri, and as such, their production is more dependent upon the lead market and its production than on the copper-silver-zinc markets. Although the market for lead was strong, the unit value of both copper and zinc declined during the year from 65 to 60 and from 37 cents to 35.5 cents per pound, respectively. Production of copper increased by 6 percent and zinc dropped by 2 percent. The average unit value of silver, which is recovered at the smelters from the zinc and lead concentrates, increased 24.6 cents over that of 1976. Production also increased by 86,000 (nearly 4 percent) troy ounces. The combined value of the lead, zinc, copper, and silver produced accounted for 44 percent of the State's mineral production value and slightly over 60 percent of this production was mined from lands leased from the Federal Government (U.S. Forest Service--Mark Twain National Forest).

The Federal Government owns 1.45 million acres of acquired lands in the Mark Twain National Forest, and mineral leases were held on 35,226 acres. Mineral lease rentals and mineral production royalties of over \$7 million were paid to the Federal Government in 1977 by the mining companies. A part of these payments are returned to the State for use by the counties for education and highways. All of the counties in which acquired lands are located receive a share of the payment whether or not minerals are produced in the particular county. All of the lead-zinc-copper-silver production is from four counties: Crawford, Iron, Reynolds, and Washington. These counties contain 4 percent of the land area in the State, of which the Federal Government owns 17 percent. Less than 10 percent of the Federally owned lands in these counties is under mineral lease. From this small area, less than one-tenth of 1 percent of the area of the State, over 60 percent of the State's lead, zinc, copper, and silver production is derived.

TABLE 3. - Missouri's land ownership and mineral production

	Ownership, percent	Percent of State mineral production value
Federal lands.....	4.9	26
State lands.....	1.8	-
Private lands.....	93.3	74
Total.....	100.0	100

In addition to the lead mines, there are three lead smelters located in the State. Combined capacity of these smelters is 480,000 tons per year pig lead, which is nearly 70 percent of the total U.S. lead smelter capacity.

Iron ore shipments from the State's two underground mines dropped by approximately 25 percent from the 1976 level. This paralleled world production, trade, and consumption of iron ore, all of which declined in 1977 as a result of reduced demand for steel in the United States, Europe, and Japan. Cutbacks in ore production and rising levels of stocks were reported from several major producing countries. In the United States, the relatively low demand for ore was partially due to increased imports of steel, although a marked decline in production was caused by strikes which idled most mines in

the Lake Superior district from August 1 until late in the year. Even with the strike in the Lake Superior district, the Missouri mines had difficulty in marketing their pellets. This resulted in a 5-week shutdown by Pilot Knob Pellet Co. and a 6-week shutdown by Meramec Mining Co. during the summer to reduce iron pellet stock. Pilot Knob Pellet Co. announced a similar 3-week shutdown at the end of the year, and in December, Meramec Mining Co. announced the closing of its Pea Ridge mine and the layoff of approximately 1,000 workers. Pea Ridge mine is the largest underground iron ore mine in the United States. The mill and pelletizing plant, owned by St. Joe Minerals Corp., have been placed on standby for a year while future market conditions and possible reopening are investigated. The closing of the Pea Ridge mine has been a blow to the local economy. Washington County received over \$800,000 in taxes from the Pea Ridge operations in 1977, and the permanent closing of this mine will result in a substantial reduction of future tax receipts.

The aluminum reduction plant at New Madrid, with two potlines rated at 70,000 tons per year, operated at near maximum capacity throughout the year providing employment to 850 persons. A new labor contract was negotiated during the year.

Nonmetallic and Industrial Minerals

Production increases were reported by all nonmetallic mineral commodities except stone, which fell nearly 5 percent below the 1976 level. The total value for nonmetals amounted to \$377 million, an 11-percent increase over that of 1976. Unit values for all commodities except barite showed increases. Barite showed the largest percentage increase in production--nearly 20 percent--but it declined by 10 percent in unit value. The increase in barite production reflects the increased consumption of barite as a weighting agent in oil well drilling mud.

