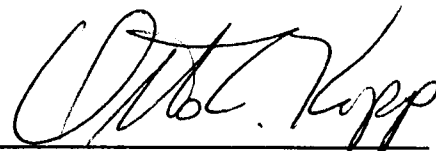


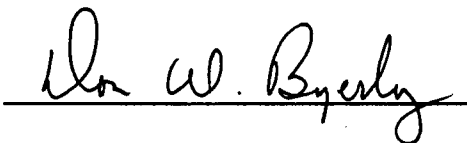
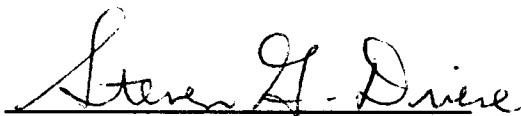
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A STRATIGRAPHIC AND GEOCHEMICAL STUDY
OF
THE JELICO COAL HORIZON
IN THE
NORTHEAST PORTION
OF THE
TENNESSEE COAL BELT

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Barry W. Miller
December 1989

This thesis is dedicated to my parents,
Virginia D. Miller and the late Ralph J. "Rowdy" Miller.

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ABSTRACT

The Jellico coal of the Breathitt Formation (Middle Pennsylvanian) is a high-volatile B bituminous coal that has been extensively mined in northeast Tennessee. The Jellico has been used as a stratigraphic datum for the correlation of other seams in the area; however, these correlations have been complicated by the use of other names for the Jellico coal in adjacent areas.

This study was undertaken within the southern Appalachian coal field of eastern Kentucky and Tennessee to develop a paleodepositional model for the Jellico and to resolve several ambiguities related to presumed equivalent seams. The areal distribution of the Jellico was determined and its stratigraphic, geological, and geochemical characteristics are shown in appropriate maps and cross-sections.

The most prominent structural feature of the area is the Pine Mountain thrust sheet. Stratigraphic cross-sections were constructed throughout the study area and extend across the thrust sheet. The lateral movement (estimated to be 70,000 feet) of the Pine Mountain overthrust was taken into account in constructing the cross sections. The stratigraphic cross-sections reveal that the Jellico horizon thickens to the southeast and northeast and that there are several seams (labeled A through F) within the Jellico horizon. Stratigraphically, the A seam is the lowest and the F seam is the highest. The total thickness of the Jellico (from the base of the A seam to the top of the F seam) ranges from 40 to 140 feet.

Palinspastic isopach, structure contour, and proximate analysis maps of the Jellico horizon suggest that the underlying lithology and

paleotopography influenced both coal thickness and quality. The A seam, which was recognized in only two quadrangles on the Pine Mountain thrust sheet, is very thin and discontinuous. The accumulation of the B and C seams was influenced by underlying topographic highs and lows depending on the position and thickness of the underlying Newcomb Sandstone. A topographic ridge that influenced peat accumulations also influenced the extent of a marine incursion during the time of C seam accumulation. All of the Jellico seams are generally low in sulfur (range 0.19% to 2.77%) and low in ash (range 1.74% to 28.62%) except for the southwestern portion of the C seam horizon where sulfur reaches concentrations greater than 5 percent and ash attains concentrations greater than 40 percent. In this southwestern region, the C seam chemistry was influenced by the marine incursion. The D, E, and, F seams do not exhibit any characteristics of a marine encroachment, but they do thin and thicken in response to the distribution and characteristics of underlying lithologies and paleotopographies. The underlying lithologies were also influenced by paleotopography.

The character of the Jellico coal horizon was also influenced by the effects of tectonic activity on the depositional environment. The Appalachian orogeny was the primary tectonic event on the study area at that time. A lower delta-plain environment was present in the relatively stable northwest while a transitional lower delta-plain environment was present in the subsiding region to the southeast and northeast. The coal seams of the Jellico horizon are thicker and more numerous in those areas that subsided the most.

The other names used for the Jellico seam (Mingo, Log Mountain,

Westbourne, White Oak, Pruden, State, Brushy Mountain, and Petros) are for the most part, equivalent. However, two of the terms comonly used as Jellico synonyms, the Kent and the Mason, are not equivalent. Their true positions lie approximately 450 feet and 650 feet below the Jellico horizon, respectively.

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CHAPTER I

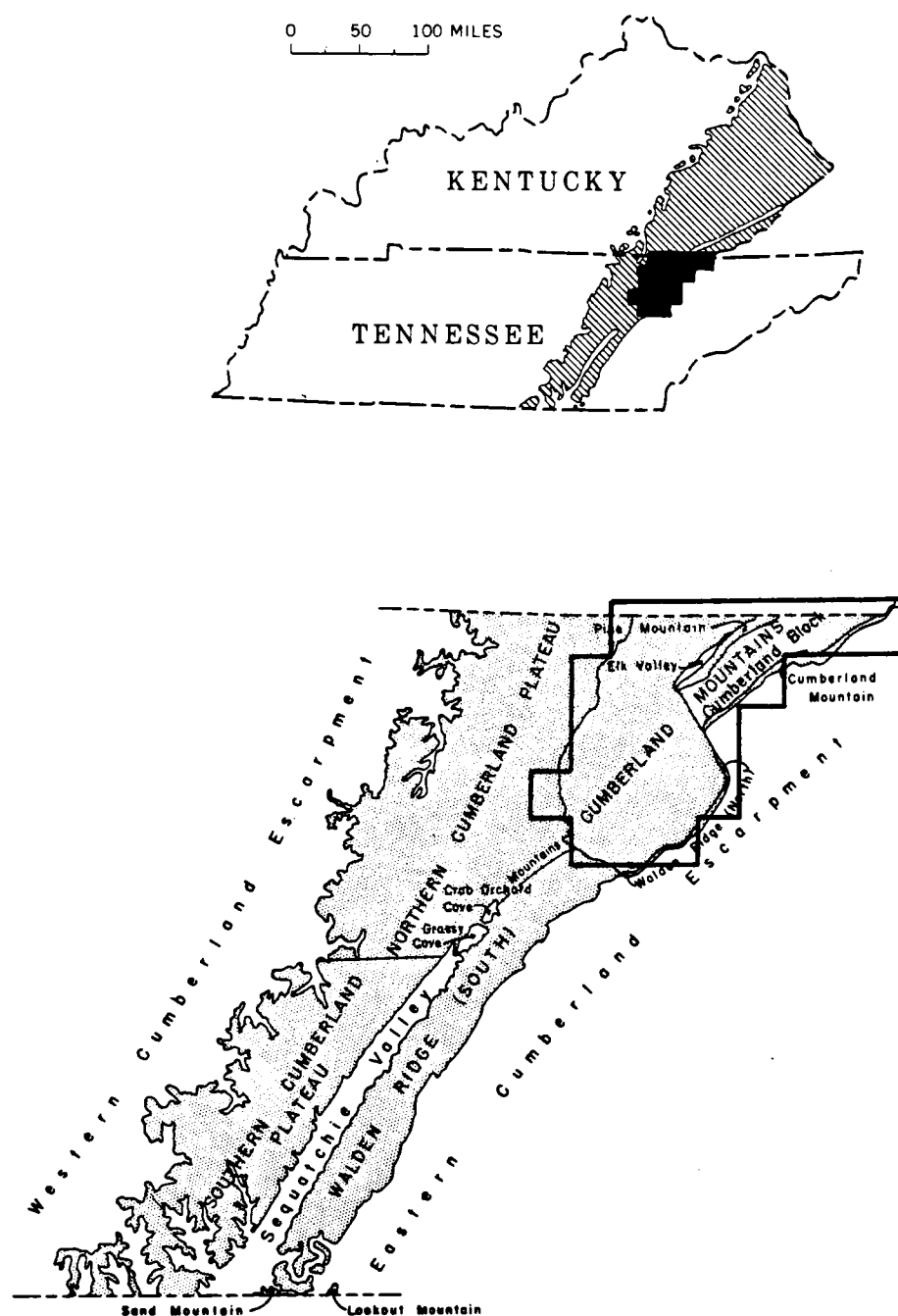
INTRODUCTION

PURPOSE OF STUDY

The Jellico coal seam is a high-volatile B bituminous coal which has been extensively mined in the northeast Tennessee coal fields. The Jellico has been used as a stratigraphic datum for the correlation of other seams in the area; however, there are several ambiguities related to the naming of the Jellico coal seam and its presumed equivalent seams. While the primary purpose of this study is to develop a paleodepositional model (or models) by determining the areal distribution of the coal and its geological and geochemical characteristics, this study will also attempt to clear up the ambiguities related to the naming of the Jellico coal seam and its equivalent seams using the available stratigraphic and geochemical data.

LOCATION OF STUDY AREA

The study area is located within the southern Appalachian coal field of eastern Kentucky and Tennessee. It is included in the Cumberland Mountain portion of the Cumberland Plateau physiographic region (Figure 1). The study area includes 24 quadrangles and occupies 900 square miles within Claiborne, Campbell, Anderson, Scott and Morgan counties of northeast Tennessee, and McCleary, Whitley, and Bell counties of southeast Kentucky (Figure 2).



PHYSIOGRAPHIC DIVISIONS

Figure 1. Index map showing the area of this report (black and outline) in the eastern Kentucky and Tennessee coal fields (shaded). Modified from England, 1968 and Wilson, et al., 1956.

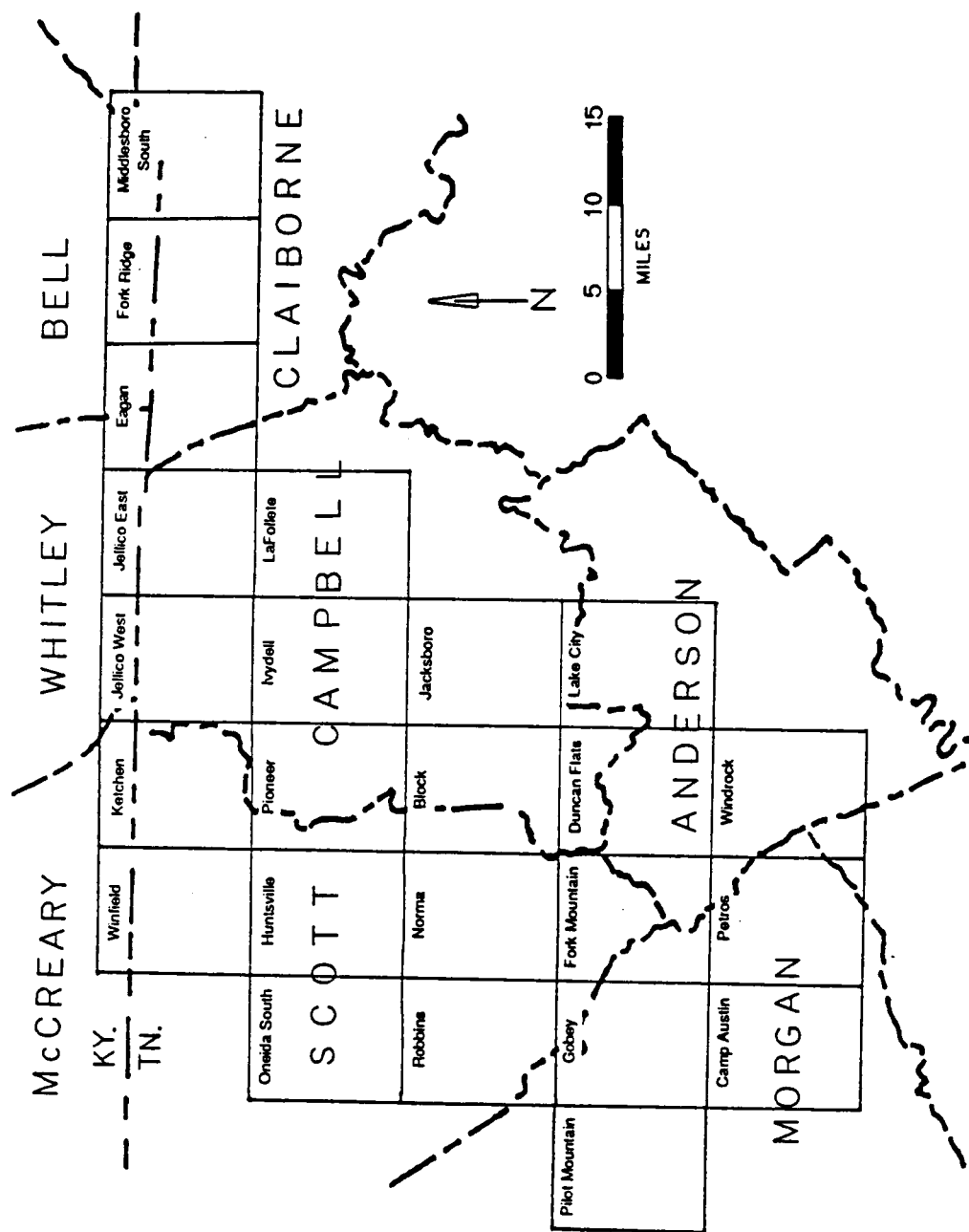


Figure 2. Quadrangle index map.

