EXPLANATION

Sand and gravel dredged from the French Broad and Tennessee Rivers is excellent as aggregate. Because these deposits are under water, their distribution is not shown on the map

Multipurpose, suitable for crushed stone, cement, chemical lime, agricultural lime, and dimension stone (marble)

Fair to good for crushed stone and agricultural lime

Limestone

Good to excellent for crushed stone and agricultural lime

Good for crushed stone and agricultural lime, but generally overlain by thick overburden

Dolomite

Calcareous sandstone with subordinate shale – Good for crushed stone, but has limited local use because of abundance of other, more suitable limestone and dolomite

Calcareous siltstone, with subordinate shale and limestone – Poor for aggregate because of high content of shale

Good to excellent as source for brick clay and lightweight aggregate. Has a low content of siltstone and limestone

Poor as source for brick clay and lightweight aggregate because of high content of limestone

Shale with subordinate limestone and siltstone

Good for aggregate but of limited use because of poor accessibility

Poor for aggregate because of high shale content

Sandstone with subordinate shale

4a 3 2 1 **Rock sequence** – Numbers indicate sequence; unit **1** is oldest

Contact – A boundary between different map units

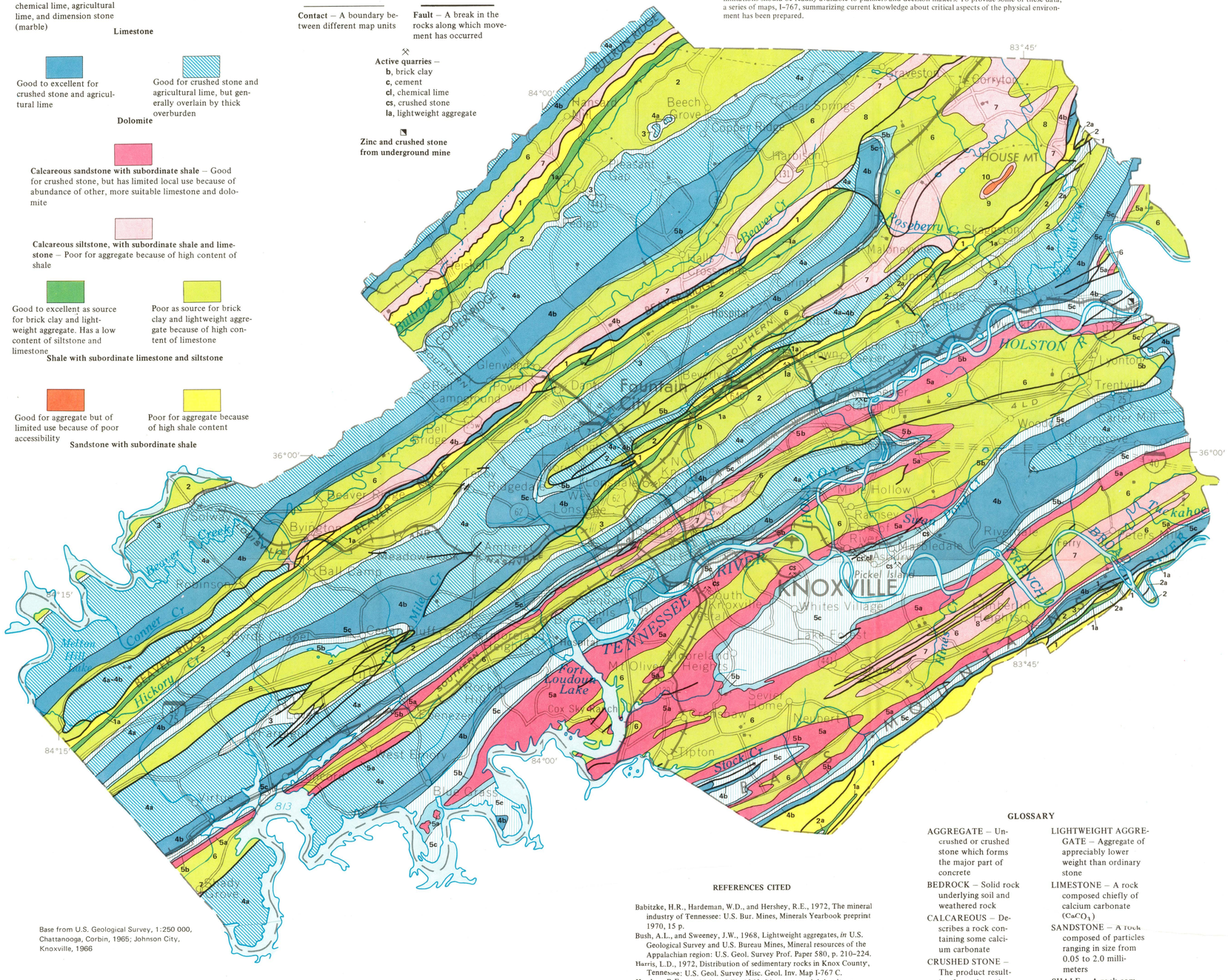
Fault – A break in the rocks along which movement has occurred