Cement production had the largest value, \$168 million, of the nonmetallic minerals. Production increased by 9 percent over that of 1976 to a record high of 4.8 million tons. Six of the State's seven cement plants are located on the Mississippi-Missouri waterway and are able to ship cement considerable distances; as a result, their market is not necessarily controlled by local economic conditions. During the year the Marquette Cement Co. announced plans to replace its Cape Girardeau facility with a new 1-million-ton-per-year plant. Total investment is placed at \$80 million and the estimated on-stream date is 1980.

Three lime plants are active in the State; two produce high-calcium quicklime and hydrated lime and the third produces dolomitic quicklime and dead-burned dolomite. Lime production was just slightly above the 1976 level; however, the 1977 value increased by 23 percent. The Mississippi Lime Co. plant at Ste. Genevieve is the largest in the United States. Principal uses of Missouri lime were in steel manufacturing, in water treatment, and by the chemical industry.

Stone production declined by nearly 5 percent below the 1976 level; however, because of an increase in unit value, the total value dropped only 2 percent. The bulk of the stone produced in Missouri is limestone (including

dolomite) with approximately 99 percent being crushed and broken. Other types of stone mined in the State are granite, felsite, sandstone, and marble. Major uses of stone are as construction aggregates (asphalt paving, concrete, roadstone, railroad ballast, riprap), in the manufacture of cement and lime, and in agricultural liming. Less than 1 percent of the stone production is dimension stone. The industry has taken advantage of the favorable geologic conditions for stone mining over a large portion of the State as demonstrated by the fact that 171 companies operated 287 limestone quarries and mines in 100 of the State's 114 counties. The 8 largest producers account for 40 percent of the production, 40 companies producing between 200,000 and 1 million tons each account for the next 40 percent, and the remaining 123 companies with less than 200,000 tons annual production each make up the remaining 20 percent.

Mineral Fuels

The value of mineral fuels--coal, oil, and gas--increased 25 percent over that of 1976. This increase came from coal, which rose over one-half million tons in production coupled with a 9-percent rise in unit value. Coal production set a new alltime high for Missouri of over 6.6 million tons, and production would probably have reached 7 million tons if the larger mines had not been closed by the yearend United Mine Workers of America strike.

According to the Missouri Oil and Gas Council, natural gas production all but ceased except for a few individually owned wells for private home use. Crude oil production showed an increase. Oil and natural gas combined represent less than 1 percent of the total value of mineral fuels produced in the State.

In 1977, 13 companies operated 17 mines in 8 counties. The three largest companies--Peabody Coal, Pittsburg & Midway, and Missouri Mining--accounted for 90 percent of the State's total production. Over 90 percent of the coal mined in Missouri is used in electric generation.

TRENDS AND ISSUES

The inability to acquire prospecting permits and leases on Federally owned lands for mineral development has been of prime concern to the mining industry of Missouri. Mining companies view the area south of the present lead mining district (Viburnum Trend) as being geologically favorable for metallic mineralization. Numerous prospecting permits have been applied for in accordance with procedures established under the Mineral Leasing Act of 1920 but none have been issued for several years. Any decision to lease Federal lands must now be based on results of land-use plans and environmental considerations. Because the environmental studies have not yet been made, prospecting permits have not been granted to any applicant in the Mark Twain Forest for several years.

Since operating mines are producing lead at the rate of 500,000 tons of metal per year and since no new discovery areas have been reported for a number of years, the State's existing lead reserves, which are the largest in the Nation, are on the decline. As a result of this decrease in reserves and the failure to find significant new deposits elsewhere in the United States, the generally favorable lead production posture of the Nation could be affected.

