Inventory of Industrial, Metallic, and Solid-Fuel Minerals in Kansas

By Ronald G. Hardy

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ABSTRACT

Kansas ranks among the upper one-quarter of the states in the U.S. in the value of mineral production. This report summarizes the type, location, and use of (1) principal industrial minerals, such as limestone, clay, and gravel, (2) metallic minerals, and (3) solid fuels (coal and lignite) in Kansas. Resources of crude oil, natural gas, and water are treated extensively in other Survey publications.

INTRODUCTION

Since 1918, sufficient minerals have been extracted from Kansas to enable it to rank among the top one-quarter of states in the U.S. in value of mineral production. The 1965 mineral values for the twelve leading states on current dollar basis are recorded in Table 1; Kansas ranked eleventh.

For Kansas, the principal minerals in order of value in 1965 were crude oil, natural gas, helium, and natural-gas liquids. In addition, production included limestone, clay and shale, coal, lead (galena), salt (halite), sand and gravel, zinc (sphalerite), gypsum, volcanic ash, and diatomaceous marl.

The contribution of the mineral industry to the economy of Kansas is considerable because minerals can be increased from low to high value by processing. For example, volcanic ash has a low in-place value; however, by converting it into specialized products, its market value may reach $75 per ton. In general, the mineral industry supplies raw materials for industries that produce high value-added products, such as the chemical industries. Kansas has no unique minerals. In order to be of maximum aid to the Kansas economy the available minerals must be upgraded as much as possible.

The analysis of past and present trends in mineral production can be an aid to the prediction of future trends. Some gross relationships between construction contracts, population growth, and mineral values for the United States and Kansas are shown in Figure 1. Projections of the rate of increase in population to 1975 are

TABLE 1.—Twelve leading states in the U.S. in value of mineral production, 1965.

State	Rank	Total mineral value*, 1965 U.S. dollars	Total population†, thousands	Per capita value	Area†, sq mi	Value per sq mi
Texas	1	$4,708,709,000	10,547	$446	267,339	$17,613
Louisiana	2	2,978,855,000	3,554	838	48,523	61,391
California	3	1,599,388,000	18,400	87	158,693	10,079
Pennsylvania	4	913,823,000	11,587	79	45,333	20,158
Oklahoma	5	907,914,000	2,456	370	69,919	12,985
West Virginia	6	859,604,000	1,817	473	24,181	35,549
New Mexico	7	773,274,000	1,013	763	121,666	6,356
Illinois	8	593,025,000	10,638	56	56,400	10,515
Arizona	9	580,182,000	1,575	368	113,909	5,093
Michigan	10	565,560,000	8,322	68	58,216	9,715
Kansas	11	553,491,000	2,248	246	82,264	6,728
Minnesota	12	507,760,000	3,558	143	84,068	6,040
U.S.		$21,433,000,000	193,815	$111	3,615,123	$5,929

* U.S. Bureau Mines, Mineral Yearbook, v. 3, 1965, Table 4, p. 8.
† Statistical Abstracts of the United States, 1968, 89th Ed.: U.S. Bureau Census, Wash., D.C., Table 11, p. 12.

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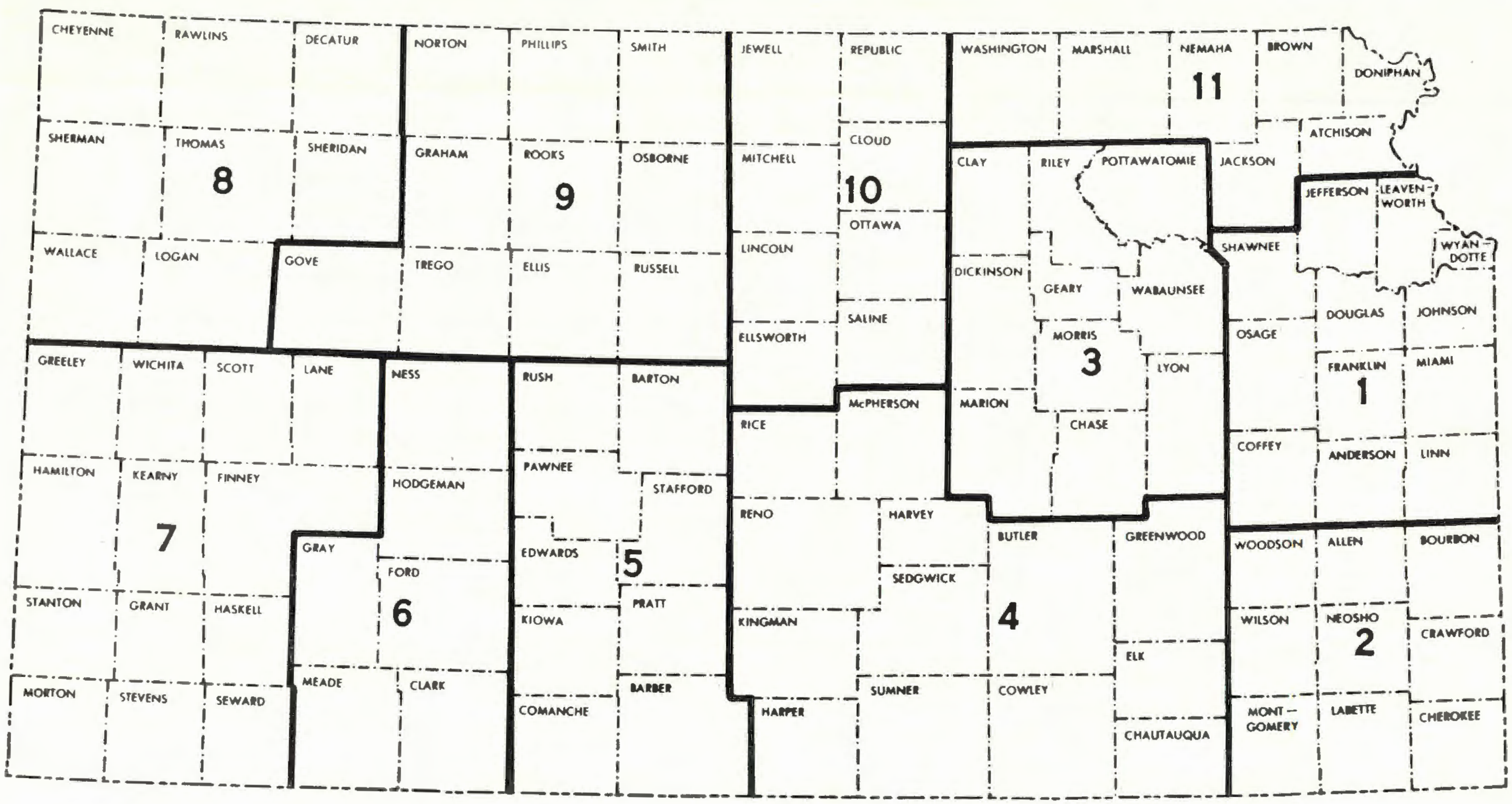