PREVIOUS WORK

The earliest work in the area was conducted by Safford in his classic *Geology of Tennessee* (1869). This was followed by Arthur Keith's (1896) description of the Briceville quadrangle, which covered most of the study area and contained a more detailed geological description than Safford's investigation. Ashley and Glenn (1906) examined the geology of part of the Cumberland Gap coal field, which included a portion of the Fork Ridge quadrangle of this study. The northern Tennessee coal field was studied by Glenn (1925). This investigation covered all of the present study area and included various coal analyses, coal bed correlations and described the Pennsylvanian geology of the region.

The Pennsylvanian geology of the southern Appalachian coal field was studied by Wanless (1946), who described the stratigraphy and correlated coal beds in eastern Tennessee and Kentucky and western Virginia. Wilson, Jewell, and Luther (1956) investigated the Pennsylvanian geology of Tennessee's Cumberland Plateau. This research consisted of a description of the region's geology and stratigraphy, and correlation of coal beds of the plateau. A summary of the stratigraphic, structural, and economic geology of Mississippian and Pennsylvanian rock in Tennessee was conducted by Milici et al. (1979). Rice (1984) delineated the stratigraphic nomenclature problems on and across the Pine Mountain thrust sheet and a re-interpretation of coal bed correlations was compiled.

Analyses of coal in the study area were reported by Glenn (1925), Nelson (1945), Snyder and Aresco (1953) and Aresco et al. (1956; 1957; 1959). Coal reserve studies were conducted by Williams et al. (1955),

Hershey et al. (1956), Williams et al. (1956), Williams et al. (1956), Williams et al. (1956), Luther (1959), and Johnson and Luther (1972).

Geologic mapping in the study area has been conducted by members of the Tennessee Division of Geology and the U.S. Geologic Survey. A list of geologic maps and authors is contained in Appendix A.

STRATIGRAPHY

The Jellico coal seam is contained within the Early and Middle Pennsylvanian age Breathitt Formation which lies directly above the Lee Formation in the study area. The Middle Pennsylvanian stratigraphy of east Tennessee is complicated by the use of different stratigraphic nomenclatures in adjacent areas and by inconsistent correlations, particularly across the Pine Mountain thrust block.

The Breathitt Formation and the underlying Lee Formation were originally undifferentiated by Safford (1869) and were called the Coal Measures (Figure 3). The Coal Measures were later divided by Keith (1896b) into the Anderson Sandstone, Scott Shale, Wartburg Sandstone, Briceville Shale, and the Lee Conglomerate. The boundaries between these divisions were arbitrarily selected on the basis of the relative amounts of sandstone and shale within each. The Jellico coal bed is located within Keith's Wartburg Sandstone section (Figure 3).

Glenn (1925) modified Keith's stratigraphy into the Briceville, Jellico, Scott, and Anderson Formations. The Jellico seam was located within the Jellico Formation whose boundaries were defined as the top of the Pioneer sandstone and the base of the Blue Gem coal (Figure 3). Glenn's nomenclature was generally accepted until Wilson et al. (1956)

SAFFORD (1869)	KEITH (1896b)	ASHLEY AND GLENN (1906) LOG MT. AREA	GLENN (1925)	WANLESS (1946)	WILSON, ET AL. (1956)	ENGLUND (1964, 1968)	SERIES
COAL	ANDERSON SANDSTONE	BRYSON FORMATION Red Spring Coal (Bald Knob Coal)	ANDERSON FORMATION "Magoffin Beds"	ANDERSON FORMATION	CROSS MOUNTAIN GROUP	BRYSON FORMATION Red Spring Coal	ALLEGHENY Rockspring Coal
		HIGNITE FORMATION Lower Hignite Coal (Pewee Coal)	Pilot Mt. SS	Pilot Mt. SS	Frozenhead SS VOWELL MT. GROUP Pewee Coal	HIGNITE FORMATION	
		CATRON FORMATION Poplar Lick Coal (Windrock Coal)	SCOTT FORMATION	SCOTT FORMATION	REDOAK MT. GROUP Windrock Coal	"Magoffin Beds" CATRON FM Windrock Coal	
		MINGO FORMATION			GRAVES GAP GROUP Windrock Coal	MINGO FORMATION	
	SCOTT SHALE	MINGO FORMATION	Pioneer SS JELICO FORMATION Blue Gum Coal	Pioneer SS JELICO FORMATION Blue Gum Coal	Pioneer SS INDIAN BLUFF GROUP Jellico Coal	Jellico Coal	KANAWHA Poplar Creek Coal
		HANCE FORMATION Bennett Fork Coal (Coal Creek Coal)	BRICEVILLE FORMATION	BRICEVILLE FORMATION	SLATESTONE GROUP	HANCE FORMATION	
		LEE FORMATION Corbin SS	LEE FORMATION FENTRESS SHALE	LEE GROUP	Wartburg Poplar Creek SS CROOKED FORK GROUP Rockcastle Conglomerate	LEE FORMATION	
	BRICEVILLE SHALE	LEE FORMATION	ROCKCASTLE SS	LEE GROUP	CRAB ORCHARD MOUNTAINS GROUP	LEE FORMATION	NEW RIVER
					Sevenses Conglomerate PENNINGTON Lee Tongue	PENNINGTON FORMATION	
					Sevenses Conglomerate GIZZARD GROUP	GIZZARD FORMATION	
MEASURES	LEE CONGLOMERATE	LEE FORMATION	LEE FORMATION	LEE GROUP	Sevenses Conglomerate GIZZARD GROUP	Sevenses Conglomerate PENNINGTON Lee Tongue	NEW RIVER
	BRICEVILLE SHALE	LEE FORMATION	LEE FORMATION	LEE GROUP	Sevenses Conglomerate GIZZARD GROUP	Sevenses Conglomerate PENNINGTON Lee Tongue	NEW RIVER
	LEE CONGLOMERATE	LEE FORMATION	LEE FORMATION	LEE GROUP	Sevenses Conglomerate GIZZARD GROUP	Sevenses Conglomerate PENNINGTON Lee Tongue	NEW RIVER

Figure 3. Stratigraphic framework of Pennsylvanian rocks in northeast Tennessee. Modified from Wilson, et al., 1956.

suggested that this terminology be dropped and be replaced by the Crooked Fork, Slatestone, Indian Bluff, Graves Gap, Red Oak Mountain, Vowell Mountain, and Cross Mountain Groups. The top of the Jellico coal seam was used as the upper boundary of the Slatestone Group while the top of the Poplar Creek coal seam was used as the base of the Group (Figure 3).

Hardeman et al. (1966) found that the divisions above the Crooked Fork Group were difficult to map and suggested that these groups be reduced in rank to formations. Geologists from the Tennessee Division of Geology have been using this nomenclature in their geologic mapping. Englund (1968) pointed out various inconsistencies with the Wilson, et al. (1956) nomenclature, particularly the placement of some group contacts. He suggested reestablishing the nomenclature of Ashley and Glenn (1906) in accordance with the rule of priority of the Code of Stratigraphic Nomenclature (1961). Englund used the Ashley and Glenn (1906) nomenclature when he mapped the Middlesboro South quadrangle and the Elk Valley area (Ketchen, Jellico West, Pioneer, and Ivydell quadrangles). The stratigraphy above the Lee Formation consisted of the Hance, Mingo, Catron, Hignite, and Bryson Formations. The base of the Jellico coal and the base of the Windrock coal delineated the contacts of the Mingo Formation (Figure 3).

Rice (1984) established that many of Ashley and Glenn's key beds were regionally discontinuous and that many of the coal seam correlations were suspect. As a result, formation boundaries were drawn inconsistently throughout the region, particularly on and across the Pine Mountain overthrust sheet. Rice suggested that the stratigraphic

nomenclature of the new Geologic Map of Kentucky (McDowell et al. 1981) be used until these problems are resolved. McDowell et al. grouped the Pennsylvanian units into an all-encompassing Breathitt Formation which could be correlated across the Pine Mountain overthrust sheet. In this study, the Pennsylvanian strata will be referred to as the Breathitt Formation. An uncomplicated representation of the general stratigraphic sequence of the Pennsylvanian strata in the study area is shown in Figure 4.

In addition to the confusing formation nomenclature, the Jellico coal seam itself has numerous equivalent terms for a seam or seams within the same stratigraphic horizon across the study area including the Mingo, Mason, White Oak, Pruden, Westbourne, Log Mountain, State, Petros, and Brushy Mountain seams (Figure 5). The Kent seam, often referred to as the Jellico seam (particularly on the overthrust sheet), is located several hundred feet below the Jellico horizon and should not be considered with the Jellico equivalent seams. Early correlations did not take into account the eastward thinning and lateral intertonguing of the Lee Formation with the Breathitt Formation. The Jellico to the west and the Kent to the east have similar vertical distances from the top of the Lee Formation and were subsequently miscorrelated (Englund, 1968).

