

INTRODUCTION

The gently dipping Olive Hill Clay Bed of Crider (1913) crops out in belt about 15 miles wide and 60 miles long from the Ohio River near Portsmouth, Ohio, south-southwesterly to Frenchburg, Ky. (see inset map).

The purpose of the structure-contour map presented here is to aid exploration by showing the elevations at which the Olive Hill Clay Bed occurs. The structure contours indicate the depths that must be reached in prospecting for the clay. The approximate depth of the clay at any one point is the difference between elevations of the structure and topographic contours. The clay has been thoroughly prospected along its outcrop belt and in most areas where it lies under overburden less than 200 feet thick. The depth of the clay bed increases eastward from the outcrop belt, and large potential resources are likely to occur at depths greater than 200 feet.

GEOLOGY

Stratigraphic sequence

The area is near the western edge of the eastern Kentucky coal fields where the stratigraphic sequence consists of a succession of Lower Pennsylvanian rocks unconformably overlying Mississippian rocks. The Mississippian rocks, from older to younger, are the Brodhead Formation, including the Floyds Knob Formation of Stockdale (1939, p. 135), the Muldraugh Formation, and the equivalents of the Warsaw(?) Limestone, St. Louis Limestone, Ste. Genevieve Limestone, Paoli Limestone of Elrod (1899), Beaver Bend Limestone of Malott (1919), Reelsville Limestone of Malott (1919), Golconda Formation (including the Beech Creek Limestone Member of Malott (1919) and Haneley Limestone Member of McFarlan and Walker (1956), Glen Dean Limestone (Butts, 1922), and Pennington(?) Formation. The Pennsylvanian rocks are composed of the Lee and Breathitt Formations, and they contain the economically important Olive Hill Clay Bed of Crider (1913).

The rocks of Mississippian age are mainly shale, siltstone, fine-grained sandstone, limestone and a small amount of dolomite.

The rocks of Pennsylvanian age are predominantly shale, sandstone, and siltstone, but they also include many coal beds and the Olive Hill Clay Bed of Crider (1913). The oldest unit is the Lee Formation which rests unconformably on rocks of Mississippian age. The Lee Formation ranges in thickness from 140 to 250 feet; south of a line from near Morehead through Elliottville to a point half way between Olive Hill and Graham it consists of a shale unit unconformably overlain by a massive crossbedded quartzose sandstone. In general, the thickness of the shale varies inversely with the thickness of the sandstone. The sandstone unit forms prominent cliffs as much as 200 feet high. The underlying shale unit is dark gray and contains a few beds and lenses of clay, sandstone, siltstone, quartzose sandstones, and red, green, and yellow ochreous shale. North of the line, the Lee Formation is predominantly shale. The lower part of the shale facies is dark gray and contains beds and lenses of sandstone and red, green, and yellow ochreous shale. The upper part of the shale facies is predominantly dark-gray shale with discontinuous beds and interfingering lenses of siltstone, clayey sandstone, quartzose sandstone, thin coal beds, and plastic underclays.

The Olive Hill Clay Bed is an underclay that occurs near the base of the Lee Formation in the shale facies. A thin coal bed, 0 to 10 inches thick, overlies the clay. The clay bed normally occurs 1 to 8 feet above the base of the Lee Formation, but locally it may be as much as 40 feet above the base. The lower contact of the Lee Formation is an unconformity that cuts across 12 of the underlying Mississippian formations.

The Breathitt Formation, which overlies the Lee Formation consists of interfingering beds and lenses of shale, siltstone, quartzose sandstones, graywacke sandstones, coal, and underclay, and a zone of dark-gray limestone and calcareous shale known as the Magoffin Beds of Morse (1931).

STRATIGRAPHIC CONTROL AND DISTRIBUTION OF THE OLIVE HILL CLAY BED

The irregular surface on which the Lee Formation was deposited governs in part the present shape and distribution of the Olive Hill Clay Bed. The clay is thin or absent where the limestone formations of younger Mississippian age are thick and presumably represent topographic highs on the pre-Pennsylvanian surface. The deposition of the oldest beds of the Lee Formation was restricted to the low areas, where the limestone is thin or missing. Evidence of this can be seen about half a mile south of Leisure along the North Fork of the Licking River. The Olive Hill Clay Bed is exposed a few feet above the Glen Dean Limestone in a water tunnel 20 feet below the road (an old logging railroad grade). In an exposure a few hundred feet north of the tunnel the contact of the Lee Formation with the Pennington Formation is exposed 5 feet above the road grade, and the clay bed is absent. Other localities where the Olive Hill Clay Bed is missing and where a thick section of Mississippian limestone is present are shown on the map. Exception to this are the A. W. Walker limestone quarry and the Licking River limestone quarry, and the quarry of the Kentucky Road Oiling Co. on the north side of Christy Creek west of Elliottville. The Olive Hill Clay Bed is exposed above the limestone at the western end of the quarry, but the clay is absent at the eastern end.