Water pollution control has been actively pursued by the mining industry. Public Law 92-500, Federal Water Pollution Control Act amendment of 1972, has as its goal the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. Section 208 of this law relates to the areawide waste treatment management including the runoff from agriculture, construction projects, industry, municipal areas, and mining areas. The mining industry, which has historically cooperated with State agencies for clean air and water, selected representatives to work on the Advisory Committee for 208 planning headed up by the Department of Natural Resources, Division of Environmental Quality. A work plan was set up and preliminary studies are being reported to citizen groups in all areas of the State. A report on the effects of coal mining is in preparation.

The final report of "An Interdisciplinary Investigation of Environmental Pollution by Lead and Other Heavy Metals From the Industrial Development in the New Lead Belt of Southeastern Missouri" which began in 1972 was published in May 1977. This two-volume report summarizes the 5-year study by the University of Missouri in cooperation with the Missouri mining industry and Federal and State agencies. The degree of cooperation between the concerned parties plus the willingness of industry to share experiences and to put suggested improvements or changes into practice set an example which would be difficult to match. The results are cleaner air and water and a demonstration that mining can exist and needed metals can be produced with little effect on the quality of the environment.

In some areas the mineral industry was not always successful in meeting air and water pollution standards. Several tailings dams at abandoned mines were eroded or topped and sediments were washed into nearby streams. In one case the owner of the land, a mining company, repaired the tailings dam area to prevent further erosion. In the other case the owner, St. Francois County, is working with the State and other parties in attempting to solve the problem.

Missouri Portland Cement Co.'s St. Louis plant was charged with violating air emission standards. The company requested a variance to allow time to carry out its \$2 million dust collection program to supplement the \$3.5 million program already completed. Ironically a variance of the noise pollution ordinance was needed to allow the company to operate its air pollution equipment which enabled it to meet the air quality standard.

NL Industries titanium pigment plant in St. Louis has had a long history of failure to meet the county's air quality standards. In June an agreement was made whereby NL was to pay \$125,000 in penalties and \$120,000 to reimburse the Federal Government for a study of the plant. Lawsuits were filed between the company and the St. Louis County air quality control group and various local residents. One stack met the requirements of the law and a variance was requested on a second. However, in October, several yellow alerts, which require a 25-percent reduction in production, and a red alert, which requires a 50-percent reduction in operations, increased the pressure against the company. The company laid off 400 employees, over half of its work force, and indicated that a further reduction was imminent. Titanium pigment requirements are expected to be made up by foreign imports.