Several cross-sections (Plates 1, 2, 3, 4, and 5) were drawn for this study and correlated with the type section of the Jellico coal seam (Glenn, 1925) located in the Jellico-Newcomb mining district, Tennessee and the type section of the Indian Bluff and Slatestone Groups (Wilson, et al., 1956) located on Cross Mountain near Lake City, Tennessee. Typical sections from the Jellico-Newcomb mining district are shown on Plate 2

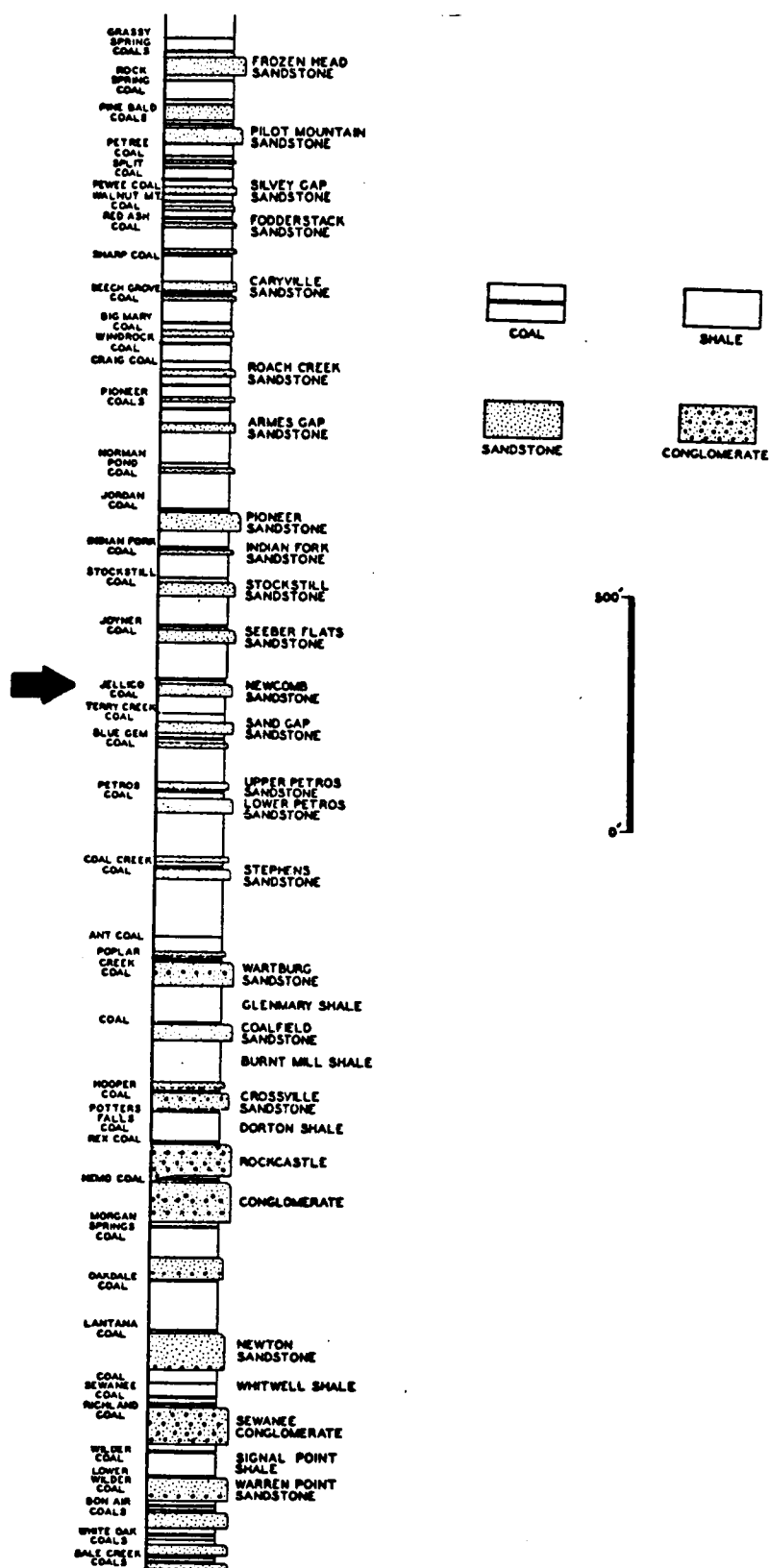


Figure 4. Generalized stratigraphic column for Pennsylvanian strata in the study area. Modified from Luther, 1959.

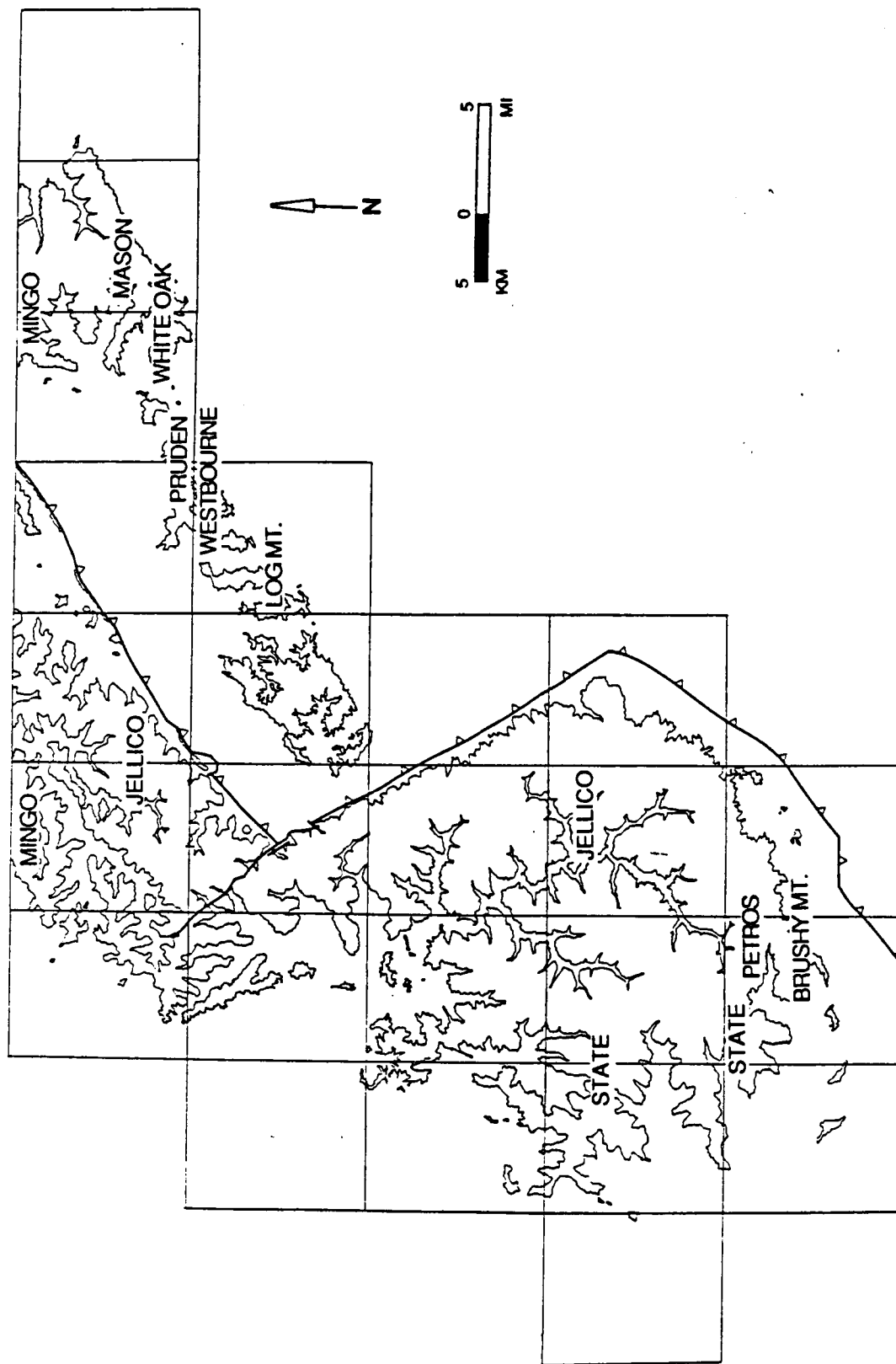


Figure 5. Names and locations of Jellico coal seam equivalents.

(sections JEW-57, JEW-72, JEW-76, JEW-77, and JEW-82). The Cross Mountain sections are shown on Plate 5 (sections LAK-43 and LAK-71) and on Plate 1 (sections LAK-42 and LAK-43). Locations of these cross-sections are summarized in Figure 6 and Figure 7.

STRUCTURE

The most prominent structural feature of the study area is the Pine Mountain thrust sheet, which is also known as the Cumberland Mountain overthrust block. The entire block covers an area approximately 125 miles long and 25 miles wide, and extends into Kentucky and Virginia.

In the study area, the thrust sheet is bounded to the northwest by the Pine Mountain thrust fault and to the southwest by the Jacksboro tear fault (Figure 8). Mitra (1988) estimated the amount of horizontal displacement on the Jacksboro tear fault to be about 13.3 miles. The Jacksboro fault extends northwest of the Pine Mountain thrust as the Terry Creek fault. The Terry Creek fault is a high-angle fault, which has as much as 200 feet of vertical displacement (Englund, 1968).

In addition to moving approximately 13 miles to the northwest, the Pine Mountain thrust sheet was warped into two broad folds, the Middlesboro syncline and the Powell Valley anticline (Figure 8). Southwest of the Jacksboro fault, a broad structural low called the Wartburg basin is bounded by the Chattanooga thrust fault, the Whetstone Mountain thrust fault and the Emory River fault. In the Camp Austin quadrangle, most of the movement on the Emory River fault is attributed to slippage along strike. Northwest of Camp Austin quadrangle, the fault displays appreciable throw in offset beds, although no evidence of

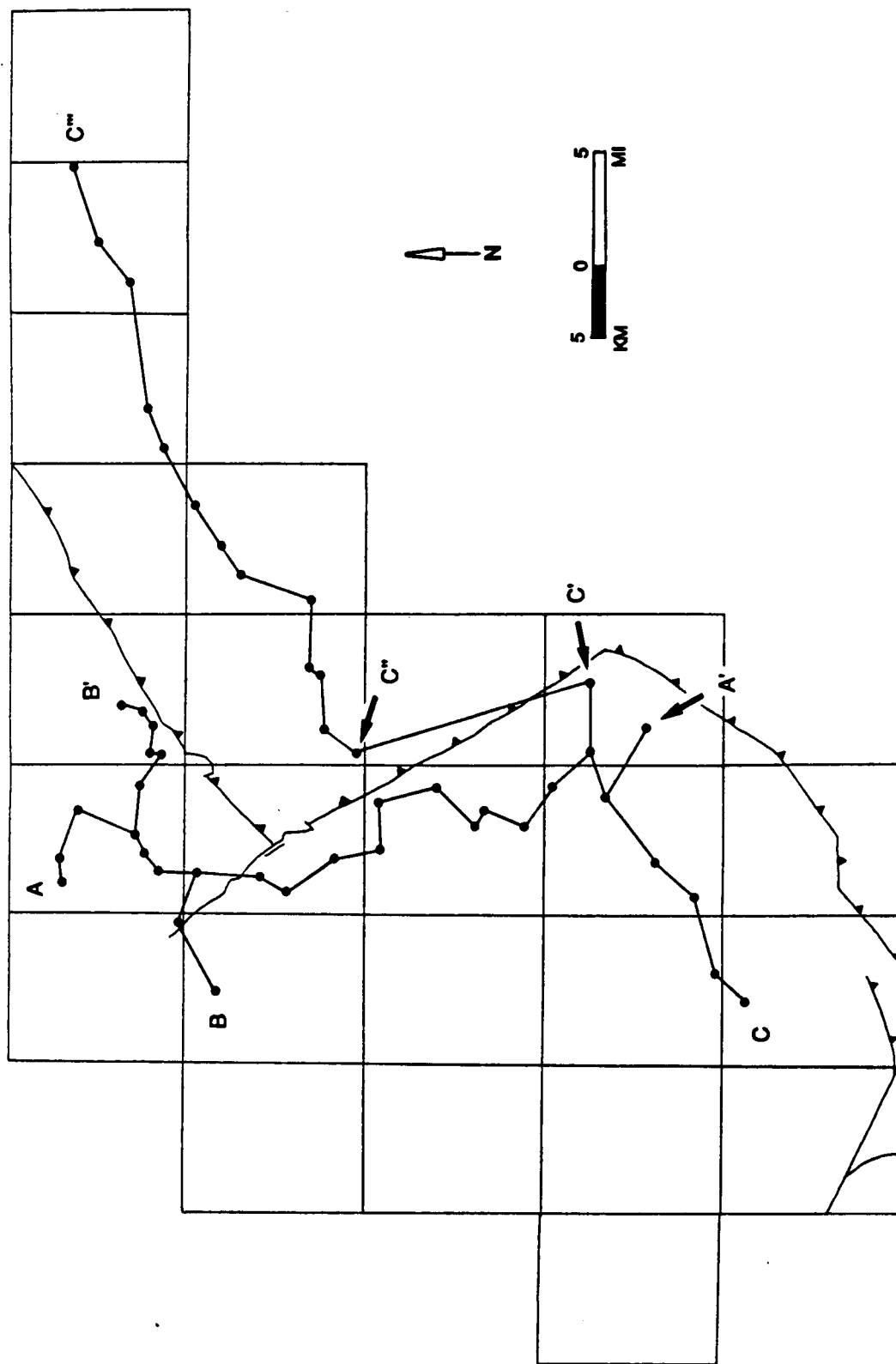


Figure 6. General location map of cross-sections shown on Plates 1, 2, and 3 (coal seam correlations).