FIGURE 2.—Regions designated in Kansas for purposes of economic studies. (Kansas Econ. Develop. Comm., 1960, p. 26).

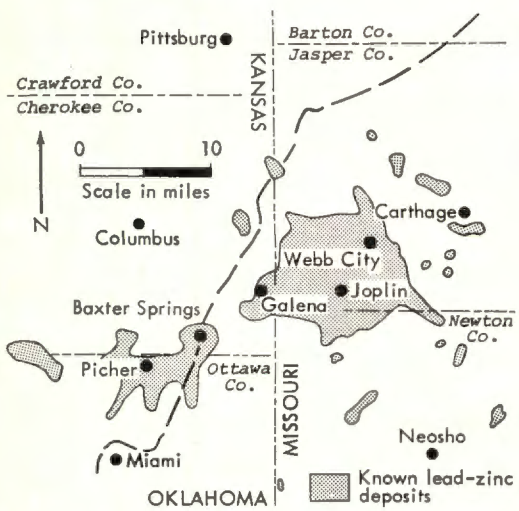

FIGURE 4.—Tri-State lead- and zinc-mining area. (Dashed line is approximate boundary between Mississippian-Pennsylvanian outcropping rocks.) (Kansas Econ. Develop. Comm., 1962, p. 52.)

All are Mississippian in age. The mines are 150 to 400 feet deep.

Reserves.—At present, known ore bodies are classified as "exhausted." Reserves of zinc have declined similarly.

Magnesium

Magnesium is present in high concentrations in subsurface brines and in dolomitic rocks. Reconnaissance studies of available data pertaining to Kansas oil-field brines have shown that over a wide area there are natural brines having a magnesium content several times that of seawater. Several hundred water analyses indicate brines of 25 pounds of magnesium per 1,000 gallons of liquid; seawater has a magnesium content of less than 12 pounds per 1,000 gallons of water.

Location and age.—Near-surface deposits of dolomite occur in central and southern Kansas in Rice, Reno, Kingman, Harper, and Clark counties. Magnesium brines are obtained as a by-product in the production of oil. Deposits of dolomite mentioned above are Permian in age and are found in the Stone Corral Formation and the Day Creek Dolomite. Many of the rocks of early Mississippian age and older are dolomitic.

Present and potential uses.—No magnesium is currently being extracted from Kansas sources. Magnesium is used as a desulfurizing agent in the manufacture of metals and alloys. Improved techniques of alloy production with magnesium should increase its use in structural materials. Increased steel production by the basic oxygen-reduction method should increase the need for basic refactories of high magnesium content. In addition, requirements for magnesium compounds in such large industries as paper, rubber, textiles, and chemicals are expected to rise rapidly in the future.

Reserves.—Extremely large quantities of useful brines are available in Kansas, and conservative estimates indicate that at least 16 million tons of dolomite can be mined easily by stripping methods.