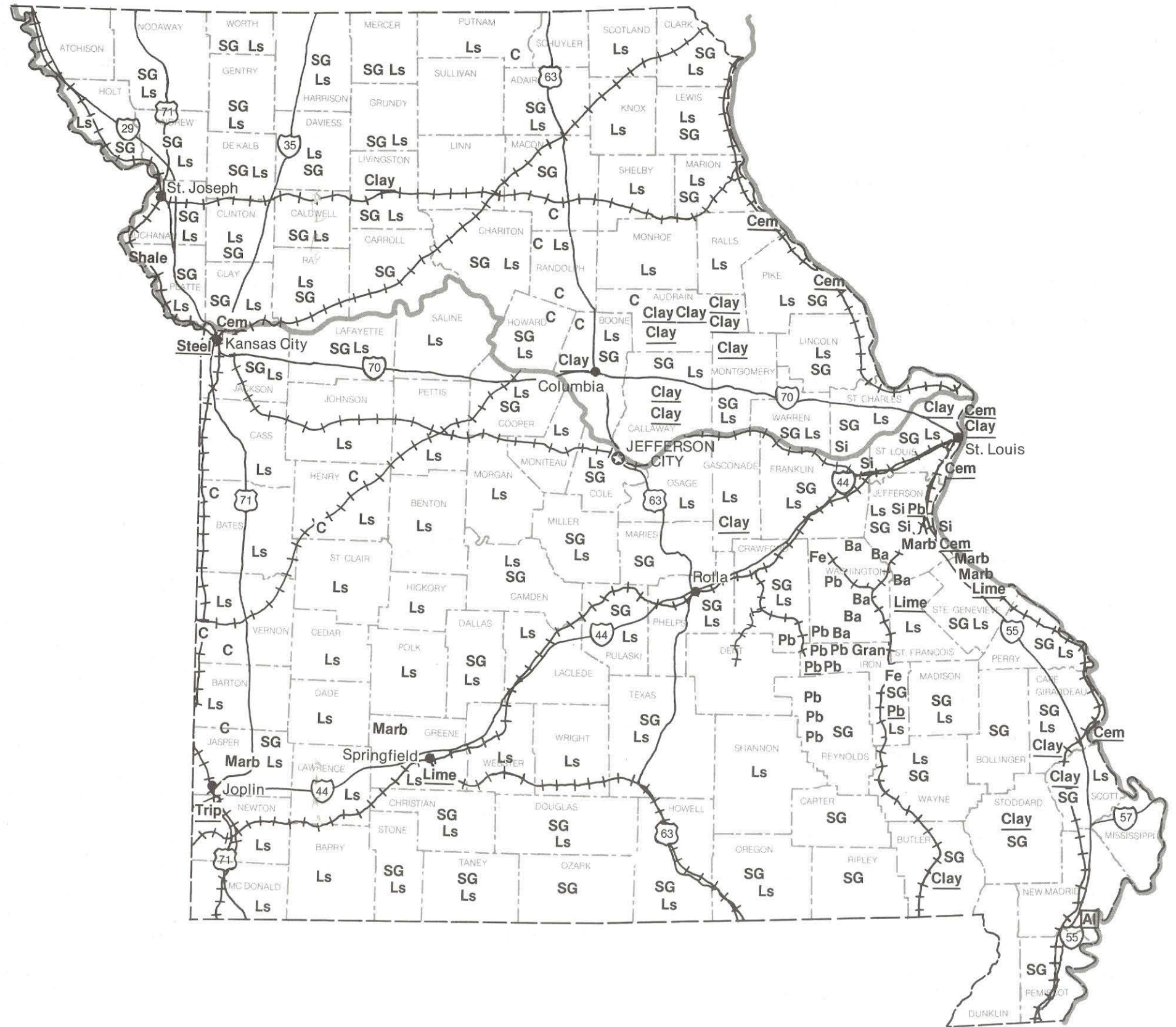
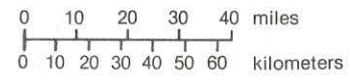
MISSOURI

LEGEND

- State boundary
- - - County boundary
- ★ Capital
- City
- Inland waterway
- + + + Railroad
- Road
- Interstate highway
- U.S. highway

Mineral Symbols

- Al** Aluminum plant
- Ba** Barite
- C** Coal
- Cem** Cement plant
- Clay** Clay products
- Fe** Iron ore
- Gran** Granite
- Lime** Lime plant
- Ls** Limestone
- Marb** Marble
- Pb** Lead ore
- Pb** Lead smelter
- SG** Sand and Gravel
- Shale** Shale
- Si** Silica sand
- Steel** Steel plant
- Trip** Tripoli



Federal Programs

Hearings by the Occupational Safety and Health Administration, U.S. Department of Labor, on proposed national ambient air standards for lead were held during the year. The Missouri lead industry is concerned that a standard be established which could be achieved reasonably and economically.

The Office of Surface Mining, U.S. Department of the Interior, held hearings in the State on the proposed interim regulations as they apply to the coal industry. Meetings were also held with the State Land Reclamation Commission, Missouri Department of Natural Resources, to discuss means of bringing the State law into compliance to enable the State to administer the Federal Act.

The U.S. Department of the Interior's Geological Survey was active in Missouri on studies involving topographic mapping surface and subsurface hydrologic conditions, earthquake hazards, and radioactive resources. The earthquake hazard study in the New Madrid area of southeast Missouri includes adjoining areas of Arkansas, Illinois, Kentucky, and Tennessee. The operational safety of nuclear reactors within the area of influence sensitive to geologic hazards is a matter of prime concern. A preliminary study of the potential uranium and thorium resources of the Precambrian igneous rocks of the St. Francois Mountains of southeast Missouri was completed and an open file report prepared. The study concluded that the granites in the area should be considered as potential source rocks for uranium deposits.