The clay is thought to have formed by the leaching and alteration of fine-grained Pennsylvanian sediments in acid swamps (Patterson and Hosterman, in press). The present distribution of the clay may be related to the size and shape of these swamps. The clay has been cut out or the shape of the clay lenses has been changed at several places by the erosion represented by the unconformity at the base of the sandstone facies of the Lee Formation and by channel deposits in the shale facies. The sandstone facies locally rests on beds older than the clay, indicating that erosion prior to deposition of the sand has removed both the clay and the enclosing beds. The shale facies contains many lenses of sandstone which were formed by sand deposited in erosional channels. Locally these channel deposits cut out part, and at a few places all, of the clay.

STRUCTURE CONTOURS

The structure contours shown on the map are at the base of the Olive Hill Clay Bed. The data upon which the structure contours are based were obtained from altimeter reading at outcrops and mines, and from several thousand drill logs provided by private companies. To protect the proprietary interests of the companies, locations of control points are not given.

The Olive Hill Clay Bed has an average easterly dip of approximately 50 feet per mile. The steepest dip is almost 200 feet per mile in the vicinity of Paragon. The shallowest dip is about 50 feet in 3 miles in the area east of Elliottville. A structural high between Beechy and Brushy Creeks about 6 miles south of South Portsmouth has an area of approximately 4 square miles and a closure of slightly less than 100 feet. In evaluating the size of this high, it should be noted that the elevations of the Olive Hill Clay Bed may be in error as much as 20 feet because the collar elevations of many drill holes are not accurately known. At places where the clay bed could not be located in the field or where it was not penetrated in drilling, contours were drawn on the Mississippian-Pennsylvanian unconformity, because of its close proximity to the clay bed. This may give an error in elevation of as much as 10 feet. The regional southwesterly dip of the Mississippian units conforms fairly closely to the dip of the Pennsylvanian beds. At a few localities, however, the dip of Mississippian beds is a little more than that of the overlying Pennsylvanian strata (Patterson and Hosterman, in press). This indicates that the Mississippian beds underwent a slight amount of tilting before the Pennsylvanian beds were deposited.

OLIVE HILL CLAY BED

The mineralogy, origin, and physical, chemical, and ceramic properties of the three types of clay that compose the Olive Hill Clay Bed have been previously described in detail by Patterson and Hosterman (1960, p. 178-194; in press). They show that about one-third of the clay bed is flint clay and two-thirds is semiflint clay. Minor amounts of plastic clay are present. The boundaries between each type of clay are generally sharp and distinct. Typically flint clay overlies semiflint. At many places the reverse is true, and at a few places the flint and semiflint clay are irregularly interlayered. Where plastic clay is present, it ordinarily occurs in the lower part of the bed, but there are many exceptions. Most of the clay is medium gray to brownish gray, but the color ranges from almost black to very light gray. The darker colors, which are due to carbonaceous material of fossil roots, occur at the top of the bed just below the overlying coal bed; the lighter colors occur toward the base of the clay bed. Reddish-brown staining of iron oxides along joints is common.

The degree of crystallinity of kaolinite varies considerably, from high crystalline flint clay to low crystalline plastic clay. Degree of crystallinity is gradational and does not change sharply at boundaries between types of clay; flint clay is in the high range and plastic clay is in the low range of crystallinity, and semiflint is in the intermediate range which, in part, overlaps the other two types. There is a subtle decrease from top to bottom in the degree of crystallinity of kaolinite for all three types of clay.

This subtle decrease in the kaolinite crystallinity gives further proof of the formation of flint clay by leaching downward, as discussed by Patterson and Hosterman (in press). An exception to this, however, is the flint clay exposed at the Rose Hill strip mine. Here the kaolinite is uniformly crystalline from top to bottom, but the flint clay is extremely brecciated. This unusual deposit probably represents an area where reworked clay was deposited, possibly clay that was removed by streams cutting channels into the clay bed prior to the deposition of the sandstone facies of the Lee Formation.

CONCLUSION

The area where most of the clay from the Olive Hill Clay Bed has been mined is from Christy Creek and its tributaries north to the Ohio River. This area has supplied the refractory industry of northeastern Kentucky and southeastern Ohio with raw material for more than 60 years, but much of the once-large reserves of flint clay are now becoming depleted. The map shows the location of many of the active and inactive clay mines, and the areas where the clay is undeveloped. In prospecting these undeveloped areas, it should be noted that where the limestone sequence is thick it is possible that the Olive Hill Clay Bed is missing.