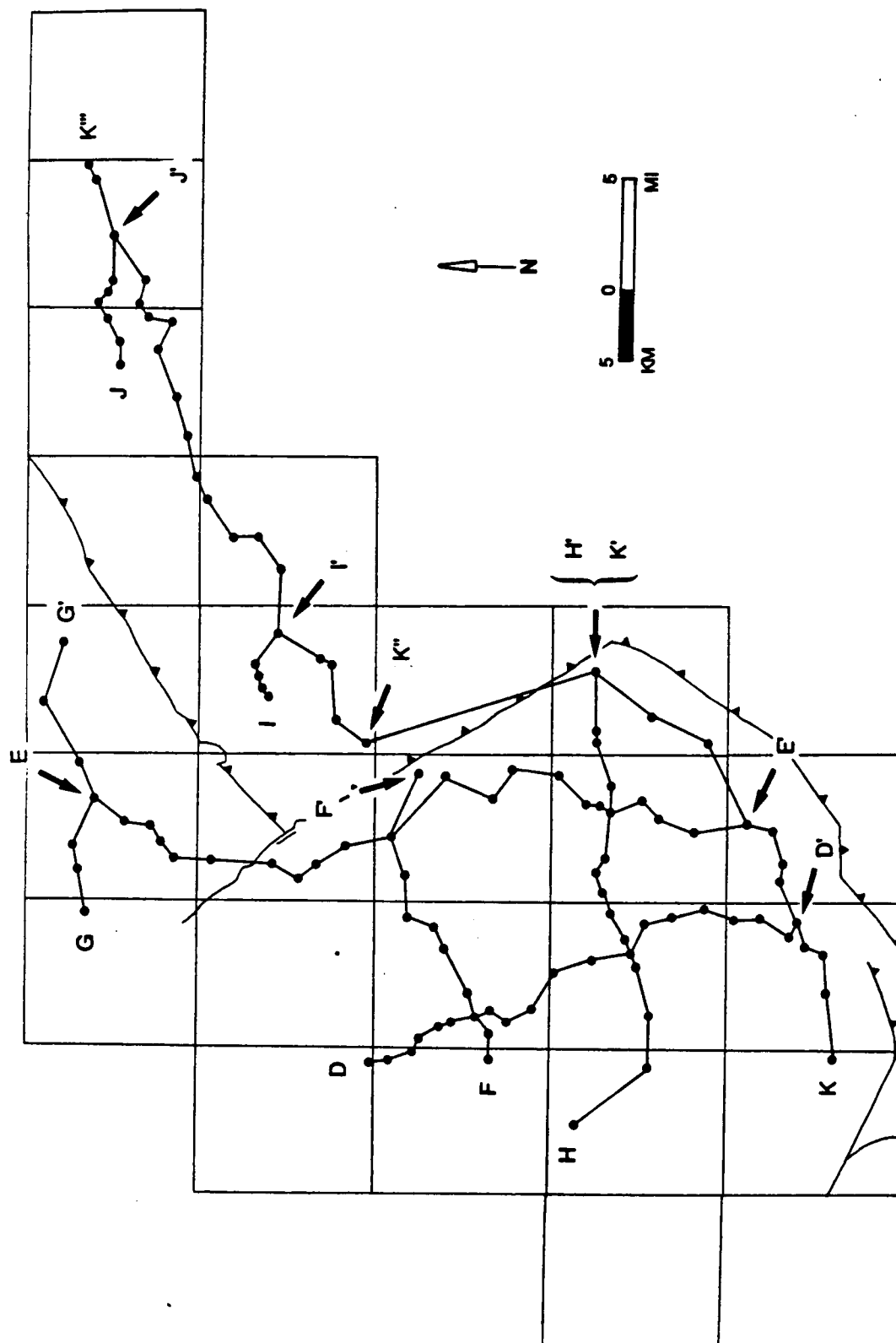


Figure 7. General location map of cross-sections shown on Plates 4 and 5 (Jellico horizon cross-sections).

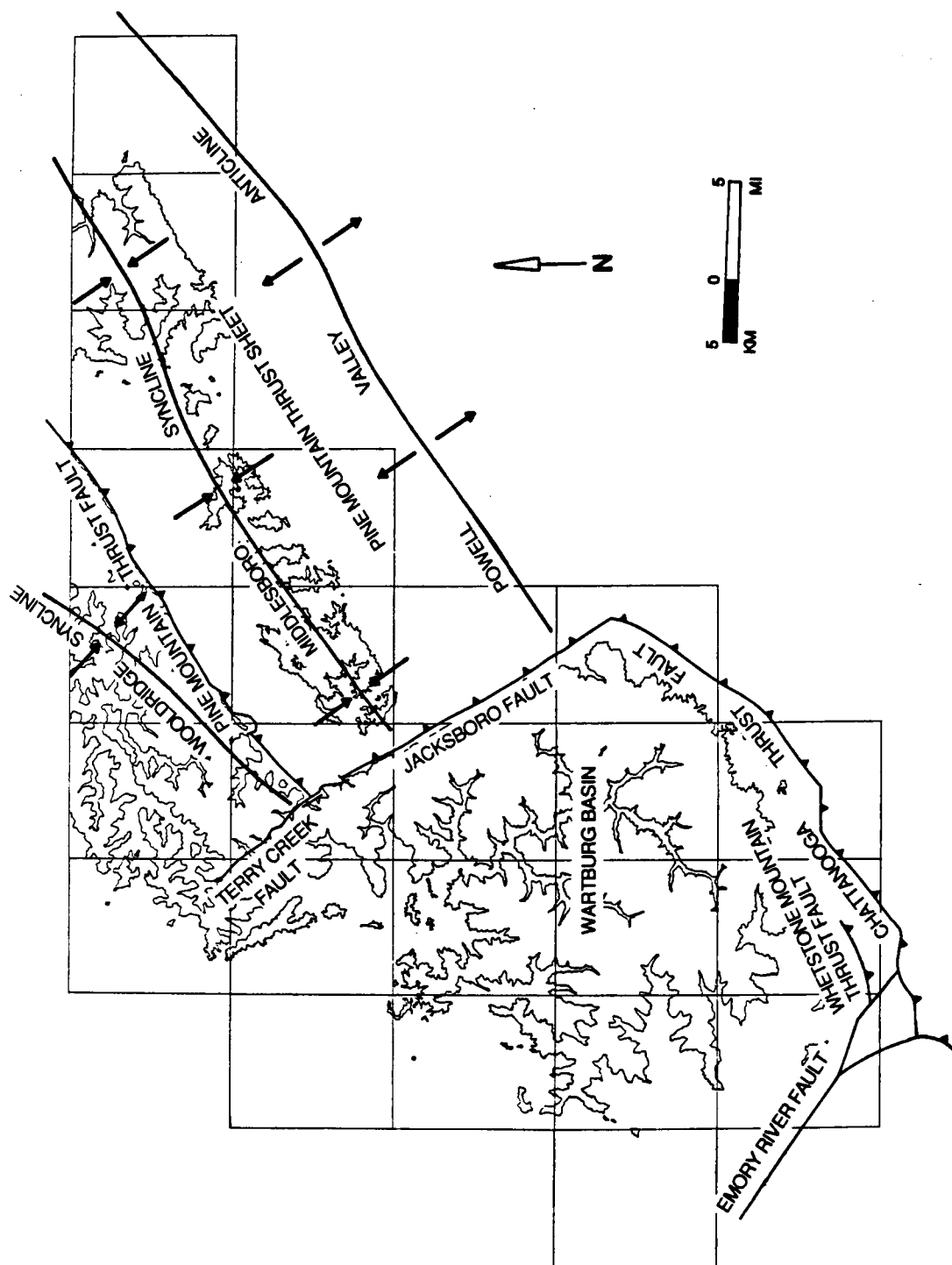


Figure 8. Prominent structural features of the study area.

appreciable throw has been seen locally (Stearns, 1954).

MINING HISTORY

The Jellico coal seam and its stratigraphic equivalents have been an important source of energy in the east Tennessee area for over a hundred years. Early settlers in the area probably knew of the coals in the Cumberland Mountains, but did not use them domestically due to the ready abundance of wood. The first recorded use of coal in the state was in forges (Englund, 1968).

Large-scale commercial mining of coal (including the Jellico seam) began with the advance of railroads into these secluded areas. The Knoxville and Ohio Railroad was built to the Caryville and Coal Creek region (Campbell county) circa 1870 and was extended to the Elk Gap area by 1882. Although the Jellico was not of workable thickness in the Caryville and Coal Creek region, several companies opened mines in the Jellico seam in the Jellico-Newcomb area. These mines were developed by the Jellico Coal Company (renamed the Wooldridge Jellico Coal Company) in 1882, the Standard Company in 1883, and the Falls Branch Coal Company in 1893 (Glenn, 1925).

Commercial mining of the Jellico seam began in 1890 in the Bennett Fork area (Claiborne county) with the development of the Mingo Numbers 1 and 2, Reliance, and Fork Ridge mines and was followed in 1891 by the Bryson Mountain mine. The Louisville and Nashville Railroad was completed north of La Follette (Campbell county) circa 1905 and was followed by the development of the Pruden mine on Clear Fork (Claiborne county) in 1906 (Glenn, 1925).

The Cincinnati Southern Railway was built in Morgan county by the late 1870's and the Southern Railway was built nearby several years later. The Southern extended from Harriman through Oliver Springs to Clinton where it connected with the railroad to Knoxville. Mining followed the extensions of these railways with the development of mines in the Oliver Springs area between 1880 and 1885. The State of Tennessee began using convict labor in its extensive Petros area mines in 1895 following the completion of the Harriman and Northeastern Railroad in the area in the same year (Glenn, 1925).

The Cincinnati Southern Railway was extended from Morgan county into Scott county between 1875 and 1881. The railway runs north-south across the county and became the main coal-carrying line after commercial mining started. A spur track was built along Smoky Creek in 1908 where the Jellico seam was developed around Newland and Smoky (Glenn, 1925).

Underground mining flourished until the 1920's when most seams of workable thicknesses were being mined. Underground mining declined in later years and was replaced by large-scale contour strip mining in the early 1940's (Englund, 1968). Presently, technological advances are allowing new development in areas where the coal was once too thin to mine; however, coal mining in the Cumberland Mountains has decreased in recent years due to the decline in the market price of coal. This trend is expected to reverse itself as the nation becomes more dependent on coal as its oil reserves are depleted.

At present, development of the Jellico seam is concentrated in the Jellico West, Ketchen, Duncan Flats, Fork Mountain, and Norma

quadrangles.