Water quality studies in the abandoned zinc mine area of southwestern Missouri were reported on by the Geological Survey. These studies indicated that the zinc content of the runoff water around some of the old tailings areas ran as high as 16,000 micrograms of dissolved zinc per liter. This study indicated that a need existed to control metal mining waste areas after mining has ceased as well as during the active mining period.

The U.S. Department of the Interior's Geological Survey and Bureau of Mines were active in several cooperative programs with the Division of Geology and Land Survey, Missouri Department of Natural Resources. The Geological Survey is involved in cooperative studies on the tar sand potential of southwestern Missouri, a geologic study of the Rolla 2° quadrangle, and in funding input of coal information into the National Coal Data System. A report entitled "Inventory of Strippable Tar Sands in Southwestern Missouri" resulted from an exploration drilling program by the State Division of Geology and Land Survey. This program was funded under a grant from the Geological Survey and is being continued under a contract from the Department of Energy (DOE). The DOE program was established to improve the estimates of the location, depth, size, and quality of heavy oil/tar sand deposits in western Missouri and to determine their geologic setting and reservoir characteristics, and the physical and chemical properties of the oil. The Rolla 2° project is a geologic study, including geochemical and geophysical evaluations, of an approximately 7,500-square-mile area in southeast Missouri. This study is particularly important since it includes much of the area of past and present lead, iron, and barite mining as well as a large part of the National Forest on which

companies are seeking permits to explore for new deposits. Bureau of Mines cooperative programs were also with the Missouri Division of Geology and Land Survey. These included the evaluation of coal reserves, ceramic potential of clays and shales, and input into the MAS Mineral Industry Location System (MILS). The coal study, funded in part by a Bureau of Mines grant, included field mapping and a drilling program of an area in north-central Missouri. A spinoff from this program was the discovery of a thick limestone bed at a relatively shallow depth in an area where the need for near-surface sources of concrete aggregate, roadstone, and agricultural stone is well-known. Selected samples of clay and shale were sent to the Bureau's Tuscaloosa, Ala., laboratory for firing tests to determine their suitability for structural clay products. Chemical and X-ray analyses were conducted by the State Survey.

State Legislation and Hearings

Severance tax bills (HB 68 and HB 463) were introduced into the State Legislature but were not brought out of the House Mines and Mining Committee.

Dam safety legislation (HB 646) proposed by the Department of Natural Resources and supported by the Mining industry was not acted upon favorably.

The mining industry has supported limited liability legislation (HB 275) but such proposals have not been acted upon. The mining industry has areas which would be suitable for hunting and fishing; however, these areas are closed to the general public because of possible liability actions which could be brought against the landowner in the event of an accident.

State Programs

The Official Manual of the State of Missouri for 1977-78 includes a 33-page feature article entitled "Underground Treasures--The Story of Mining in Missouri." The history of mining in Missouri is traced from the Indians' use of flintstone for tools and weapons, iron oxide for pigment, and clay for pottery and proceeds through the early French lead mining period in the late 18th century, through the 19th century, to the present date.

Studies were conducted on the State's limestone resources, including physical tests and chemical analyses, and on the chemical composition and rock types of the buried Precambrian igneous rocks of southeast Missouri with emphasis on potential mineralization. A report was prepared on a statewide analysis of LANDSAT 1 and 2 imagery which included recognition of a relationship between observed lineaments and mineral occurrences.