Active quarries –
b, brick clay
c, cement
cl, chemical lime
cs, crushed stone
la, lightweight aggregate

Zinc and crushed stone from underground mine

LAND RESOURCE ANALYSIS MAPS OF KNOX COUNTY

Knox County has a 1972 population in excess of 270,000. The Metropolitan Planning Commission (1968) projects an increase in population to approximately 360,000 by 1990. As the population grows and favorable areas like west Knox County approach their limit of development, more and more marginal land will be utilized. In order to utilize the existing land resources safely and efficiently, and in order to maintain a suitable environmental quality, knowledge concerning the physical environment and its limitations should be readily available to planners and decision makers. To provide some of these data, a series of maps, I-767, summarizing current knowledge about critical aspects of the physical environment has been prepared.



Base from U.S. Geological Survey, 1:250 000, Chattanooga, Corbin, 1965; Johnson City, Knoxville, 1966

SCALE 1:125 000

5 4 3 2 1 0 5 MILES

5 4 3 2 1 0 5 10 KILOMETERS

GLOSSARY

AGGREGATE – Uncrushed or crushed stone which forms the major part of concrete

BEDROCK – Solid rock underlying soil and weathered rock

CALCAREOUS – Describes a rock containing some calcium carbonate

CRUSHED STONE – The product resulting from the artificial crushing of rock

DIMENSION STONE – Naturally occurring rock material cut, shaped, or selected for use in construction units of specified shape or size

DOLOMITE – A rock composed chiefly of calcium magnesium carbonate [$CaMg(CO_3)_2$]

LIGHTWEIGHT AGGREGATE – Aggregate of appreciably lower weight than ordinary stone

LIMESTONE – A rock composed chiefly of calcium carbonate ($CaCO_3$)

SANDSTONE – A rock composed of particles ranging in size from 0.05 to 2.0 millimeters

SHALE – A rock composed of particles less than 0.002 millimeters in size

SILTSTONE – A rock composed of particles ranging in size from 0.002 to 0.05 millimeters

ZINC CONCENTRATES – Enriched ore after removal of unneeded constituents in a beneficiation mill

REFERENCES CITED

Babitzke, H.R., Hardeman, W.D., and Hershey, R.E., 1972, The mineral industry of Tennessee: U.S. Bur. Mines, Minerals Yearbook preprint 1970, 15 p.

Bush, A.L., and Sweeney, J.W., 1968, Lightweight aggregates, *in* U.S. Geological Survey and U.S. Bureau Mines, Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 210–224.

Harris, L.D., 1972, Distribution of sedimentary rocks in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I-767 C.

Hershey, R.E., and Maher, S.W., 1963, Limestone and dolomite resources of Tennessee. Tennessee Div. Geology Bull. 65, 231 p.

Maher, S.W., 1973, Economic geology of Knox County, *in* Geology of Knox County: Tennessee Div. Geology Bull.70, p. 76–81.

Metropolitan Planning Commission, 1968, General plan 1990, Knoxville, Knox County, Tennessee: Knoxville, Tenn., Metropolitan Planning Commission, 1 sheet, scale 1 inch = approx. 1 mile.