DATA AND SAMPLE COLLECTION

An extensive literature and map search was conducted at the Tennessee Division of Geology, the U.S. Office of Surface Mining, the Tennessee Valley Authority, the Kentucky Geologic Survey, the U. S. Geologic Survey, and the University of Tennessee library. All of the available data on the Jellico section and coal chemistry was accumulated and drafted onto 1:24,000 quadrangle bases. Once the extent of the coal outcrop had been established, coal companies, land companies and consulting geologists were contacted for additional data. In order to insure correct correlations, stratigraphic cross-sections were constructed across the study area and tied into known type sections. These cross-sections were also helpful in areas where the personnel of some companies disagreed with the correlations of the Tennessee Division of Geology.

Once the positions and elevations of the Jellico seam were established over the study area, a field survey was conducted. The Jellico coal was sampled and the overburden and underburden was described. It was not always possible to obtain samples of the coal due to reclamation or debris talus. When samples could be collected, the surface facing was excavated to obtain the freshest possible material. Special care was taken to insure that the overlying rocks or splits in the coal did not contaminate the coal sample. Relatively equal amounts were collected throughout the coal section (channel sample) in order to obtain a representative sample of the coal. The samples were labeled and stored

in plastic bags until they could be prepared for analysis.

CHAPTER II

METHODS

STRATIGRAPHIC CROSS SECTIONS

Numerous coal seam nomenclature discrepancies and miscorrelations were encountered during the collection of the preliminary data. Several stratigraphic cross-sections (Plates 1, 2, 3) were constructed throughout the study area in order to have a reference with which to compare all data, particularly drill hole and outcrop section data. The general location of the cross-sections is summarized on Figure 6 (page 12). The cross-sections were correlated with type sections which contained the Jellico horizon in order to insure that the same horizon was studied throughout the area of interest. Coal seam elevations, thicknesses, and associated lithologies were considered in all correlations. The type sections of the Jellico coal horizon are located in the Jellico-Newcomb mining district, Tennessee (Glenn, 1925) and the type sections of the Indian Bluff and Slatestone Groups are located on Cross Mountain near Lake City, Tennessee (Wilson et al., 1956). Typical sections from the Jellico-Newcomb mining district are shown on Plate 2 (sections JEW-57, JEW-72, JEW-76, JEW-77, and JEW-82). The Cross Mountain sections are shown on Plate 1 (sections LAK-42 and LAK-43). These cross-sections take into account the lateral movement of the Pine Mountain overthrust.

DATA DISTRIBUTION MAPS

The Jellico coal outcrop and data points were plotted on 1:24,000

topographic quadrangle bases. These quadrangles were then used in field reconnaissance and coal sample recovery. Once all available field data were recorded, a 1:96,000 base map was drafted displaying all known and projected outcrops of the Jellico coal seam, quadrangle boundaries, and fault boundaries. The data distribution maps as well as all other maps of different scales in the text were constructed using the base map. The data distribution maps (Appendix B) consist of individual quadrangle bases with longitude and latitude crosshatches, Jellico outcrop boundaries, and data points. The data points were divided into seven categories: drill hole data, drill hole data with coal analysis, coal seam measurement only, coal seam measurement only with coal analysis, coal analysis only, measured strata section (which may or may not include a coal measurement), and measured strata section with coal analysis. The symbols used for the different categories are shown in Appendix C. Each data point was given its own individual designation, which is a combination of a quadrangle abbreviation, quadrangle section and description number in that order. The longitude and latitude crosshatches are used to divide each quadrangle into nine sections (Figure 9). Each data point in each section is sequentially numbered so that each point has a unique designation. For example, data point DUN-513 is the 13th point in the 5th or middle section located in the Duncan Flats quadrangle.

OUTCROP AND PALINSPASTIC MAPS

The individual data distribution maps were combined to exhibit the total areal extent of the Jellico outcrop, fault boundaries, and quadrangle boundaries. Individual data points were omitted to reduce clutter at the

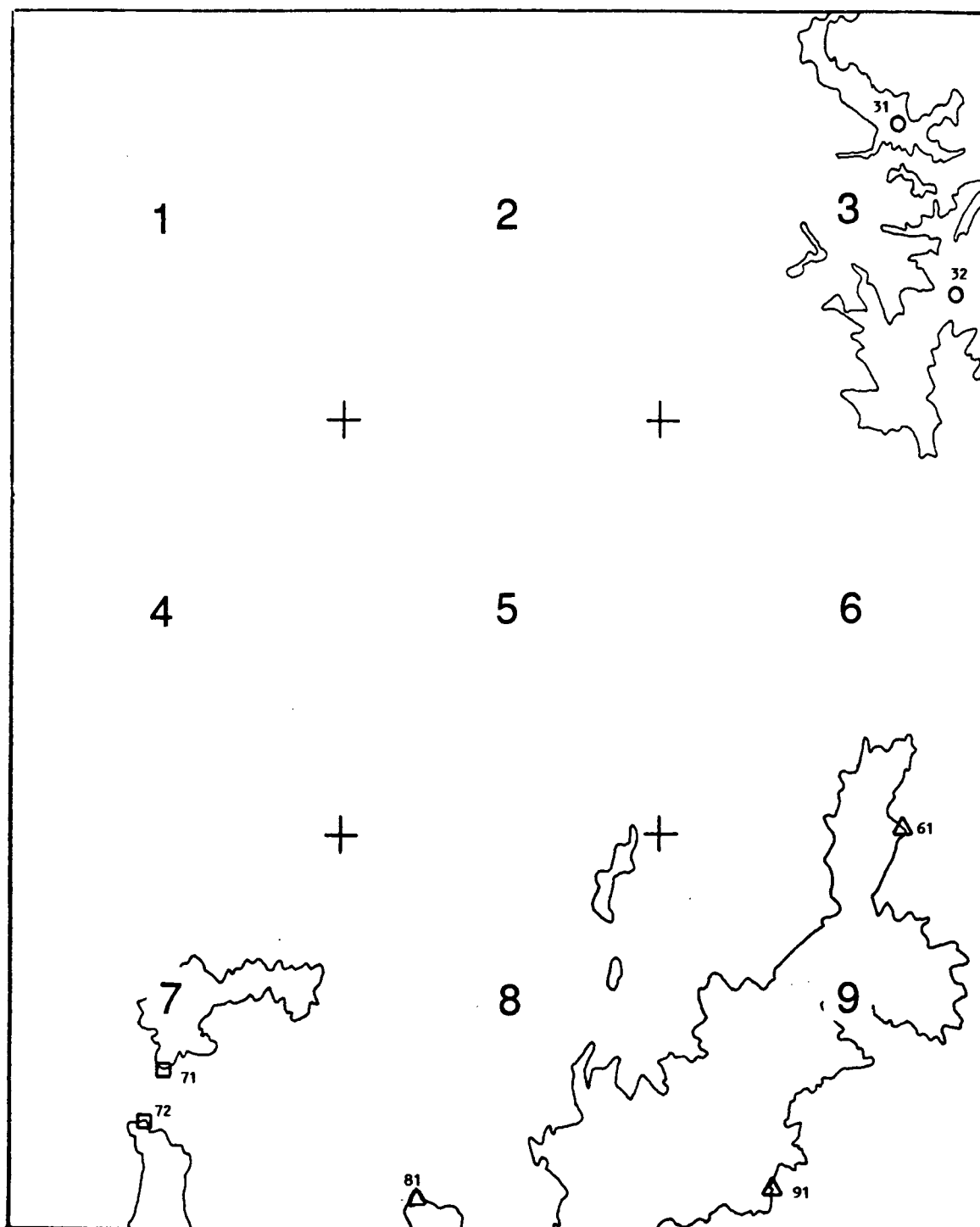


Figure 9. Quadrangle sections.

reduced scale (Figure 10). The most laterally continuous and thickest seam was chosen as the outcrop boundary.

Maps were constructed using a palinspastic base map to display the original relative paleogeographic position of the Pine Mountain thrust sheet to the rest of the study area (Figure 11). The palinspastic base map was used to create the coal isopach, proximate analysis distribution, sandstone isopach, and trace element distribution maps. The map was constructed by using Mitra's (1988) balanced cross-section calculations of 70,000 feet of displacement along the Jacksboro tear fault and 52,000 feet of displacement along a section approximately 30 miles northeast of the Middlesboro South quadrangle. A 7 degree angle of divergence between the direction of movement of the thrust sheet and the Jacksboro fault (Englund, 1968) was also used in the construction of the palinspastic base map. Outcrop features and quadrangle boundaries were omitted on some maps for the sake of clarity.

PROXIMATE ANALYSIS

Proximate analyses and some ultimate analyses were obtained from various coal companies, the Office of Surface Mining, and available literature. In addition to their data, the coal samples obtained from field reconnaissance were analyzed by Kenwill, Inc. under ASTM standards. The analyses are given in Appendix D and the location of the samples analyzed can be found on the data point maps in Appendix B.

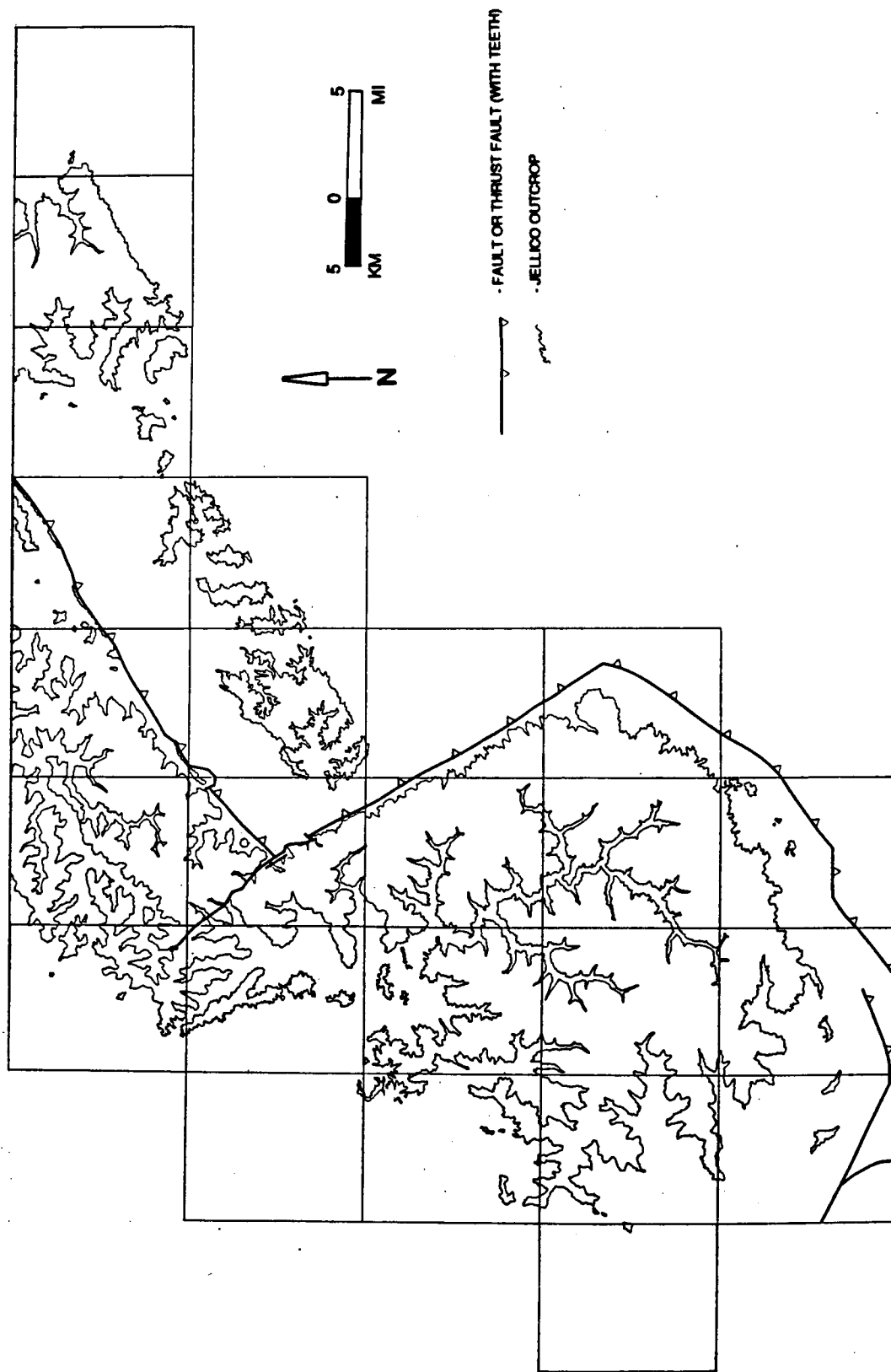


Figure 10. Jellico outcrop map with quadrangle boundaries and faults (See Figure 2, page 3 for quadrangle names and Figure 8, page 14 for fault names).

