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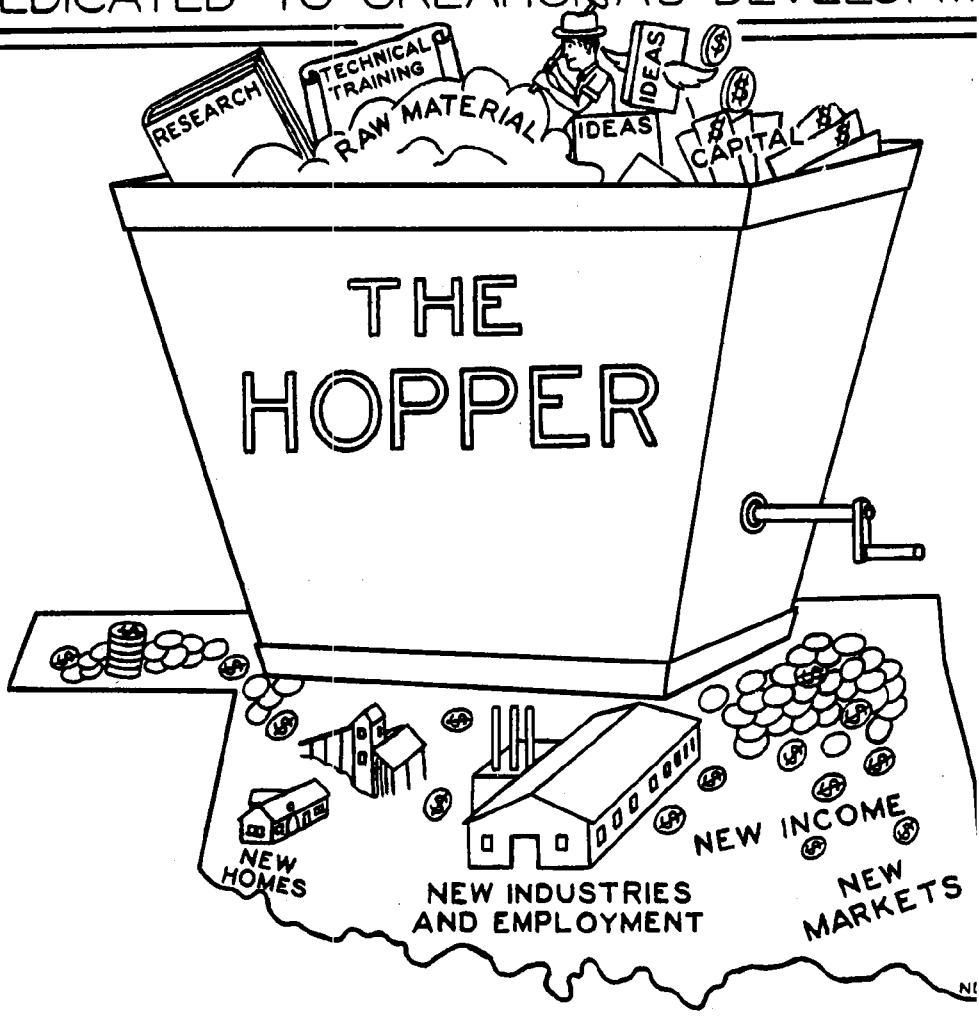

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GEOLOGY AND INDUSTRIAL MINERALS OF OKLAHOMA

by
Robert H. Dott, Director
Oklahoma Geological Survey

Geologic and Physiographic Provinces

Geologically, Oklahoma may be divided into four mountain areas, three basin areas, and four plains areas. The mountains are areas of uplift, ranging from broad arching with minor folding and faulting, to strong folding and thrust-faulting; the basins are areas of downwarp and downfolding; and the plains are distinguished mainly by the relatively gentle dip of the rocks.

These eleven provinces may be designated as follows:

TABLE I. Geologic and Physiographic Provinces of Oklahoma

Province	Location in State
Ozark Mountains	Northeastern
Ouachita Mountains	Southeastern
Arbuckle Mountains	South-central
Wichita Mountains	Southwestern
McAlester Basin	East-central
Anadarko Basin	Western
Ardmore Basin	South-central
Central Plains	Central
Southwestern Plains	Southwestern
Coastal Plain	Southeastern
High Plains	Northwestern

Subsurface Structure

Large-scale folding during Pennsylvanian time produced the structural features listed above, and

in addition, several others that are not exposed at the surface, These were truncated by erosion, and all but the highest were buried beneath younger rocks. Records of over half a million wells drilled for oil and gas give detailed information on the subsurface geology of much of the state.

Following is a generalized list of the major subsurface structural features:

TABLE II.