INDUSTRIAL MINERALS

Clay

Clay is a fairly widespread mineral resource in Kansas (Fig. 5). Of particular commercial interest are the clays of the Dakota Formation, which are made up of approximately one-third white- to buff-firing clays and two-thirds dark buff- to red-firing clays. The clay mineral in these beds is predominantly kaolinite. The clays are somewhat pyritic, but definitely noncalcareous. Ceramic tests and chemical analyses indicate that the white- to buff-firing clays may be classed as kaolin, ball clay, plastic fire clay, siliceous fire clay, or highly siliceous fire clay (Plummer and Romary, 1947).

Location and age.—Extensive deposits of clay are found in Washington, Clay, Cloud, Lincoln, Ottawa, and Ellsworth counties. These deposits occur in the Dakota Formation (Cretaceous).

Present and potential uses.—Dakota Formation clays can be used in the manufacture of a wide range of ceramic products such as face brick, tile, pottery, and refractory bodies. Furthermore, with proper beneficiation, high purity refractory materials could be produced as well as clays for use as diluents, parting agents, fillers, extenders, and suspending agents. Large quantities of Dakota clays are currently being used in the manufacture of both light-colored and red facing bricks. Smaller amounts are used in the manufacture of pottery.

Reserves.—Estimated total reserves range from 150 to 400 billion tons.

Bentonite (Montmorillonitic Clay)

Substantial quantities of clay in Kansas consist principally of the mineral montmorillonite. The clays can be divided into two groups based upon the presence or absence of marked swelling with the addition of water. The Kansas montmorillonites are predominantly a nonswelling calcium type.

Location and Age.—Montmorillonitic clay has been investigated in Clark, Graham, Phillips, and Wallace counties. The clays occur predominantly in the Pliocene Ogallala Formation, and shales of Cretaceous age.

Present and potential uses.—Kansas montmorillonites have not been exploited and are not commercially used at present. Extensive tests indicate that these clays can be used in the bleaching process. They may also be adapted for use in the manufacture of cosmetics, insecticides, foundry facings, sealers, removal of sediment and bacteria in water-purification and to prevent excessive seepage loss in ponds.

Reserves.—The volume of reserves has not been accurately determined.

Shale

Shale comprises a large portion of the rocks of Kansas. It is present in almost every part of the State (Fig. 5). At least 57 shale formations and 62 shale members of limestone formations are recognized. Most of the presently utilized shale deposits are in the eastern one-third of the State.

Location and age.—The shales of eastern Kansas are Pennsylvanian in age; those of the central portion are a part of the Permian System (Wellington Shale, Ninnescah Shale); Cretaceous shale (Pierre, Blue Hill, Dakota-Kiowa) occurs in the central and western part of the State.

Present and potential uses.—Shale in Kansas is currently utilized in the manufacture of various types of brick and sewer pipe. Some shale also is being used for manufacturing lightweight aggregate. The shale is also ideally suited for many types of structural ceramic products, i.e., quarry tile, roofing tile, lightweight and other synthetic aggregates, and drain tile. They also could be used for acid brick, roofing granules, and possibly as a source of alumina.

Reserves.—The reserves of shale in Kansas are almost unlimited.

Limestone

Kansas limestones range in composition from nearly pure calcium carbonate to mixtures of calcium carbonate, silica, clay minerals, iron compounds, and other impurities. Limestone composed of relatively pure calcium carbonate is abundant in the State. These units may be as much as 50 feet in thickness.

Location and age.—The eastern one-third of Kansas has abundant limestone deposits, and most are readily accessible for quarrying operations. Limestone has been quarried in eastern Kansas in nearly every township. Limestone beds are less abundant in central and northern Kansas, although good beds in quantity are available in some places. A great deal of the limestone in central Kansas is in the form of chalk, as described elsewhere in this report (Fig. 6). The limestones in eastern Kansas are Mississippian, Pennsylvanian, and Permian in age. Those of central and northern Kansas are Cretaceous in age.

Present and potential uses.—In addition to its use as road metal and as concrete aggregate, limestone is used for building stone, portland cement, and as agricultural lime. Kansas limestones may also be used for producing lime, natural cement, and whiting powder. These limestones are also adaptable for fillers in asphalt roofing and plastics.

Reserves.—As has been indicated, Kansas has unlimited reserves of limestone adaptable to numerous uses.

Chalk

Chalk is a variety of limestone which is an abundant, distinctive rock in Kansas (Fig. 6). It consists of an accumulation of calcium carbonate tests of microscopic one-celled animals together with chemically precipitated calcium carbonate. The calcium carbonate content of the chalk ranges from 88 to 98.2 percent. The remaining constituents are mainly silica, iron oxides, and magnesium carbonate. Grain size is estimated to range from 0.3 to 0.55 microns and is relatively constant.

Location and age.—Limestone, chalk, and chalky shale comprise most of the middle beds of the Cretaceous System in Kansas. Chalk and chalky limestone occur in thin beds throughout the Greenhorn Limestone, and the Niobrara Chalk consists of interbedded chalk and calcareous shale. The Smoky Hill Chalk Member, which ranges in thickness from about 450 to 600 feet, is predominantly shale and chalky shale. The Fort Hays Limestone Member consists of massively bedded chalk and chalky limestone.

The Fort Hays Limestone Member crops out in Kansas in a large area extending from Smith and Jewell counties on the north southwestward to northern Finney County.