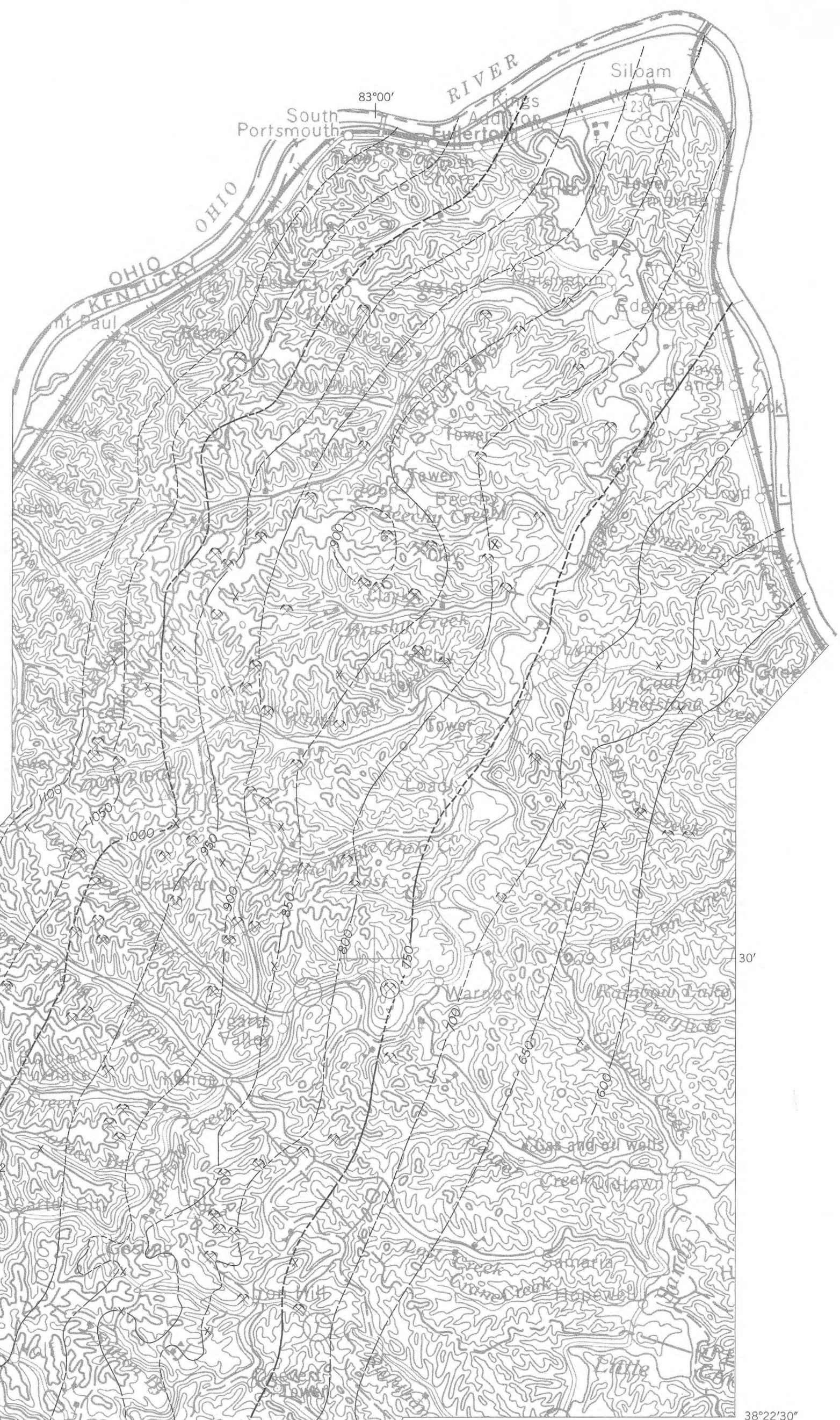
Recently, the refractory companies have been prospecting the area south of Christy Creek in an effort to find more clay. This area undoubtedly has quite a large clay reserve, but the thick limestone sequence and sandstone channel deposits make finding the clay a difficult task. Also, the thick overburden of sandstone will necessitate the use of expensive underground mining methods.

ACKNOWLEDGMENTS

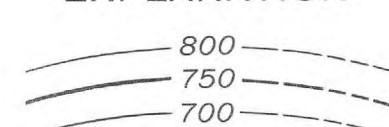
The writer is grateful for permission to use core-drilling information given by private sources. Particular thanks are due Mr. Fred Geising, Consulting Engineer, Ashland, Ky.; Mr. R. C. Valenta and Mr. J. G. Henthorne of the General Refractories Co., Olive Hill, Ky.; Mr. P. C. Mitchell and Mr. Russell Freeman of the Harbinson-Walker Refractories Co., Pittsburgh, Pa.; the North American Refractories Co., Enterprise, Ky.; and the Ironton Firebrick Co., Ironton, Ohio. The writer wishes to express appreciation for the many courtesies shown by the residents of the area.