Swingle, G.D., 1964, Elevation of the Chickamauga Limestone to group status in east Tennessee [abs.]: Tennessee Acad. Sci. Jour., v. 39, no. 2, p. 66.

Wedow, Helmuth, Jr., and Heyl, A.V., 1968, Zinc and lead, *in* U.S. Geological Survey and U.S. Bureau Mines, Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 450–466.

MINERAL RESOURCES OF KNOX COUNTY

The mineral industry in Knox County is a complex multiproduct business with a 1970 approximate annual value of $24 million (Babitzke and others, 1972). The sedimentary rocks, which form the bedrock(principally limestone, dolomite, and shale), as well as some unconsolidated materials (sand and gravel) form the mineral resource base for the county.

The bedrock consists of sedimentary rocks which have been folded and faulted during mountain-building processes to form northeast-trending bands of varying width (Harris, 1972). The bedrock has been subdivided into ten mineral-resource categories; their distribution is shown on the map.

Principal mineral products recovered or manufactured include zinc concentrates, cement, dimension stone, brick, lightweight aggregate, crushed stone, chemical lime, agricultural lime, and sand and gravel.

Although zinc concentrates and much of the other products are shipped out of the county, large quantities of construction materials are used in the local industry. Consequently, the economic stability of the construction industry of Knox County is strongly dependent upon the local availability of mineral raw materials. Although natural mineral resources are abundant, many usable resources have been restricted to limited development or completely removed from the raw material base by encroachment of residential, commercial, and industrial development. To assure adequate future resources at a reasonable cost, current land-use decisions must consider the impact on the raw material base. To aid in assessing this impact, data concerning the natural resources of Knox County are presented on the accompanying map with a brief economic evaluation.

		Formation and map unit number		Thickness, in feet	Economic evaluation
QUATERNARY			Sand and gravel		Unconsolidated mixed sand and gravel, dredged from the French Broad and Tennessee Rivers. Because the deposits are covered by water, distribution is not shown.
SILURIAN	Lower and Middle Silurian		Clinch Sandstone	10	±200	Sandstone with subordinate shale. Good for crushed stone but is relatively inaccessible; outcrop limited to House Mountain in northeast part of county.
ORDOVICIAN	Upper		Sequatchie Formation	9	±450	Calcareous siltstone with subordinate shale and limestone. Poor for crushed stone because of high content of shale.
	Middle Ordovician	Chickamauga Group of Swingle (1964) Upper part	Martinsburg Shale	8	±1500	Shale with subordinate limestone and siltstone. Poor for crushed stone because of high shale content. Poor as a source for clay because of high content of limestone.
		Middle part	Bays Formation and Moccasin Formation	7	300–600	Calcareous siltstone with subordinate shale and limestone. Poor for crushed stone because of high shale content. Locally may contain limestone of sufficient thickness to quarry for crushed stone.
		Lower part	Ottosee Shale	6	1100–2000	Shale with subordinate limestone and siltstone. Poor for crushed stone because of high shale content. Locally may contain limestone of sufficient thickness to quarry for crushed stone and dimension stone (marble).
			Chapman Ridge Sandstone	5a	0–500	Calcareous sandstone with subordinate shale. Good for crushed stone where shale content is low. Shale has been used as an additive in the manufacture of cement.
			Holston Formation	5b	0–500	Limestone. Excellent as a multipurpose rock; can be used for dimension stone (marble), crushed stone, chemical lime, cement manufacture, aggregate, and agricultural lime. Extensively quarried.
			Lenoir Limestone	5c	40–400	Limestone. Good for crushed stone but locally may contain appreciable shale. Extensively quarried.
	Lower Ordovician	Knox Group	Mascot Dolomite	4b	±700	Dolomite. Good for crushed stone but needs to have close control for chert. Extensively quarried.
			Kingsport Formation		±300	Dolomite, may contain some limestone locally. Good for crushed stone but needs to have close control for chert; formation is extensively mined underground at Mascot for zinc ore (sphalerite); considerable crushed stone and agricultural lime are produced as a by-product of mining.
			Chepultepec Dolomite		±700	Dolomite. Good for crushed stone but needs to have close control for chert; has not been extensively quarried because suitable quarry sites in other dolomite and limestone units are more readily available.
			Copper Ridge Dolomite	4a	±900	Dolomite. Good for crushed stone but needs to have close control for chert; has not been extensively quarried because more suitable quarry sites in other dolomite and limestone units are more readily available.
CAMBRIAN	Upper Cambrian	Conasauga Group	Maynardville Formation	3	200–400	Limestone includes some dolomite. Good for crushed stone; has been quarried extensively.
	Middle Cambrian		Nolichucky Shale, Maryville Limestone, Rogersville Shale, Rutledge Limestone	2, 2a	1200–1600	Shale with subordinate limestone and siltstone. Poor for crushed stone because of high shale content; poor as source for brick clay because of high content of limestone; locally contains zones of limestone (Maryville and Rutledge Limestones), with sufficient thickness to quarry for crushed stone.
			Pumpkin Valley Shale	1a	200–700	Shale. Excellent as source of clay with low content of limestone and siltstone; used for brick clay and lightweight aggregate.
	Lower Cambrian		Rome Formation	1	±1000	Sandstone with subordinate shale. Poor for crushed stone because of high shale content.

SEQUENCE OF ROCK TYPES (OLDEST AT BOTTOM) AND THEIR ECONOMIC EVALUATION

LIMESTONE AND DOLOMITE

Limestone and dolomite are the most widely used raw materials in the construction industry of Knox County. In general, limestone and dolomite can be divided into two broad groups based on their physical and chemical properties: (1) general-use stone with relatively low physical and chemical requirements suitable for large-volume crushed stone production and (2) special chemical grade stone, where high purity is required. Specifications and tests used to determine the suitability of limestone and dolomite for particular products are discussed in detail by Hershey and Maher (1963). Most limestone and dolomite in the county are suitable for general use; however, only one limestone (Holston limestone) is of sufficient purity (approximately 97 percent $CaCO_3$) to meet specifications for chemical lime. The Holston is also the source of the famous Tennessee marble, formerly quarried extensively in Knox County and used as dimension stone nationally (Maher, 1973). Currently, no Holston limestone is quarried for stone in Knox County, but some quarried in adjacent counties is processed in Knoxville plants.

SHALE

Shale, containing large amounts of clay minerals (hydrous aluminum silicates) and only small quantities of other minerals, is the principal raw material used in making bricks and lightweight aggregate, and is added to limestone in the manufacture of cement. In Knox County, the Pumpkin Valley Shale is the only clay source of a suitable quality and sufficient quantity to support large-volume production of bricks and lightweight aggregate. Lightweight aggregate is prepared from certain clays that expand when heated and reduce weight by creating void space (Bush and Sweeney, 1968). It is used as a substitute for gravel or crushed stone to reduce the weight of concrete. Locally, clay from the shaly part of the Chapman Ridge Sandstone is mixed with the Holston limestone in manufacture of cement.

SAND AND GRAVEL

Sand and gravel, principally for construction use, are dredged from the bed of the Tennessee and French Broad Rivers in what is now Fort Loudoun Lake. Supplies are probably ample, but natural replenishment has been reduced since the construction of dams farther up these rivers.

ZINC

The western part of the Mascot-Jefferson City zinc district lies in the northeastern part of Knox County (Wedow and Heyl, 1968). Zinc ore has been mined for more than 60 years from the upper part of the Knox Group. No other commercial deposits of zinc ore are known in the county, though other areas have been explored to a limited extent. A major by-product of both mining and concentration of these ores is crushed and ground dolomite, which constitutes a large part of the county's output of crushed stone and agricultural lime.

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MINERAL RESOURCES OF KNOX COUNTY, TENNESSEE

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1974

Blackline copies of this map are available at cost on transparent scale-stable material from the U.S. Geological Survey, Washington, D.C. 20244

For sale by U.S. Geological Survey, price 75 cents