Present and potential uses.—Chalk may be substituted for other commercial whiteners and thus has potential use in paints, as well as putties, rubber, glass and ceramic bodies, fertilizers, lime, insecticides, and other chemical applications. The Fort Hays chalk has been used locally as building blocks and in portland cement in Superior, Nebraska, and Boulder, Colorado.

Reserves.—Chalk reserves are unlimited.

Salt

Kansas is one of the most important salt-producing states west of the Mississippi River. The salt occurs as thick beds of halite, at depths varying from 500 to 1,000 feet. Extraction is mostly by shaft mining. (Removal as brine is also being used as an extraction method.)

Location and age.—Salt underlies much of Kansas from Sumner County on the east to Osborne County on the north and west to the Colorado line. It is currently being mined at Hutchinson, Kanopolis, and Lyons (Fig. 7). Brine is being pumped from underground deposits near Wichita. The salt deposits are Permian in age and occur in the Wellington Formation of the Sumner Group, and also in the upper part of the Nippewalla Group, below the Blaine Formation.

Present uses.—Salt is presently used in meat packing, for block salt, chemicals, as common table salt, and highway salt.

Reserves.—The quantity of salt in reserve is considered to be unlimited.

Gypsum

Gypsum is a common mineral that is widely distributed in sedimentary rocks in Kansas (Fig. 8), both as thick beds and joint or crack fillings. Large quantities of rock gypsum are mined for commercial use. High-grade products have been manufactured for many years from Kansas gypsum. Although mined only at a few localities, the deposits are extensive enough to maintain extraction at the present rate for many years.

Location and age.—Large tonnages of rock gypsum are mined in Barber and Marshall counties. Deposits occur in Saline, Dickinson and Comanche counties as well. Deposits of gypsum occur in Kansas in rocks of lower and upper Permian age. The lower Permian gypsum is present in the Easly Creek Shale and is mined near Blue Rapids in Marshall County. It is present in the upper Permian rocks in the lower part of the Wellington Formation of the Sumner Group and in the upper part of the Nippewalla Group. Gypsum deposits in the Easly Creek Shale and the Wellington Formation are generally thicker and of wider areal extent than other deposits of gypsum in the State.

Present uses.—The products made from Kansas gypsum are wallboard, Keene's cement, dental, orthopedic, pottery, casting, and molding plasters, and portland cement retarder. A considerable quantity is used as paper filler.

Reserves.—Kansas gypsum reserves are unlimited.

Sand

Sand occurs abundantly in Kansas (Fig. 9). Most of it consists of grains of quartz, but it is frequently mixed with varying amounts of feldspar and other minerals.

Location and age.—Large quantities of sand deposits occur in almost all counties. However, usable sand is scarce in some eastern counties. Sand may be found almost anywhere along major stream valleys, such as those of the Arkansas, Big Blue, Missouri, Ninnescah, Neosho, Republican, Saline, Smoky Hill, and Solomon rivers. Glacial deposits of sands are confined to the northeastern portions of Kansas. Much of the sand from the major stream valleys is older material reworked by modern streams. In northeastern Kansas, sand was deposited by streams that carried sediment from melting glaciers during the Pleistocene Period. Sand deposits of the western part of the State were deposited primarily by streams that came from the Rocky Mountains.

Uses.—Sand in Kansas is used mainly as structural or road material. Other uses are as traction sand, grinding and polishing sand, and molding sand. Certain sands are currently being used in glass compositions.

Reserves.—Sand reserves in Kansas are unlimited.

Gravel

Kansas has unlimited quantities of gravel, also (Fig. 9). These vary greatly in composition, grain size, shape, thickness, color, and structure. They consist of outwash material, weathered chert or flint, and glacier-deposited material.

Location and age.—Gravel deposits of glacial origin are present in northeastern Kansas. In southeastern Kansas gravels consist primarily of flint or chert from Pennsylvanian and Permian rocks. Limestone gravels are known to be pres-