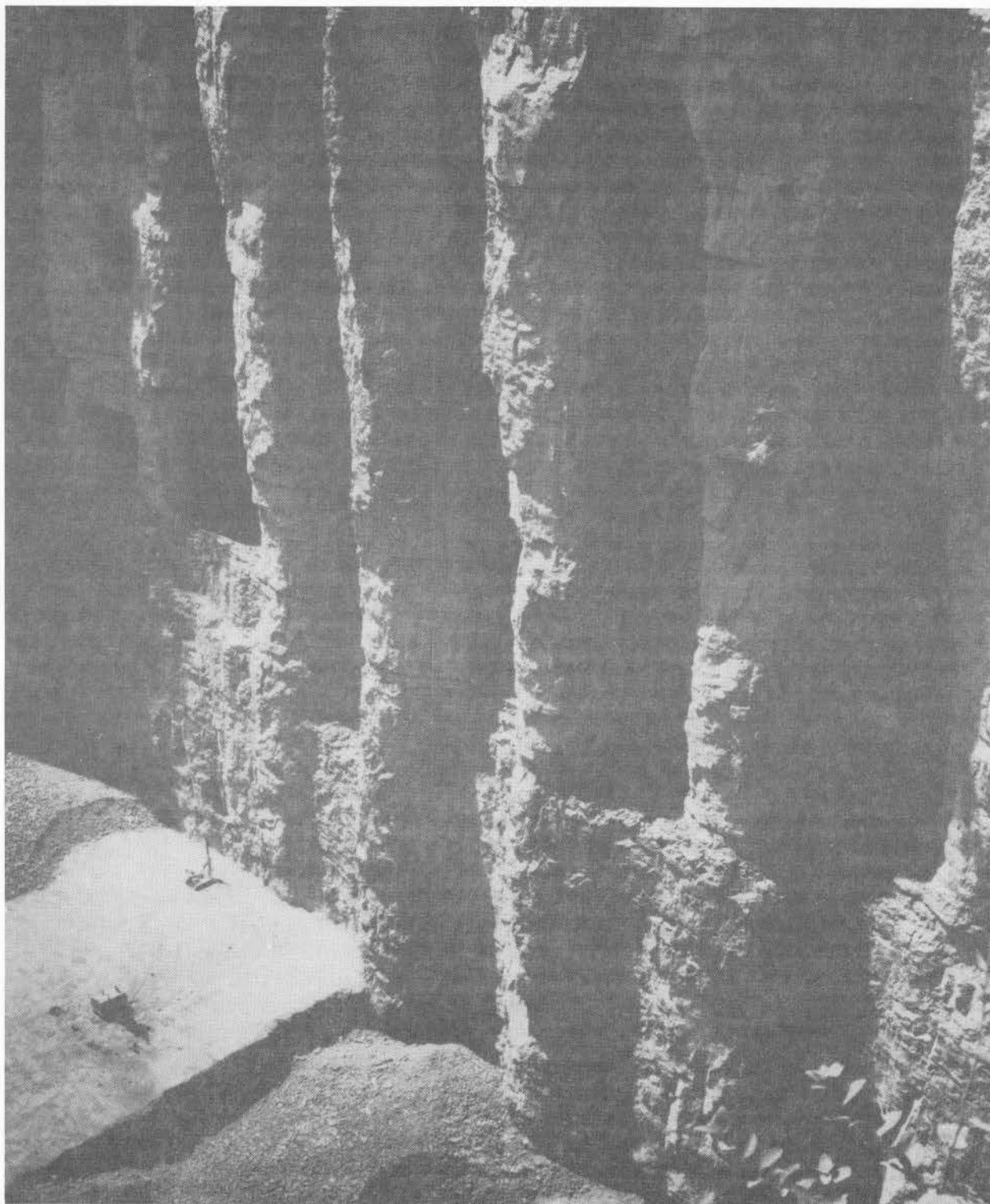


FIGURE 1. - Marquette Cement Co.'s limestone quarry in Cape Girardeau. Pit shown here is 350 feet deep. The huge portals of the underground workings were opened in the 1950's. *(Courtesy, Missouri Division of Geology and Land Survey.)*