Major Subsurface Structural Features of Oklahoma

Feature	Location in State
Ozark uplift	Northeastern
McAlester Basin	East-central
Ouachita Uplift	Southeastern
Central Oklahoma Arch	North-central
Nemaha Ridge	North-central
Arbuckle Uplift	South-central
Anadarko-Ardmore Basin	Western and south-central
Amarillo-Wichita Uplift	Southwestern
Paladuro-Marietta Basin	Southwestern
Red River Uplift	Southwestern
Las Animas Arch	Panhandle

Stratigraphy

Rocks in Oklahoma range in age from pre-Cambrian to recent, and include a great variety of lithologic types, many of which are of actual or potential industrial value. The oldest rocks are exposed in the mountain areas, and the youngest are found in the river valleys. Table III gives the systems of rocks exposed in Oklahoma, and their distribution in the different Geologic and Physiographic Provinces (Table I):

TABLE III. Distribution of rocks exposed in Oklahoma (Oldest at the bottom)

Rock System	Distribution by Provinces (Table I).
Quaternary	
Recent	River alluvium
Pleistocene	High river terraces
Tertiary	High Plains
Cretaceous	Coastal Plains, High Plains, Anadarko Basin
Jurassic-Triassic	High Plains
Permian	Central Plains, Anadarko Basin, Wichita Mountains, Southwestern Plains, High Plains
Pennsylvanian	Ozarks, Ouachitas, Arbuckles, McAlester Basin, Ardmore Basin, Central Plains
Mississippian-Devonian-Silurian	Ozarks, Ouachitas, Arbuckles
Ordovician	Ozarks, Ouachitas, Arbuckles, Wichitas
Cambrian	Ouachitas, Arbuckles, Wichitas
pre-Cambrian	Ozarks, Arbuckles, Wichitas

Industrial Rocks and Minerals

The minerals and rocks of Oklahoma actually in production or of potential value, comprise a list of 34 items, most of which fall in the class of industrial minerals and rocks. Total value of mineral production for 1948 was $503,654,000 of which fuels, zinc, and lead accounted for $488,426,000 or 97 percent.

These minerals and their stratigraphic and geographic distribution are listed in the following table, arranged according to geologic age:

TABLE IV. Minerals of Oklahoma, showing age of enclosing rocks, and distribution.

Age	Mineral or Rock	Distribution
Pre-Cambrian:	Anorthosite	Wichitas
	Granite	Ozarks, Arbuckles, Wichitas*
	Kaolin	Wichitas
	Titaniferous iron ore	Wichitas
Cambrian:	Dolomite	Arbuckles* Wichitas
	Hematite (paint pigment)	Wichitas*
	Limonite	Arbuckles
	Phyllite (yellow and black)	Ouachitas
	Quartz (vein)	Ouachitas
	Rock wool materials	Arbuckles
	Zinc	Arbuckles
Ordovician:	Asphalt (rock)	Arbuckles*
	Calcite (vein)	Wichitas*
	Cement materials	Arbuckles*
	Dolomite	Arbuckles, Wichitas
	Glass sand	Arbuckles* Ozarks
	Limestone (chemical)	Arbuckles
	Limonite	Arbuckles
	Petroleum	general
	Phyllite (yellow)	Ouachitas
	Quartz (vein)	Ouachitas
	Stone (crushed)	Ouachitas*, Arbuckles*, Wichitas*
Silurian:	Limestone (chemical)	Ozarks
	Manganese	Arbuckles
	Petroleum	general*

Devonian:	Novaculite	Ouachitas
	Petroleum	general*
Mississippian:	Chats	Ozarks*
	Grahamite	Ouachitas
	Limestone (chemical)	Ozarks
	Manganese	Ouachitas
	Novaculite	Ouachitas
	Petroleum	general*
	Rock wool material	Ozarks
	Tripoli	Ozarks*
	Volcanic tuff	Ouachitas
	Lead-zinc ores	Ozarks*
Pennsylvanian:	Asphalt (rock)	Arbuckles, Ardmore Basin, Ouachitas
	Brick clay	general*
	Cement materials	Central Plains*
	Coal	McAlester Basin*, Central Plains*
	Gravel (conglomerate)	Central Plains*
	Impsonite	Ouachitas
	Limestone (chemical)	Arbuckles
	Petroleum	general*
	Stone (crushed)	general*
	Rock wool materials	general
Permian:	Brick clay	general*
	Gypsum	Anadarko Basin*, Southwestern Plains
	Montmorillonite	Wichitas
	Petroleum	general*
	Rock wool materials	Anadardo Basin
	Salt	Anadarko Basin*

Cretaceous:	Petroleum*	Coastal Plain
	Rock wool materials	
	Stone (crushed)*	
Tertiary:	Metabentonite*	High Plains
	Rock wool materials (caliche)	
	Sand and Gravel*	
	Volcanic ash	
Recent:		
Pleistocene terraces	Rock wool material (caliche)	Wichitas
	Sand and gravel	general*
	Volcanic ash	general, Northwestern Oklahoma*
River alluvium:		
	Sand and gravel	general*
	Titaniferous magnetite (black sands)	Wichitas

*In Production.