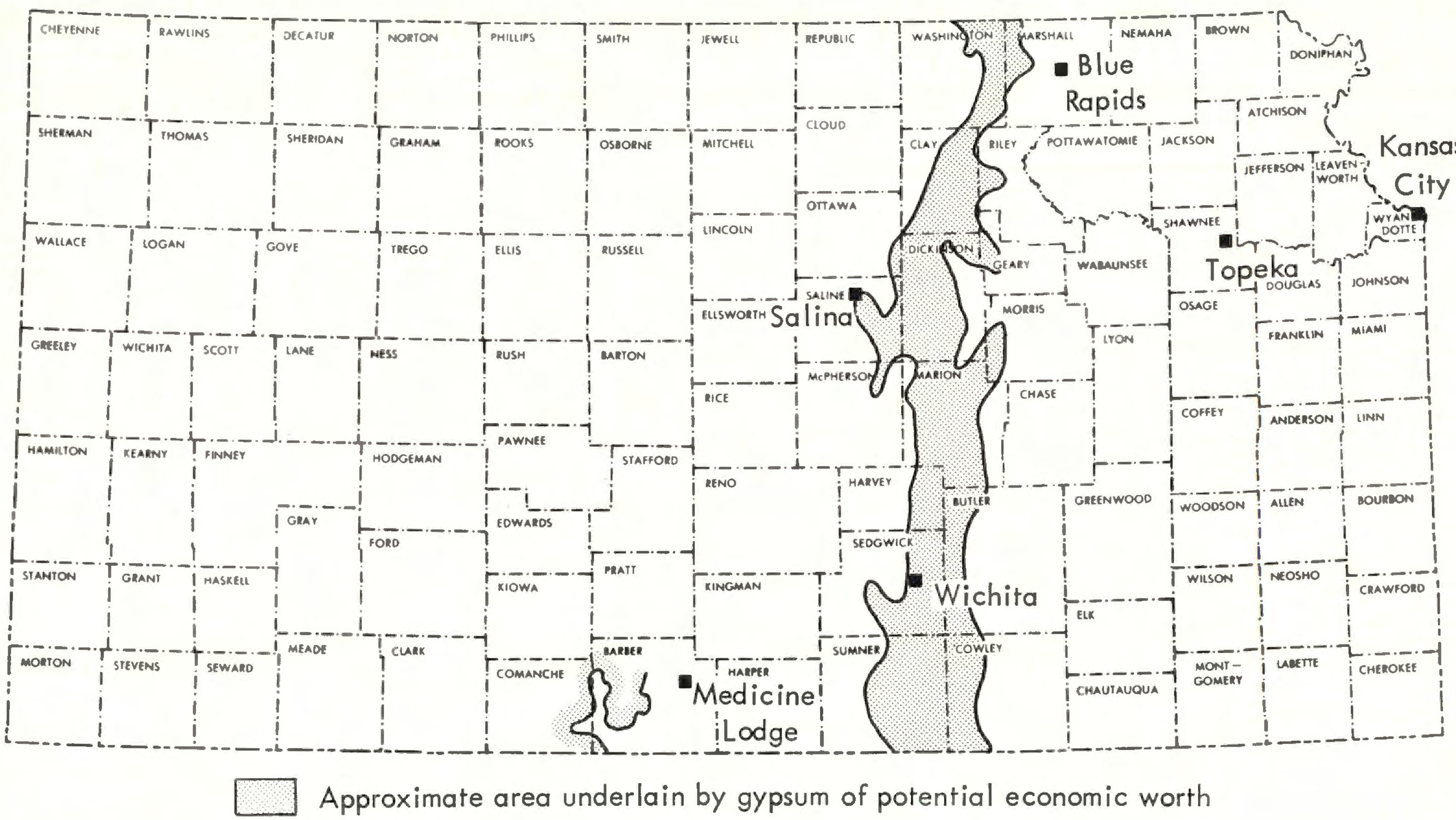

FIGURE 8.—Gypsum deposits in Kansas. (Kansas Econ. Develop. Comm., 1962, p. 83.)

ent in Brown, Douglas, Jewell, Lincoln, and Smith counties. Gravels in the western part of the State are primarily arkosic. Most of this gravel was carried into Kansas by streams which drained the Rocky Mountains during Pliocene time.

Uses.—Gravel is used in Kansas primarily for construction and paving. It also is used extensively for railroad ballast.

Reserves.—Gravel reserves in Kansas are unlimited.

Diatomaceous Marl

Diatomaceous marl is a rock consisting of calcium carbonate and the siliceous remains of diatoms. Diatomaceous marl in Kansas consists approximately of 20 percent silica and 80 percent calcium carbonate.

Location and age.—This material occurs in the Ogallala Formation, principally in Wallace and Sherman counties. Small outcrops of diatomaceous marl also are found in Meade and Seward counties (Fig. 10).

Present and potential uses.—Diatomaceous marl is used as a mineral filler. The properties of this material should make it useful as a paint filler, a diluent for insecticides, a mild abrasive, and a parting agent in fertilizer.

Reserves.—Reserves are estimated to be in excess of 1 million tons. (Estimate by Elias, 1931, Bull. 18, p. 219).

Volcanic Ash

Volcanic ash, a material of many and varied uses, occurs in small but widely distributed deposits in central and western Kansas (Fig. 10). Found in outcrops and pits, volcanic ash is white to light pearly gray, locally with tints of yellow or red. It consists of small particles or shards of glass similar in composition to rhyolite. These are generally less than 1 mm across and are more or less compacted. In a few places they are cemented together by calcium carbonate. The deposits range in thickness from a few inches to more than 30 feet.

Location and age.—The principal volcanic ash deposits occur in Meade, Norton, Jewell, Lincoln, and Phillips counties. Deposits are reported in almost every county in the northwestern quarter of the State. The volcanic ash deposits occur as lenticular bodies within the alluvial sediments that comprise the Pliocene Ogallala Formation and the Pleistocene (late Kansan) Sappa Formation. Evidence shows conclusively that the ash was deposited at most localities in a shallow body of water, even though it is clear that the ash shards were carried by winds into Kansas from a volcanic source southwest of the State.