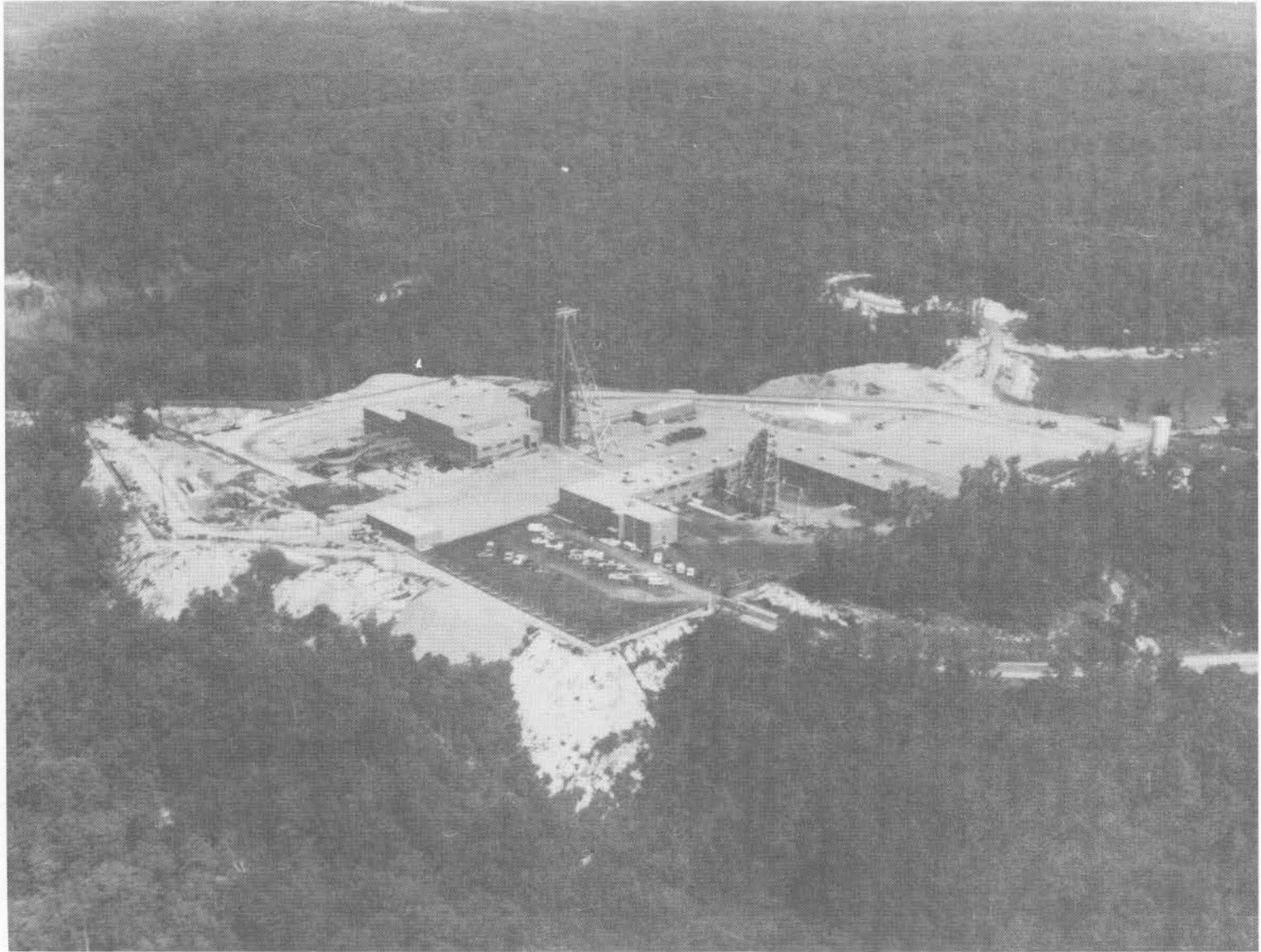


FIGURE 2. - St. Joe Minerals Corp.'s Brushy Creek lead mine and mill, Reynolds County. (*Courtesy, Missouri Division of Geology and Land Survey.*)

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