There are a number of miscellaneous mineral materials that should be mentioned, though most of them are of no commerical value at this time, and some are not likely to be unless discovered in much greater quantities than are now known. Agricultural limestone is being produced from strata of many different ages, and in many parts of the state: some of it is quarried and prepared specifically for the agricultural market, much of it recovered as a byproduct from crushers preparing stone for other uses. Both limestone and sandstone are quarried extensively in several parts of the state for building stone. Cadmium, indium, and germanium are recovered from smelting zinc ores.

Among the minerals of lesser or questionable

importance are barite, celestite, copper, phosphate, and zircon, and some oil field brines are known to contain barium, strontium, and boron, in addition to sodium, calcium, and magnesium.

A substantial proportion of Oklahoma's manufacturing is based on mineral raw materials, and most of these industries were first established here because of the combination of raw materials and natural gas. The products of mineral manufacturing in the state excluding petroleum, include: glass, gypsum products, cement, brick and tile, lime, pottery, mineral wool insulation, monuments, and concrete products. The value added by manufacturing in mineral processing industries is given in Table V.

TABLE V. Manufacturing in Oklahoma based on mineral raw materials, 1947 (U. S. Bureau of the Census, Census of Manufacturing, 1947)

Major Industry Group:	Value Added by Manufacturing
Chemicals and allied products	$12,100,000
Petroleum products	79,900,000
Stone, clay and glass products	23,400,000
Primary metals industry	16,400,000
	$131,800,000
All Industry Groups:	$340,500,000

On the basis of these figures, processing of mineral raw materials constituted 37.5 percent of the manufacturing in Oklahoma in 1947. Processing of industrial minerals, principally included in the group entitled "stone, clay and glass products," made up 7 percent of total manufacturing. A breakdown probably would show glass products to be the major item in this group, and this is the fastest-growing phase of the state's mineral processing industry.

Production and Value, 1949*, and Potential Production

Commodity	Quantity	Value	
Anorthosite	NP	.....	
Asphalt (native) ..... short tons	(1)	(1)	
Calcite	(1)	(1)	
Cement ..... barrels	(1)	(1)	
Chats	(1)	(1)	
Clay			
Products, heavy clay (other than pottery and refractories).....	.....	1,999,000	2
Raw (sold or used)..... short tons	480,199	374,179	3
Coal ..... do	2,510,000	12,023,000	
Dolomite	(4)	(4)	
Glass sand	(5)	(5)	
Grahamite	NP[6]	.....	
Granite	(4)	(4)	
Gypsum (crude) ..... do	(1)	(1)	
Hematite	(1)	(1)	
Impsonite	NP[6]	.....	
Kaolin	NP	.....	
Lead ..... do	19,858	6,275,128	
Lime ..... do	(1)	(1)	
Limonite	NP[6]	.....	
Manganese	NP[6]	.....	
Metabentonite	(1)	(1)	
Montmorillonite	NP	.....	

Mineral waters	.....	(7)	(7)
Natural gas (estimated value at wells)	M cubic feet	432,516,000	21,626,000
Natural gasoline and allied products:			
Natural gasoline	gallons	291,000,000	18,372,000
Liquefied petroleum gases	do	238,939,000	7,909,000
Novaculite	.....	NP	.....
Ores (crude), etc.:			
Lead	short tons	78,351	(5)
Zinc	do	1,394,404	(5)
Zinc-lead	do	2,121,666	(5)
Petroleum	barrels	151,902,000	388,870,000
Phyllite	.....	NP	.....
Pumice	short tons	(1)	(1)
Quartz (vein)	.....	NP	.....
Rock wool material	.....	NP[6]	.....
Salt	do	(1)	(1)
Sand gravel	do	2,921,157	1,525,415
Sand and sandstone (ground)	do	(1)	(1)
Stone	do	4,341,930	4,027,409
Sulfuric and (basis, 100 percent)[8]	do	(1,9)	(1,9)
Titanium ore	.....	NP	.....
Tripoli	.....	(1)	(1)
Volcanic ash	.....	(1)	(1)
Zinc	do	44,033	10,920,184
Miscellaneous[10]	.....	.....	9,090,222
Total value, eliminating duplications			$482,253,000

Footnotes on next page.

Footnotes:

*Data obtained in cooperation with U. S. Bureau of Mines.
1. Included under miscellaneous.
2. Does not include pottery or refractories. Value obtained through Bureau of the Census.
3. Sold or used; value of clay used in cement and heavy clay products included here, but not in total value.
4. Included with stone.
5. Included with sand and gravel.
6. Has been produced in the past.
7. No canvass.
8. From zinc smelting.
9. Value not included in total value.
10. Includes minerals indicated by footnote 1 above.

NP No production.