Present and potential uses.—Volcanic ash is presently used as a mild abrasive, oil absorbent in construction, for bituminous roads, and as a filter aid. It has been used in scouring and polishing compounds for more than 50 years. Volcanic ash has a varied potential. Certain ashes have pozzolanic properties that make them useful as additives to portland cement. In recent years the pyrochemical properties of volcanic ash have been investigated, which have led to its use in formulations for ceramic artware.

Certain types of ash can be expanded to produce a very lightweight aggregate suitable for acoustical and insulating plasters, wallboard, and lightweight blocks or slabs. This material also gives promise of being a good filter medium.

Reserves.—An estimated 20 million tons of volcanic ash are in reserve.

Oil Shale

Oil shale is a compact, laminated rock of sedimentary origin containing organic matter that yields oil on slow distillation. Oil shales constitute a potentially usable fuel in Kansas, which under favorable economic conditions could be developed.

Location and age.—Most of the beds that may be properly classed as oil shale are concentrated in the eastern part of the State (Cherokee, Bourbon, Crawford, Neosho, Labette, Montgomery, Linn, and Douglas counties) (Fig. 10). These dark oil-bearing shales occur in Pennsylvanian rocks in eastern Kansas.

Potential uses.—Aside from use as a source of oil and/or gas, the oil shales of Kansas could be utilized for portland cement, building bricks, mineral wool, and alumina. Another possibility is use as a fertilizer material, because of the presence of considerable phosphate. The black shales are known to contain uranium and rare earths.

Reserves.—It is estimated that approximately 3 billion barrels of oil and 3,000 billion cubic feet of gas could be recovered from Kansas oil shales (Runnels, Kulstad, McDuffee, and Schleicher, 1952, p. 176).

Feldspar

River sands in Kansas contain almost 30 percent by weight of feldspar, with orthoclase (potash feldspar) predominating. It is believed that suitable flotation methods could be worked out to produce a feldspar concentrate that would meet industrial requirements.

The theoretical composition of the three common feldspar species used in commercial products is:

	Orthoclase (Potassium feldspar)	Albite (Sodium feldspar)	Anorthite (Calcium feldspar)
SiO_2	64.7%	68.8%	43.3%
Al_2O_3	18.4%	19.4%	36.6%
K_2O	16.9%	......	......
Na_2O	......	11.8%	......
CaO	......	......	20.1%

The Fe_2O_3 content of feldspar used for clear glass should not exceed 0.05 percent.

For amber glass, the Fe_2O_3 content should not exceed 0.5 percent. Typical commercial feldspars yield the following compositional variations:

SiO_2	65.60-71.50%
Al_2O_3	16.70-19.40%
Fe_2O_3	0.05- 0.10%
CaO	0.50- 1.94%
MgO	Trace
K_2O	4.05-11.43%
Na_2O	2.46- 6.76%
Loss on ignition	0.13- 0.40%

Feldspar extracted from sands in Kansas show the following range of chemical constituents:

SiO_2	64.63-65.67%
Al_2O_3	0.44- 0.74%
CaO	0.84- 1.11%
MgO	0.16- 1.01%
K_2O	8.82- 9.57%
Na_2O	3.74- 4.04%
Loss on ignition	0.37- 0.49%

Potential Uses.—Kansas feldspar is useful as a component of glass.

Reserves.—An unlimited supply of feldspar is available in Kansas from the arkosic sands in the principal river valleys.

PHOSPHATE

Sedimentary phosphate occurs in Kansas in the Pennsylvanian shales and limestones in the eastern one-third of the State. Samples have been obtained in Crawford, Bourbon, Franklin, Labette, and Wyandotte counties. The phosphate occurs in nodules disseminated throughout the shale. The nodules have an average P_2O_5 content in the range of 30 to 35 percent. Analyses suggest that the phosphate is present in sufficient quantity for the shale to merit evaluation as a source of agricultural fertilizer. This material currently is not being used for any commercial purposes. No determination of reserves has been made, but it is estimated that they should be very large.

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TABLE 6.—Industrial and metallic mineral reserves from Region 4.

County	Code number	Mineral								
		Clay	Gravel	Gypsum	Limestone	Magnesium (Brine)	Salt	Sand	Sandstone	Shale
Butler	08	....	Proven	....	Proven	Proven	....	....	....	Proven
Chautauqua	10	....	"	....	"	....	....	Proven	Proven	"
Cowley	18	....	"	....	"	....	....	"	....	"
Elk	25	....	"	....	"	....	....	"	Proven	"
Greenwood	37	....	"	....	"	....	....	"	"	"
Harper	39	....	"	....	....	Possible	Proven	"	....	"
Harvey	40	....	"	Proven	....	Proven	....	"	....	"
Kingman	48	Possible	"	....	....	Possible	Proven	"	....	"
Reno	78	Possible	"	....	....	Proven	"	"	....	"
Rice	80	"	"	....	....	Possible	"	"	Possible	"
Sedgwick	87	....	"	Proven	Probable	"	"	"	....	"
Sumner	96	....	"	"	"	Proven	"	"	....	"

Data from various Kansas Geological Survey bulletins.