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EXPLANATION



Structure contours
Drawn on base of the Olive Hill Clay Bed of Crider (1913). Long dashed where control is incomplete. Short dashed where datum is above land surface. Contour interval 50 feet.

X
Selected outcrop of Olive Hill Clay Bed

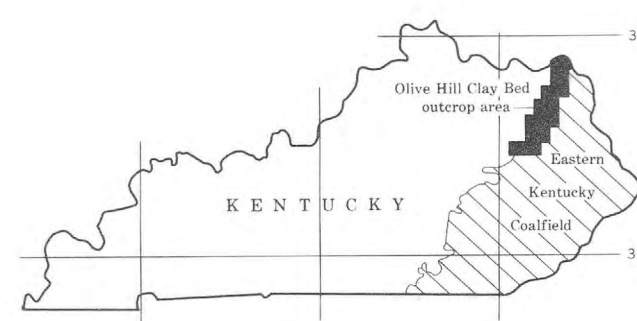
Adit of underground clay mine

Inaccessible underground clay mine

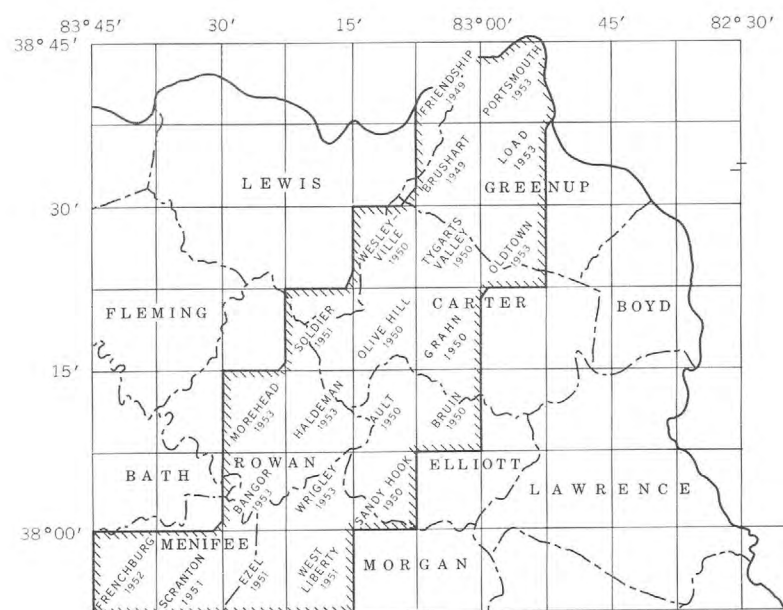
Clay strip mine

Limestone quarry

- Number gives name of quarry listed below:
1. Poplar Island quarry
2. Carter City quarry (abandoned)
3. Acme Stone quarry
4. Olive Hill quarry (abandoned)
5. Leavitt quarry (abandoned)
6. Kentucky Road Oiling Co. quarry
7. Cumberland National Forest quarry
8. Roth Brothers quarry
9. Morgan County quarry
10. Licking River quarry
11. A. W. Walker quarry



INDEX MAP OF KENTUCKY SHOWING THE LOCATION OF THIS AREA AND THE EASTERN COAL FIELD OF KENTUCKY

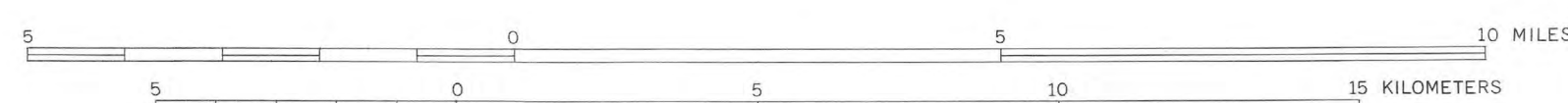


INDEX MAP SHOWING THE OUTLINE OF THE STRUCTURE CONTOUR MAP AND THE QUADRANGLES AND COUNTIES OF NORTHEASTERN KENTUCKY IN WHICH THE OLIVE HILL CLAY BED CROPS OUT

STRUCTURE-CONTOUR MAP OF THE OLIVE HILL CLAY BED IN NORTHEASTERN KENTUCKY

By
John W. Hosterman

Kentucky (Olive Hill clay bed). Structure. 1:125,000. 1963.
cop. 1.



CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL