LIMESTONE RESOURCES IN THE APPALACHIAN REGION OF KENTUCKY

Preston McGraing and Garland R. Dever, Jr.
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LETTER OF TRANSMITTAL

April 5, 1967

Dr. Raymond C. Bard  
Assistant Vice President for Research  
University of Kentucky

Dear Dr. Bard:

The construction of roads, dams, and other structures should accelerate in the Appalachian region of Kentucky in the years ahead. Sources of aggregate materials in this area necessary for such projects are shown in this report which, if utilized, should provide considerable savings to those engaged in this construction.

Very truly yours,

WALLACE W. HAGAN  
Director and State Geologist  
Kentucky Geological Survey
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LIMESTONE RESOURCES IN THE
APPALACHIAN REGION OF KENTUCKY

Preston McGrain and Garland R. Dever, Jr.

ABSTRACT

Proposed construction projects in connection with the Appalachian regional development program have focused considerable attention on sources of aggregate materials. Limestone is the principal source of concrete aggregate and read stone in the Appalachian region of Kentucky.

As defined by Public Law 89-4, March 9, 1965, the Appalachian region includes 49 of Kentucky's 120 counties. At the present time there are 41 active limestone operations located in 27 of these counties. Rocks in the region range from Pennsylvanian to Ordovician but the active limestone quarries, pits, and mines are limited to rocks of Mississippian and Ordovician ages, with the former predominating.

Primary sources of future supplies of limestone from this area for concrete aggregate and read stone can be expected to be obtained from Upper Mississippian (Chester and Ste. Genevieve) limestones along the Pottsville Escarpment and Pine Mountain; Lower Mississippian (Warlow and Fort Payne) limestones in the Cumberland and Green Rivers drainage basins; and Middle Ordovician limestones along the valley of the Kentucky River. Smaller quantities may be secured from thin Upper Ordovician limestones at scattered points west of the Pottsville Escarpment and from Upper Mississippian limestones in the subsurface of the Paint Creek uplift of Johnson, Magoffin, and Morgan Counties.

INTRODUCTION

The Appalachian regional development program, with its proposed construction projects and potential resulting private development in the region, has focused considerable attention on the location of sources of aggregate materials. As defined by Public Law 89-4, March 9, 1965, the Appalachian region includes 49 of Kentucky's 120 counties (Fig. 1). The outcropping rocks range in age from Ordovician through Pennsylvanian, with the sandstones, siltstones, and shales of the Pennsylvanian dominating the surface exposures in the largest part of the region. Limestone is presently and will continue to be the principal source of aggregate material in this region.

Limestone that is satisfactory for concrete aggregate and road stone must be hard, strong, and resistant to abrasion and weathering. It should be free of clay, shale, chert, and soluble sulphides which cause weakening or disintegration of the stone and concrete.

This paper is primarily the result of field reconnaissance by the writers to determine the quality and extent of the limestone deposits in the 49-county region. It is a refinement of earlier geological work on the subject, and includes potentially commercial limestone deposits disclosed by the joint Kentucky Geological Survey-United States Geological Survey geologic mapping project. The location of the published geologic quadrangles is shown in Figure 2.

PRINCIPAL AREAS OF OCCURRENCE

The region as defined above involves several geologic provinces. The principal structural features which control the geographic distribution of the limestone resources are the Cincinnati arch, Appalachian basin, Pine Mountain fault, and Paint Creek uplift (Fig. 3). The resulting principal limestone areas are the narrow belts along the western edge of the Eastern Kentucky Coal Field and the front of the Pine Mountain overthrust block, the Kentucky River area of the Inner Blue Grass, and the Mississippian Plateau of the south-central part of the Commonwealth.

At the present time there are 41 active quarries, pits, and mines located in 27 of the Appalachian area counties. Stratigraphically, they are limited to rocks of the Mississippian and Ordovician, with the former predominating. Almost 50 percent of these active operations are partially or entirely in the Ste. Genevieve Limestone (Fig. 4). Limestones
Figure 1. Map of Kentucky showing counties included in the Appalachian region as defined by Public Law 89-4.
Figure 2. Map of Kentucky showing location of areas covered by new geologic quadrangle maps published as of January 1, 1967.
of the Lower Chester appear to be equally important. The distribution of limestones offering the greatest potential for concrete and road aggregates is shown on Plate 1 (in pocket).