TABLE 7.—Industrial and metallic mineral reserves from Region 5.

County	Code number	Mineral								
		Clay	Gravel	Gypsum	Limestone	Magnesium (Brine)	Salt	Sand	Sandstone	Shale
Barber	04	....	Proven	Proven	....	Possible	....	Proven	Proven	Proven
Barton	05	Proven	"	....	Proven	....	Proven	"	"	"
Comanche	17	....	"	Proven	....	....	"	"	"	"
Edwards	24	....	"	....	Probable	Possible	"	"	....	Probable
Kiowa	49	Proven	"	Probable	....	"	"	"	Proven	Proven
Pawnee	73	"	"	....	Proven	"	"	"	"	"
Pratt	76	"	"	....	....	"	"	"	....	....
Rush	83	....	"	....	Proven	"	"	"	....	Proven
Stafford	93	....	"	....	....	Proven	"	"	....	....

Data from various Kansas Geological Survey bulletins.

TABLE 8.—Industrial and metallic mineral reserves from Region 6.

County	Code number	Mineral									
		Benton-ite	Clay	Gravel	Limestone	Magnesium (Brine)	Salt	Sand	Sandstone	Shale	Volcanic ash
Clark	13	Proven	....	Proven	Probable	Possible	Proven	Proven	Proven	Proven	Proven
Ford	29	....	Proven	"	"	....	"	"	Probable	Probable	....
Gray	35	....	"	"	"	....	....	"	....	"	Probable
Hodgeman	42	....	"	"	Proven	....	Proven	"	Proven	Proven	....
Meade	60	....	"	"	Probable	Possible	....	"	Probable	Probable	Proven
Ness	68	....	....	"	Proven	"	Proven	"	Proven	Proven	"

Data from various Kansas Geological Survey bulletins.

TABLE 12.—Industrial and metallic mineral reserves from Region 10.

County	Code number	Mineral								
		Clay	Gravel	Gypsum	Limestone	Salt	Sand	Sandstone	Shale	Volcanic ash
Cloud	15	Proven	Proven	....	Proven	....	Proven	Proven	Proven	....
Ellsworth	27	"	"	....	"	Proven	"	"	"	Proven
Jewell	45	Probable	"	....	"	....	"	Probable	"	"
Lincoln	53	Proven	"	....	"	....	"	Proven	"	"
Mitchell	62	Probable	"	....	"	....	"	"	"	....
Ottawa	72	Proven	"	....	"	....	"	"	"	Proven
Republic	79	"	"	....	"	....	"	"	"	....
Saline	85	"	"	Proven	Probable	Proven	"	"	"	....

Data from various Kansas Geological Survey bulletins.

TABLE 13.—Industrial and metallic mineral reserves from Region 11.

County	Code number	Mineral						
		Clay	Gravel	Limestone	Sand	Sandstone	Shale	Volcanic ash
Atchison	03	....	Proven	Proven	Proven	Proven	Proven	....
Brown	07	....	"	"	"	....	"	....
Doniphan	22	Proven	"	"	"	Proven	"	....
Jackson	43	....	"	"	"	....	"	....
Marshall	59	....	"	"	"	....	"	Probable
Nemaha	66	....	"	"	"	....	"	Possible
Washington	101	Proven	"	"	"	Proven	"	....

Data from various Kansas Geological Survey bulletins.

Crawford	19	Girard	1000	598	AT&SF; MKT; MP; SL&SF; KCS	US 69, 160	628	371	698	124	582	232	330	346	157
Labette	50	Oswego	900	654	AT&SF; MKT; MP; SL&SF	US 59, 160, 166, 169; K 96	678	333	710	174	632	194	346	344	169
Neosho	67	Erie	825	1371	AT&SF; MKT	US 59, 169	642	369	680	138	596	230	310	380	139
Montgomery	63	Independence	825	649	AT&SF; MKT; MP; SL&SF	US 75, 160, 166, 169; K 96	679	369	672	175	633	194	302	377	131
Wilson	103	Fredonia	900	574	AT&SF; MP; SL&SF	US 75; K 96	662	397	644	158	616	222	285	405	103
Woodson	104	Yates Center	1125	504	MP	US 54, 75	630	449	618	126	584	234	253	378	92

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.

TABLE 16.—Geographic data by county in Region 3.