Western Rim of the Eastern Kentucky Coal Field

Upper Mississippian carbonates constitute the most important source of aggregate in Kentucky's Appalachian region. Their principal exposures are in the Pottsville Escarpment, extending northeastward across the State, along the western edge of the Cumberland Plateau. The Ste. Genevieve Limestone is a very important quarry rock and a majority of the quarries in this area are partially or entirely in this formation. The superjacent Chester limestone ledges are also important, being quarried with the Ste. Genevieve or operated separately depending upon availability and the topographic situation. These formations attain their greatest thicknesses in the south, in the Lake Cumberland area of Pulaski, Wayne, and Clinton Counties, and decrease northward. This is due in part to the thinning of individual units and in part to pre-Pennsylvanian and pre-Chester erosion. An unconformity is also recognized between the Ste. Genevieve and the St. Louis. The greatest local variations in thicknesses occur from Rowan County northward where a part or all of the carbonate sequence may be missing entirely (with basal Pennsylvanian clastics resting on Lower Mississippian siltstones), whereas a few miles away limestone thicknesses as great as 80 to 100 feet may be measured. Detailed field investigations together with core drilling are necessary in this area to make a quantitative determination of the limestone resources at any specific locality.

Two other conditions that may affect quarry operations locally along the Pottsville Escarpment should be noted. Displacement along the Irvine-Paint Creek fault system may restrict the size of
Figure 4. Generalized geologic section of the Appalachian area of Kentucky showing the stratigraphic positions of limestone operations and thicknesses of commercial stone.
a potential operation in or near the fault zone which extends through Wolfe, Powell, Estill, and Madison Counties. Generally, sand is found in increasing amounts in the Ste. Genevieve formation northward from Wolfe County.

**Pine Mountain**

The Upper Mississippian limestones are exposed again to the southeast by the Pine Mountain overthrust. They are continuously exposed along the fault scarp for a distance of approximately 100 miles, from near Jellico, Tennessee, to the vicinity of Elkorn City, Kentucky. This limestone sequence has been referred to as Newman and as Greenbrier. For the most part these limestones appear to be equivalent to the Ste. Genevieve and Chester limestones of the western edge of the Cumberland Plateau. Lithologies similar to the St. Louis have also been observed.

Limestone thicknesses in excess of 300 feet have been measured on Pine Mountain and represent a large reserve of potential aggregate material. The rugged topography, thick overburden, and steeply dipping beds pose the greatest problems in operating these deposits.

**Mississippian Plateau of South-Central Kentucky**

This area is largely on the Cumberland saddle of the Cincinnati arch. The exposed rocks range in age from Late Ordovician through Pennsylvanian, with the Early (Lower) Mississippian predominating. The older rocks are exposed along the valleys of the Cumberland River and its major tributaries, and successively younger rocks are exposed to the east and west. The Fort Payne Formation, though primarily clastic, is of particular interest because of its varied lithologies and abrupt facies changes. Operable thicknesses of Fort Payne limestones have been brought to light by the cooperative geologic mapping program of the Kentucky and United States geological surveys. Published geologic quadrangles and the regional map in this report (Pl. 1, in pocket) show that this limestone facies may vary in occurrence from local thin lenses to thick bodies whose areal extent is measured in terms of miles.

Locally, the St. Louis and Warsaw formations may contain strata satisfactory for quarrying. The St. Louis is being mined in Casey County and the Warsaw is quarried in Monroe County. In general, however, these formations are argillaceous and the stone fails to meet soundness tests. The Upper Ordovician limestones are similar lithologically to their central Kentucky counterparts and should be beneficiated before use in concrete aggregate. Upper Mississippian limestones may occur on isolated knobs.

**Kentucky River Area of the Inner Blue Grass**

The combination of the Jessamine dome and the deep entrenching of the Kentucky River has exposed the Middle Ordovician Tyrone and Camp Nelson Limestones along the incised valleys of the river and its tributaries. These limestones are hard and dense and produce good aggregate. With the main valley attaining depths of 300 to 400 feet below the Lexington Plain, underground operations are frequently the most satisfactory methods of recovering this rock. The locating of a quarry site can be further complicated by the presence of a system of faults which roughly parallels part of the course of the river. This faulting may cause the ledges of quarry rock to be below drainage level or may limit the size of the potential operation.

Younger Ordovician limestones are quarried locally elsewhere in the Appalachian region. In general, these rocks, being somewhat argillaceous and containing shale partings, must be beneficiated before passing state and federal specifications for use in concrete aggregate for highways.

**Paint Creek Uplift**

In areas of Johnson, Magoffin, and Morgan Counties, in the middle of eastern Kentucky's coal field, the Upper Mississippian limestones may be found within less than 400 feet of the surface. Earlier geological investigations (Stokley, 1949; Hauser, 1953) have called attention to this limestone at possible minable depths on the Paint Creek uplift. These deposits represent a substantial reserve of aggregate material for the area. Problems associated with the occurrence of subsurface waters should be investigated before initiating underground operations.

**Silurian Limestone in Northeastern Kentucky**

Geologic mapping near the Ohio River in northeastern Lewis County (Morris, 1966) indicates that the Bisher Limestone (Middle Silurian) attains thicknesses as great as 100 feet. It is a dolomitic and sandy, finely crystalline to coarsely textured limestone. Silty and sandy ledges of this formation are too soft and friable for use as crushed stone, but the crystalline, dolomitic facies appears more resistant and may be worthy of further investigations.
### Representative Sections of High-Calcium Low-Magnesium Limestone

<table>
<thead>
<tr>
<th>GEOLOGIC UNIT</th>
<th>COUNTY</th>
<th>THICKNESS</th>
<th>%CaCO₃</th>
<th>%MgCO₃</th>
<th>%SiO₂</th>
<th>%Fe₂O₃</th>
<th>%Al₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reelsville-Beech Cr</td>
<td>Pulaski</td>
<td>41 FT.</td>
<td>97.1</td>
<td>1.05</td>
<td>1.02</td>
<td>0.18</td>
<td>0.28</td>
</tr>
<tr>
<td>Paoli-Beaver Bend</td>
<td>Madison</td>
<td>12 FT.</td>
<td>96.6</td>
<td>0.96</td>
<td>1.56</td>
<td>0.28</td>
<td>0.11</td>
</tr>
<tr>
<td>Ste. Genevieve</td>
<td>Madison</td>
<td>13 FT.</td>
<td>97.2</td>
<td>0.76</td>
<td>1.42</td>
<td>0.15</td>
<td>0.07</td>
</tr>
<tr>
<td>Fort Payne</td>
<td>Adair</td>
<td>33 FT.</td>
<td>92.49</td>
<td>2.17</td>
<td>1.46</td>
<td>0.47</td>
<td>3.24</td>
</tr>
</tbody>
</table>

#### Representative Section of Fort Payne Limestone Facies

Figure 5. Analyses of representative limestone sections.

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### Figure 6. Distribution of high-calcium zones in Upper Mississippian limestones.

- **CoCO₃ > 95%**
- **CoCO₃ < 95%**
- **NO SAMPLES**
The distribution of this facies was not plotted on the regional map.

Though it is not quarried at the present time, this unit may be important because of the general absence of limestone aggregate in the immediate area. Deposits of Upper Mississippian limestones in this county are thin and spotty and the Upper Ordovician limestones outcropping to the west are considered too shaly to produce good aggregate without beneficiation.

**POTENTIAL USES OTHER THAN AGGREGATE**

Though this paper has emphasized the sources of rock for concrete aggregate and road stone, the limestone resources of this area are suitable for a variety of uses. Reports by Stokley and others (1949, 1952, 1953) indicate that the Upper Mississippian limestones contain high-calcium (more than 95 percent CaCO₃) and low-magnesium (less than 3 percent MgCO₃) ledges of sufficient purity to qualify them for a variety of uses in chemical, metallurgical, and special industries, such as the manufacture of portland cement, mine dust for underground coal mines, flux for use in the steel industry, agricultural lime, and filler material for use in agricultural fertilizers (Figs. 5 and 6). Since high-calcium or high-purity limestones are comparatively rare, they may have greater value for special markets than for construction purposes.

**REFERENCES CITED**


Hauser, R. E., 1953, Geology and mineral resources of the Paintsville quadrangle, Kentucky: Kentucky Geol. Survey, ser. 9, Bull. 13, 80 p.


LIMESTONE RESOURCES MAP
APPALACHIAN REGION, KENTUCKY
SHOWING PRINCIPAL AREAS OF OCCURRENCE


Scale 1:600,000
1 inch = approximately 8 miles

January 1, 1967

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>NAME OF COMPANY</th>
<th>CITY</th>
<th>COUNTY</th>
<th>QUARRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Company Name 1</td>
<td>City 1</td>
<td>County 1</td>
<td>Quarry 1</td>
</tr>
<tr>
<td>2</td>
<td>Company Name 2</td>
<td>City 2</td>
<td>County 2</td>
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<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

1. ACTIVE LIMESTONE QUARRY OR MINE
2. IDENTIFICATION NUMBER
3. OUTCROP OF LIMESTONE SUITABLE FOR AGGREGATE
4. PAINT CREEK UPLIFT AREA WHERE LIMESTONE IS PRESENT AT VARIABLE DEPTHS (MADON)

Drawn by Roger B. Parks
Base map by U.S. Geological Survey, 1952