County	Code number	County seat	Elevation (county seat)	Area, sq mi	Railroads	Major highways	Distance from county seat in miles to:								
							Chicago	Dallas	Denver	K.C., Mo.	Minne-apolis	Oklahoma City	Omaha	St. Louis	Wichita
Chase	09	Cottonwood Falls	1200	744	AT&SF	I-35; US 50	632	459	550	128	581	244	222	380	102
Clay	14	Clay Center	1200	659	AT&SF; UP; CRI&P	US 24	662	526	477	158	570	311	211	410	160
Dickinson	21	Abilene	1150	855	AT&SF; MP; UP; CRI&P	I-70; US 40, 56, 77	661	485	462	157	597	270	238	409	119
Geary	31	Junction City	1075	401	UP	I-70; US 40, 77	638	478	486	134	590	263	231	386	112
Lyon	56	Emporia	1150	852	AT&SF; MP	I-35; US 50, 56	616	443	568	112	565	228	206	364	86
Marion	58	Marion	1350	959	AT&SF; CRI&P	US 50, 56, 77	674	430	512	170	628	215	278	422	63
Morris	64	Council Grove	1250	707	AT&SF; MP; CRI&P	US 56, 77	626	474	532	122	580	259	228	374	108
Pottawatomie	75	Westmore-land	1250	854	UP	US 24	622	525	533	118	530	310	171	370	158
Riley	81	Manhattan	1025	626	CRI&P; UP	I-70; US 24, 77	622	497	505	118	576	282	218	317	131
Wabaunsee	99	Alma	1100	795	AT&SF; CRI&P	I-35, 70; US 40	609	495	519	105	561	280	203	357	138

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.

Kiowa	49	Greensburg	2225	723	AT&SF; CRI&P	US 54, 154, 183	823	476	434	319	777	261	426	571	116
Pawnee	73	Larned	2000	742	AT&SF; MP	US 56, 183, 156	806	502	397	302	479	287	359	554	136
Pratt	76	Pratt	1900	726	AT&SF; CRI&P; MP	US 54, 281	789	442	448	285	743	227	392	537	82
Rush	83	La Crosse	2050	719	AT&SF; MP	US 183; K 96	810	517	361	306	700	302	341	558	151
Stafford	93	St. John	1900	796	AT&SF; MP	US 50, 281	782	466	431	278	736	251	379	530	106

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.

Table 19.—Geographic data by county in Region 6.

County	Code number	County seat	Elevation (county seat)	Area, sq mi	Railroads	Major highways	Distance from county seat in miles to:								
							Chicago	Dallas	Denver	K.C., Mo.	Minneapolis	Oklahoma City	Omaha	St. Louis	Wichita
Clark	13	Ashland	1973	973	AT&SF; CRI&P	US 54, 160, 183, 283	874	422	440	370	828	207	474	622	177
Ford	29	Dodge City	2475	1086	AT&SF; CRI&P	US 50, 54, 56, 154, 283	869	519	387	365	781	304	422	617	159
Gray	35	Cimarron	2600	857	AT&SF	US 50, 56	866	538	366	362	778	323	419	614	178
Hodgeman	42	Jetmore	2250	858	AT&SF	US 156, 283	849	552	369	345	752	337	393	597	189
Ness	68	Ness City	2200	1079	AT&SF; MP	US 283; K 96	827	545	344	323	739	330	380	575	178
Meade	60	Meade	2500	984	CRI&P	US 54, 160	890	411	457	386	838	242	491	638	178

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.

Rawlins	77	Atwood	2850	1064	CB&Q	US 36	805	705	229	427	690	490	331	679	339
Sheridan	90	Hoxie	2700	896	CRI&P; UP	US 24, 83, 383	810	646	290	367	695	367	336	619	279
Sherman	91	Goodland	3700	1049	CRI&P	I-70; US 24	861	710	200	434	745	497	386	686	346
Thomas	97	Colby	3125	1065	CRI&P	I-70; US 24, 83, 383	825	676	236	398	709	461	350	650	310
Wallace	100	Sharon Springs	3475	921	UP	US 40	887	706	191	428	772	491	413	680	340

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.

Table 22.—Geographic data by county in Region 9.

County	Code number	County seat	Elevation (county seat)	Area, sq mi	Railroads	Major highways	Distance from county seat in miles to:								
							Chicago	Dallas	Denver	K.C., Mo.	Minne-apolis	Oklahoma City	Omaha	St. Louis	Wichita
Ellis	26	Hays	2000	901	UP	US 40, 183; I-70	776	530	337	264	703	326	337	519	174
Gove	32	Gove	2600	1080	UP	US 40; I-70	837	635	279	356	722	420	363	608	268
Graham	33	Hill City	2200	857	UP	US 24, 283	799	605	297	323	689	390	317	578	238
Norton	69	Norton	2300	880	CB&Q; CRI&P; MP	US 36, 283, 383	794	615	287	356	654	400	282	611	271
Osborne	71	Osborne	1550	894	AT&SF; MP; UP	US 24, 281	735	558	393	276	620	343	261	528	192
Phillips	74	Phillips-burg	1900	887	CB&Q; CRI&P; MP	US 36, 186 383	749	600	318	325	639	390	267	580	240
Rooks	82	Stockton	1800	890	UP	US 24, 183	773	584	329	302	663	369	291	557	217
Russell	84	Russell	1850	897	UP	I-70; US 40, 281	750	503	364	255	671	289	312	507	149
Smith	92	Smith Center	1800	888	CRI&P; MP	US 36, 281	798	576	347	294	594	361	235	546	210
Trego	98	Wakeeney	2475	899	UP	I-70; US 40, 283	800	574	304	315	685	359	326	570	208

Source: Official Kansas State Railroad Map, 1968: Kansas Corp. Comm.; Rand McNally Road Atlas, 1969: Rand McNally & Co., Chicago.