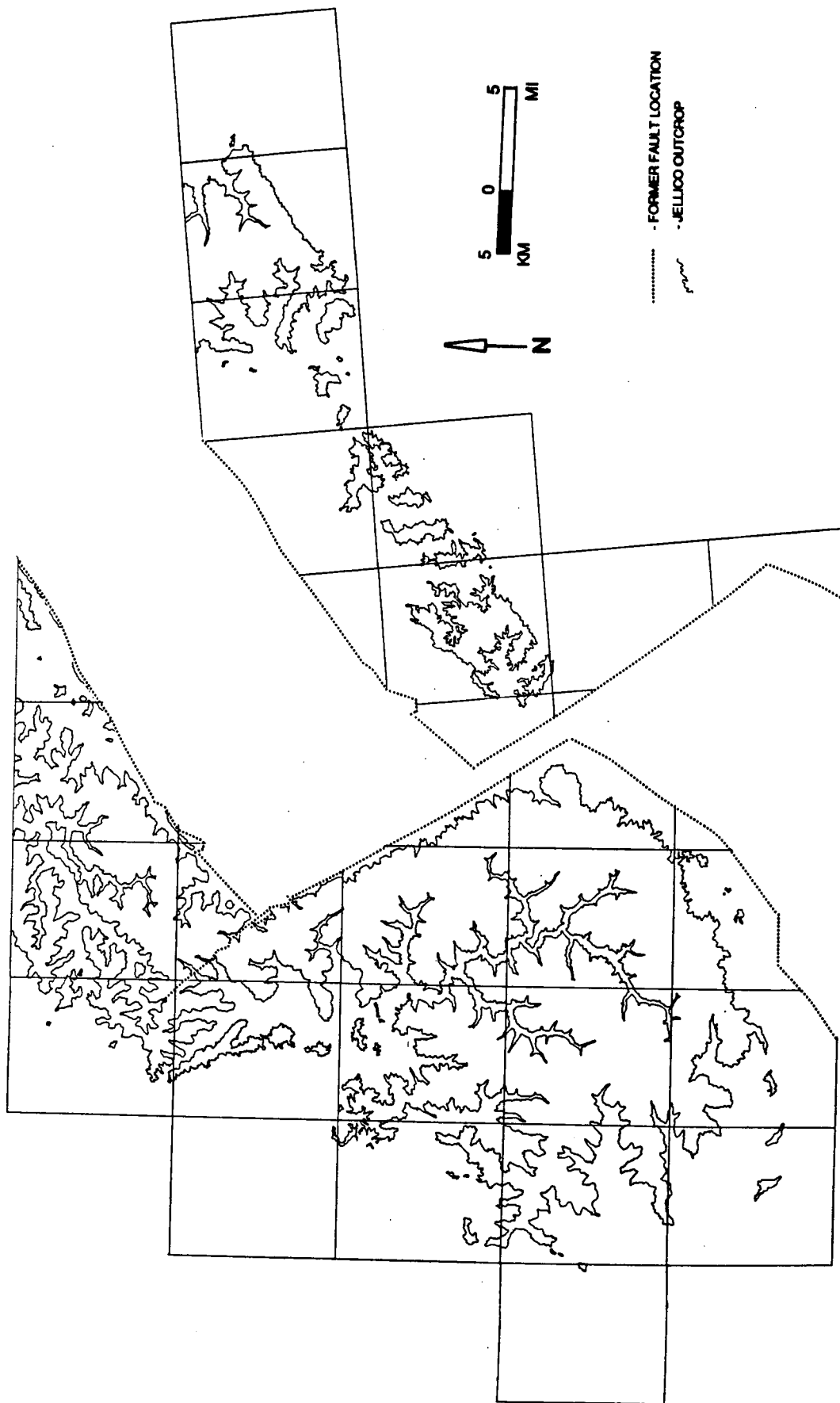


Figure 11. Palinspastic map with quadrangle boundaries. (See Figure 2, page 3 for quadrangle names and Figure 8, page 14 for fault names).

CHAPTER III

RESULTS

UNDERLYING SEDIMENTARY ROCKS

The interval between the overlying Jellico coal horizon and the underlying Blue Gem coal horizon ranges from 80 to 150 feet (Plates 1, 2, and 3). This interval generally contains an upper sandstone member (Newcomb Sandstone), an unnamed middle shale member, and a lower sandstone member (Sand Gap Sandstone). The Newcomb Sandstone is discontinuous, but generally more prevalent than the Sand Gap Sandstone. The Newcomb Sandstone lies below the Jellico coal horizon with an intervening 5-10 foot shale bed. These sandstone members are yellowish-gray to yellowish-brown, fine- to medium-grained, thin- to thick-bedded, and cross-bedded in part (Wilson et al. 1956).

An isopach map was constructed for the Newcomb Sandstone (Figure 12) to determine whether any features at this scale might suggest channel locations or directions. Although the sandstone isopach map does not display any definite channel features, a sandstone distribution map of the Newcomb Sandstone constructed by Wilson et al. (1956) exhibits a digitate pattern of massive sandstone bodies generally trending to the northwest over the whole area. A reconnaissance of the Newcomb sandstone revealed only limited data on its cross-bedding; however, the available data suggests migration to the west or northwest (Figure 12). Of the three sites where cross-bed readings could be taken for this study, only one site (HUN-82) proved to be statistically significant.

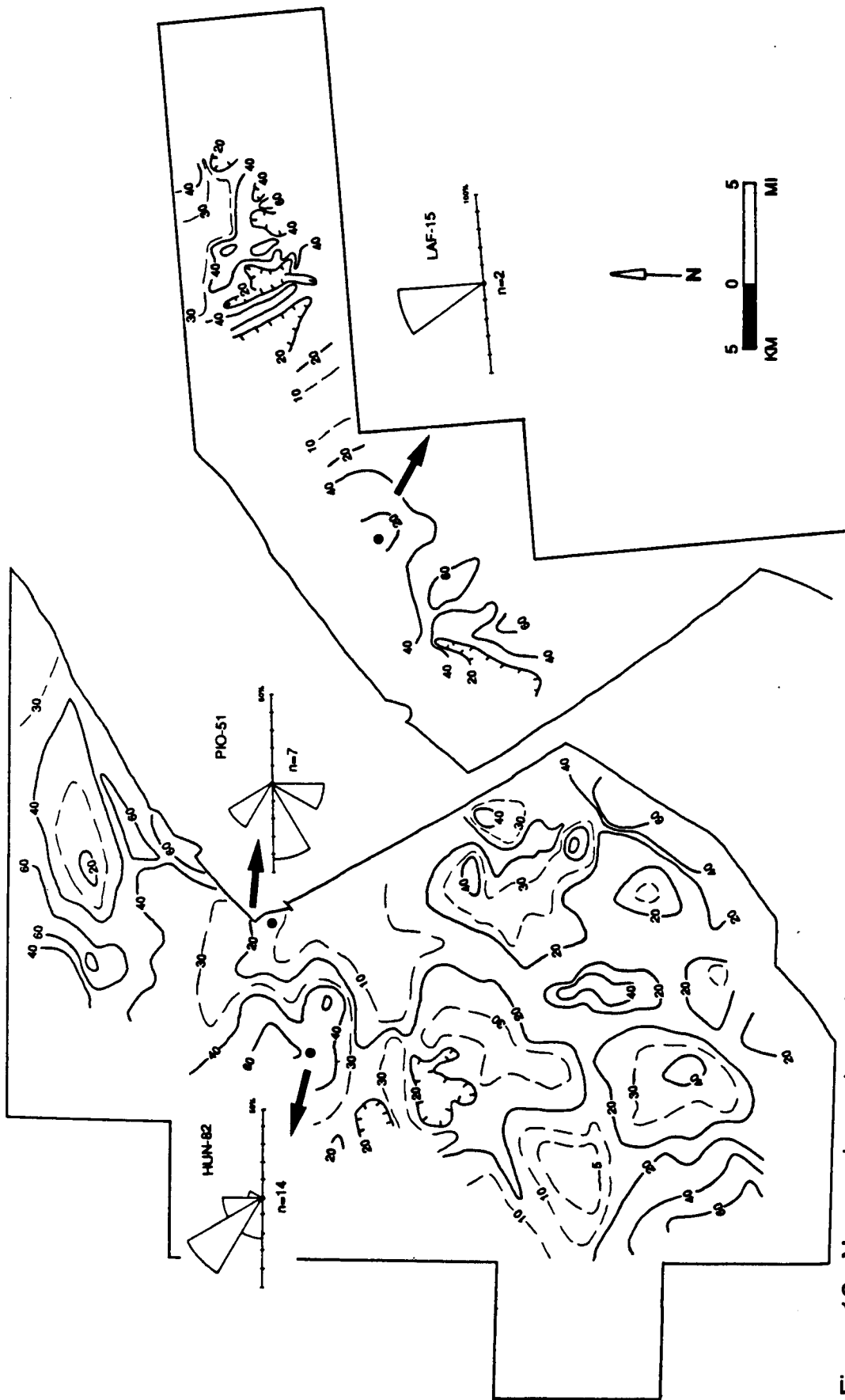


Figure 12. Newcomb sandstone isopachs (contour interval 20 feet, intermediate intervals shown with dashed lines).

The unnamed shale member consists of light-brown to dark gray, clayey to sandy shale which is locally carbonaceous and sideritic. The shale above the Blue Gem generally represents a coarsening upward sequence with darker shale closer to the Blue Gem or its rider. Plant fossils are common in the shale directly above the coal. brackish-water fossils (Lingula) were observed in shale 15 feet above the Blue Gem in the Winfield quadrangle. fresh-water fossils (Naiadites) were contained in shale immediately above the Blue Gem in the La Follette quadrangle and in the shale between the Blue Gem and Jellico coals in the Windrock quadrangle (WRK-22 on Plates 4 and 5) (Wanless, 1946, and Glenn, 1925). Naiadites has been regarded as an indicator of fresh-water environments; however, Barlow (1969) in a study of younger Pennsylvanian strata in the area noted that Naiadites had a common association with Lingula and ostracods in some sections which may raise some doubt concerning the fresh-water assumption.

JELICO HORIZON CROSS-SECTIONS

During the data compilation, it became evident that in some areas there were several seams within the Jellico horizon. Cross-sections of the Jellico horizon (Plates 4 and 5) were constructed to correlate these Jellico seams. These cross-sections take into account the lateral movement of the Pine Mountain overthrust. The letters A through F were chosen to represent the individual seams. The A seam denoted the stratigraphically lowest coal while the F seam denoted the highest coal. The C seam was used as the datum for the horizon's cross-section due to its lateral continuity. In areas where there was sufficient information to

justify correlation of splits within an individual seam, a number was added to the letter designation (1 being the stratigraphically lowest split). Where the splits were absent, or could not be correlated, the numbers were not used and a single letter was used as a designation. Descriptions of these seams are given in Appendix E.

STRUCTURE CONTOURS

Structure contours were drawn at the base of the C seam (Figure 13) because of its lateral continuity. In the northeast corner of the study area, where the C seam is absent, the contours were drawn on the base of the B seam. The B seam was chosen due to its close stratigraphic proximity to the C seam; typically less than 30 feet separate the B and C seams.

The contours reveal that the Jellico generally dips inward toward the center of the Pine Mountain thrust sheet, corresponding with the Middlesboro syncline (Figure 13). Northwest of the Pine Mountain thrust fault, the Wooldridge synclinal structure is developed almost parallel to that thrust fault. The strata also gently dip inward toward the center of the Wartburg basin formed between the Jacksboro and Emory River faults. Movement along the Jacksboro and Terry Creek faults has caused some undulatory structures along those faults. In addition to moving 70,000 feet to the northwest on the Pine Mountain thrust sheet, the Jellico seam has a vertical displacement across the Jacksboro fault of approximately 400 to 500 feet (Englund, 1968 and Figure 13).

A palinspastic structure map was constructed to determine the basic shape of the basin before the Jellico horizon was deposited (Figure 14).

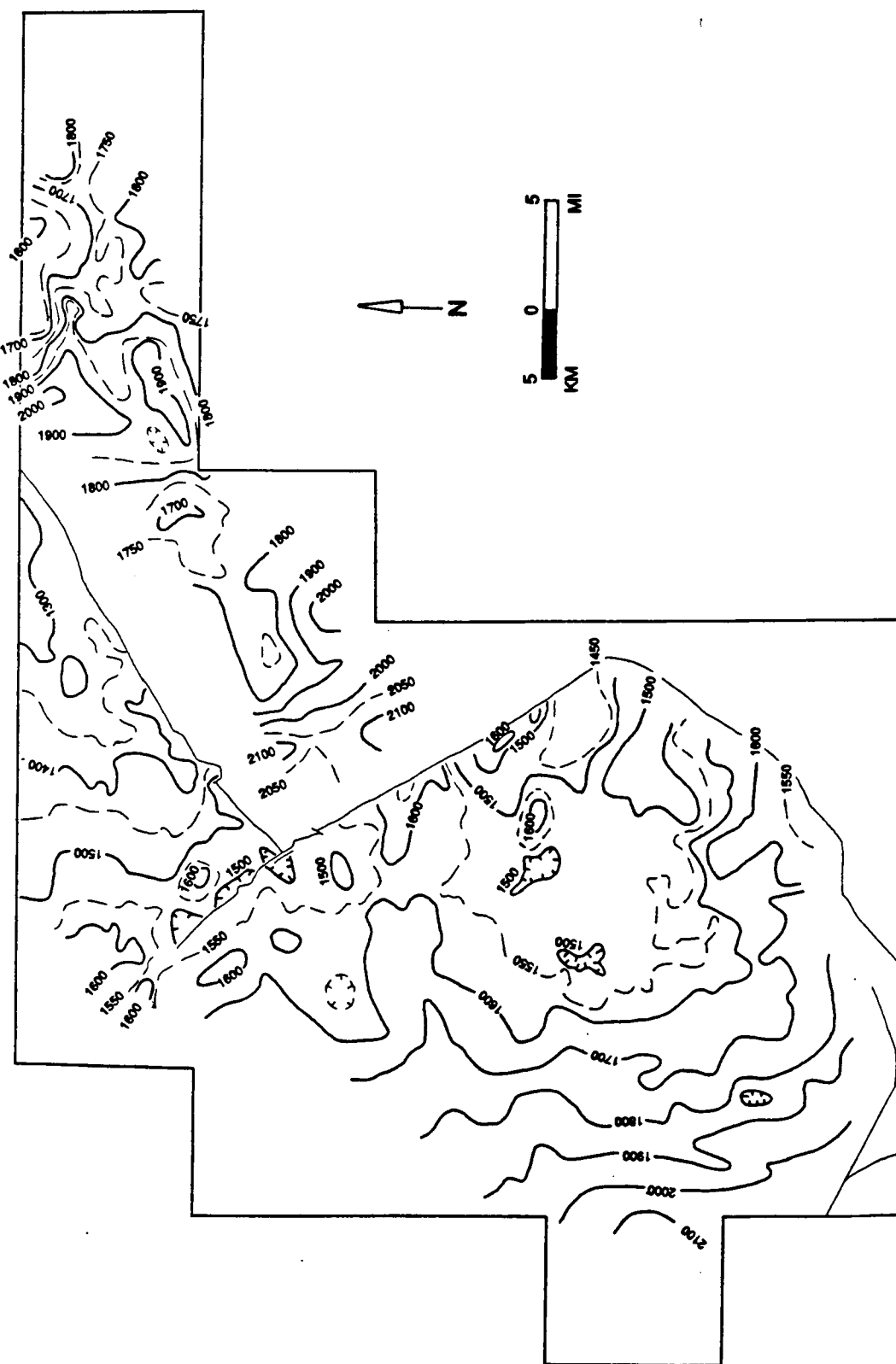


Figure 13. Structure contours on the base of the Jellico coal (contour interval 100 feet, intermediate intervals shown with dashed lines).

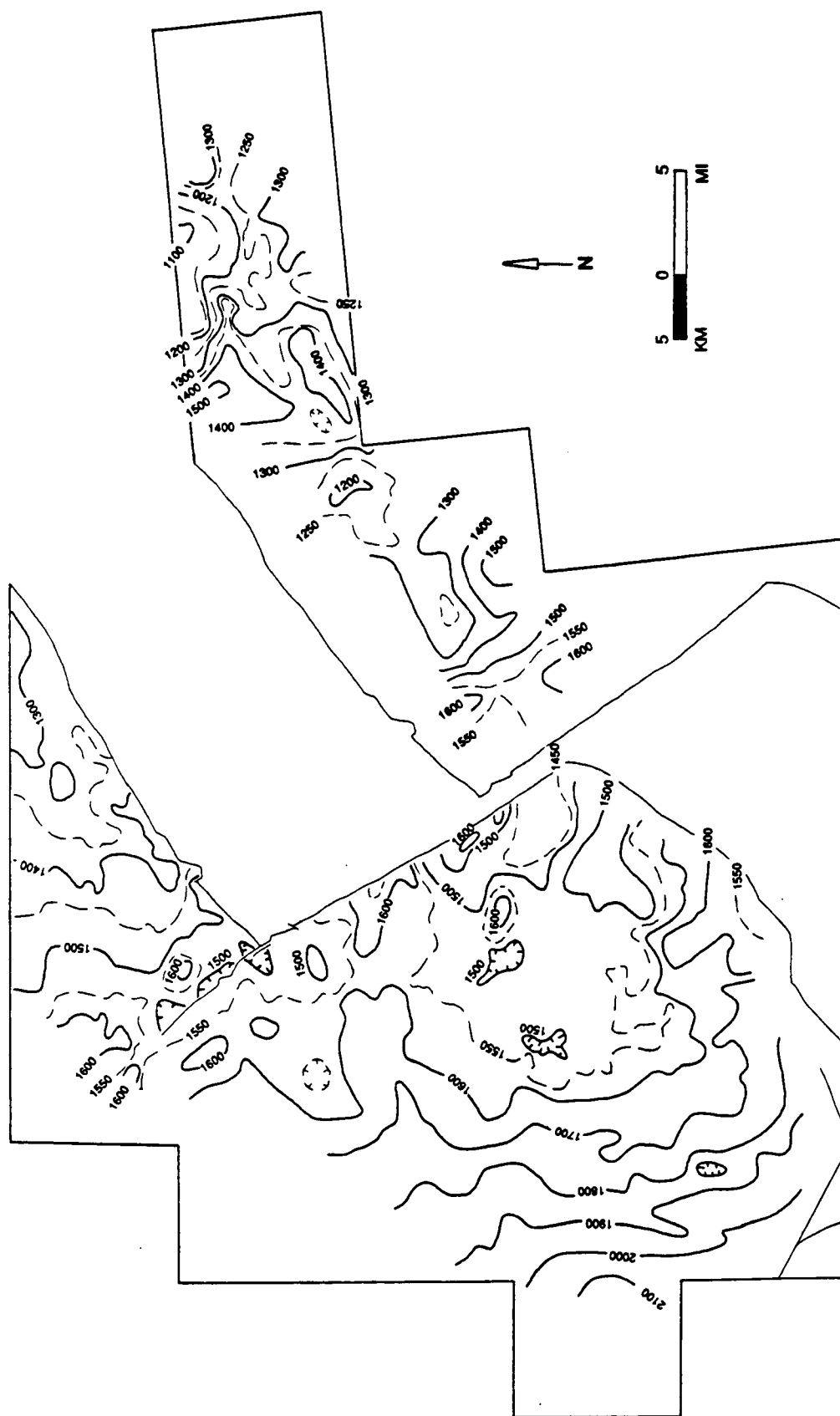


Figure 14. Palinspastic structure contours on the base of the Jellico coal (contour interval 100 feet, intermediate intervals shown with dashed lines).

To construct this map the Pine Mountain thrust sheet was returned to its original paleogeographic position and the elevations on the sheet were corrected for the 500 feet of vertical displacement. Interpretation of the map is complicated by the folding and faulting in the study area; however, the map shows that the original basin generally dipped toward the northeast and that the basin may have been split into two sub-basins by a small ridge indicated by the 1600 foot contour line to the north of the Wartburg basin.

COAL HORIZON CHARACTERIZATION

Coal analyses and coal seam descriptions of the various Jellico seams are given in Appendices D and E. The locations and legend of these various data points are given in Appendices B and C.

A Seam Character

The A seam (Plates 4 and 5) is the stratigraphically lowest seam in the Jellico horizon. The seam is thin (0-11 inches), very discontinuous, and was recognized only in the Fork Ridge and Eagan quadrangles. No samples or chemical analyses were obtained for this seam.

B Seam Character

The B seam (Plates 4 and 5) is located approximately 5 to 15 feet above the A seam horizon. The seam attains its greatest development on the Pine Mountain thrust sheet (Figure 15) where thicknesses of over 40 inches have been observed. The B seam tends to thin toward the southwest on the thrust sheet. The B seam remains thin and fairly

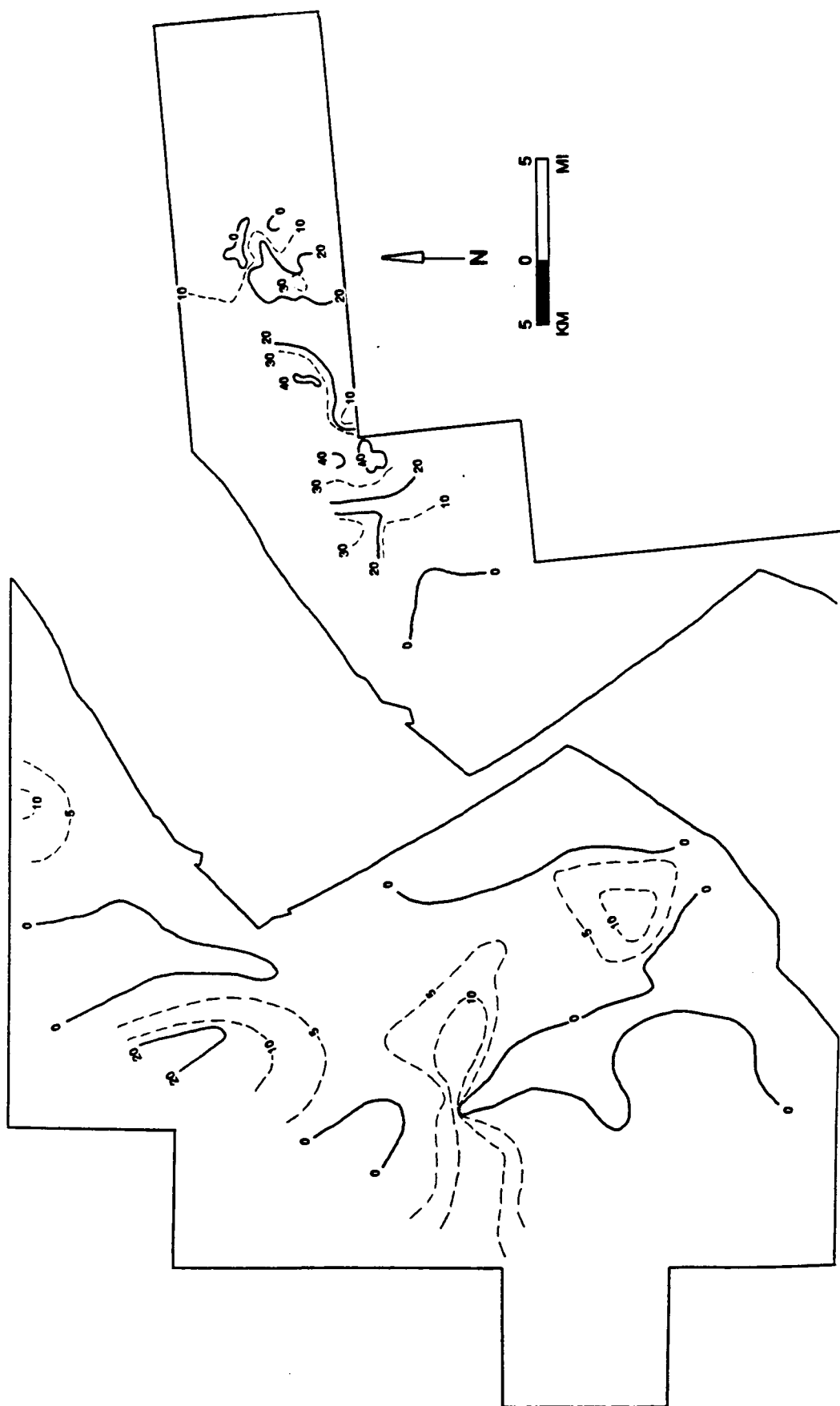


Figure 15. Isopachs of the B seam (contour interval 20 inches, intermediate intervals shown with dashed lines).

continuous on the Cumberland Plateau, where it averages between 1 and 10 inches (Figure 15). Very few splits occur in the seam.

Chemical analyses of the B seam were not readily available. The distribution of sulfur concentrations (Figure 16) indicates that the coal contains less sulfur on the thrust sheet and that the sulfur increases slightly to the west on the sheet and on the Cumberland Plateau. A sample (NOR-55) obtained where the B seam splits indicates that the bottom split contains more than twice the amount of sulfur (3.63%) as the upper split in that area (1.50%). The ash content of the B seam (Figure 17) ranges widely from 2.33 percent to 28.62 percent. The high ash content occurs in the bottom split where the seam divides. The volatile matter content of the B seam ranges from 38.10 percent to 41.50 percent (Figure 18). The dry, mineral-matter free (dmmf) fixed carbon content of the B seam ranges from 57.83 percent to 60.62 percent (Figure 19).

C Seam Character

The C seam (Plates 4 and 5) is located 5 to 30 feet above the B seam horizon. The C seam is very continuous and widely-mined throughout the study area. The seam attains its greatest thicknesses (>40 inches) in the Jellico, La Follette, Duncan Flats, Fork Mountain, and Petros areas (Figure 20). The C seam tends to be thinner on the Pine Mountain thrust sheet. In some areas the C seam contains several continuous partings and can be separated into three splits. The stratigraphically lowest split was denoted as C1 and the stratigraphically highest split was designated as C3 (Figure 21). The C seam was divided into splits in the Duncan Flats

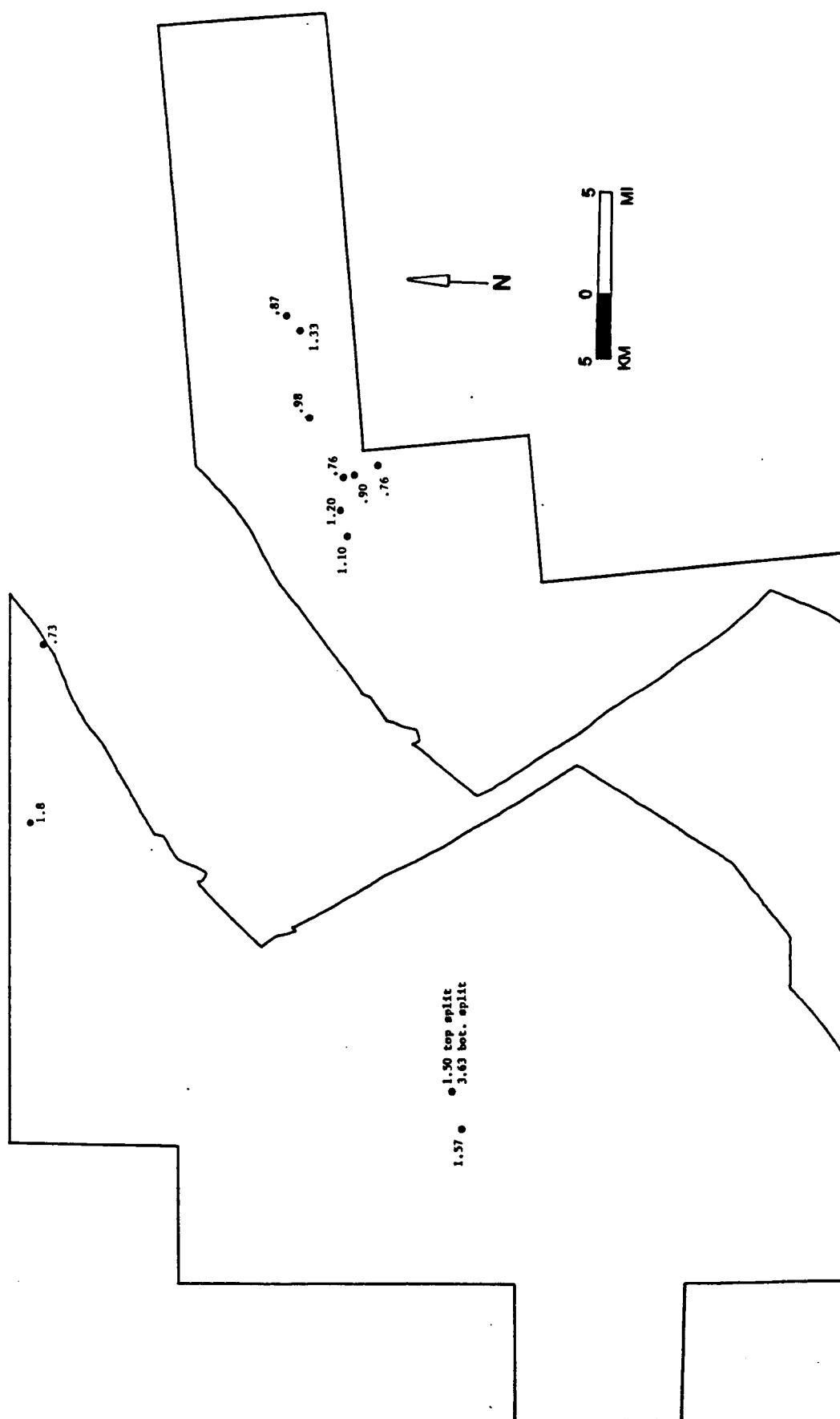


Figure 16. Sulfur distribution in the B seam (%).

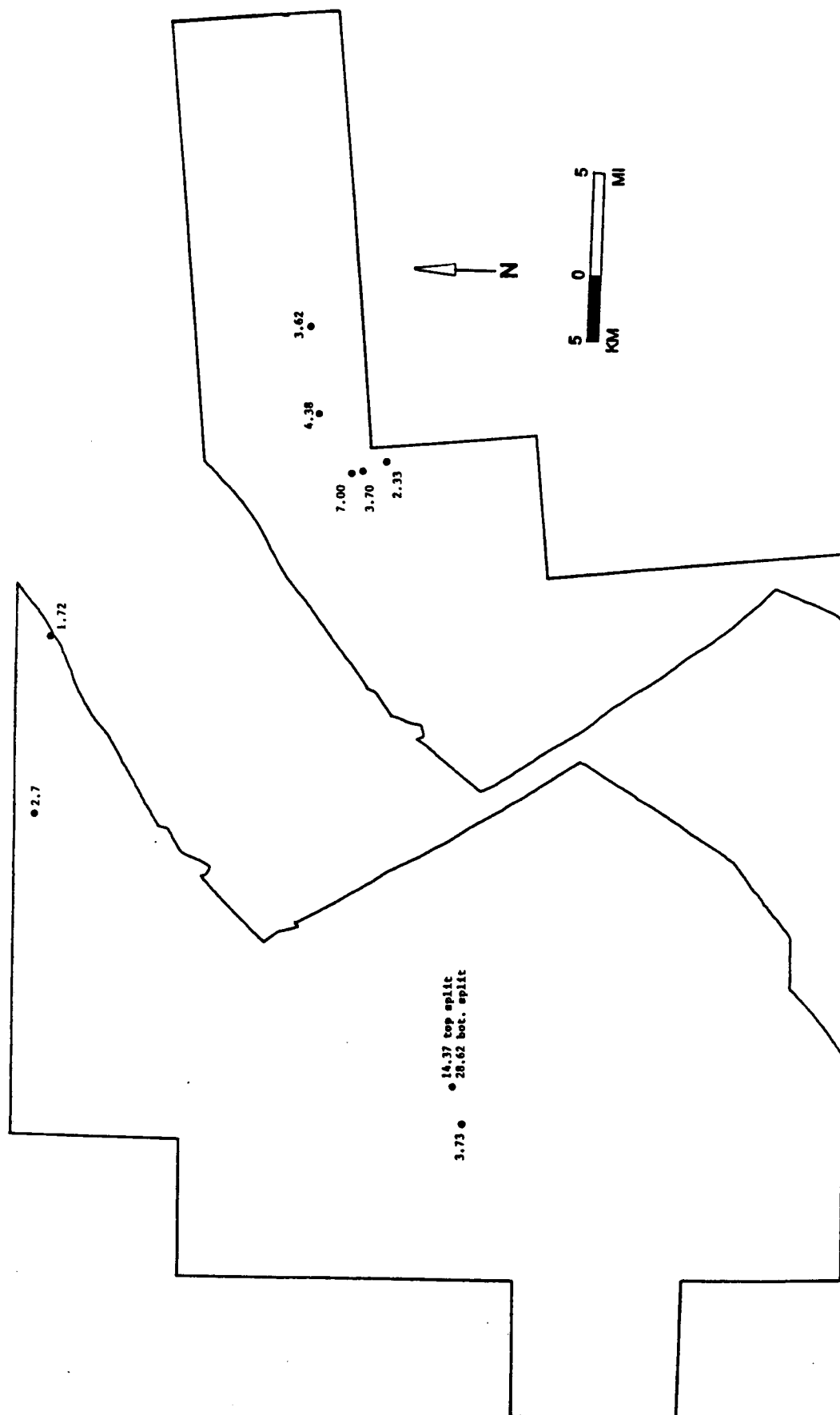


Figure 17. Ash distribution in the B seam (%).

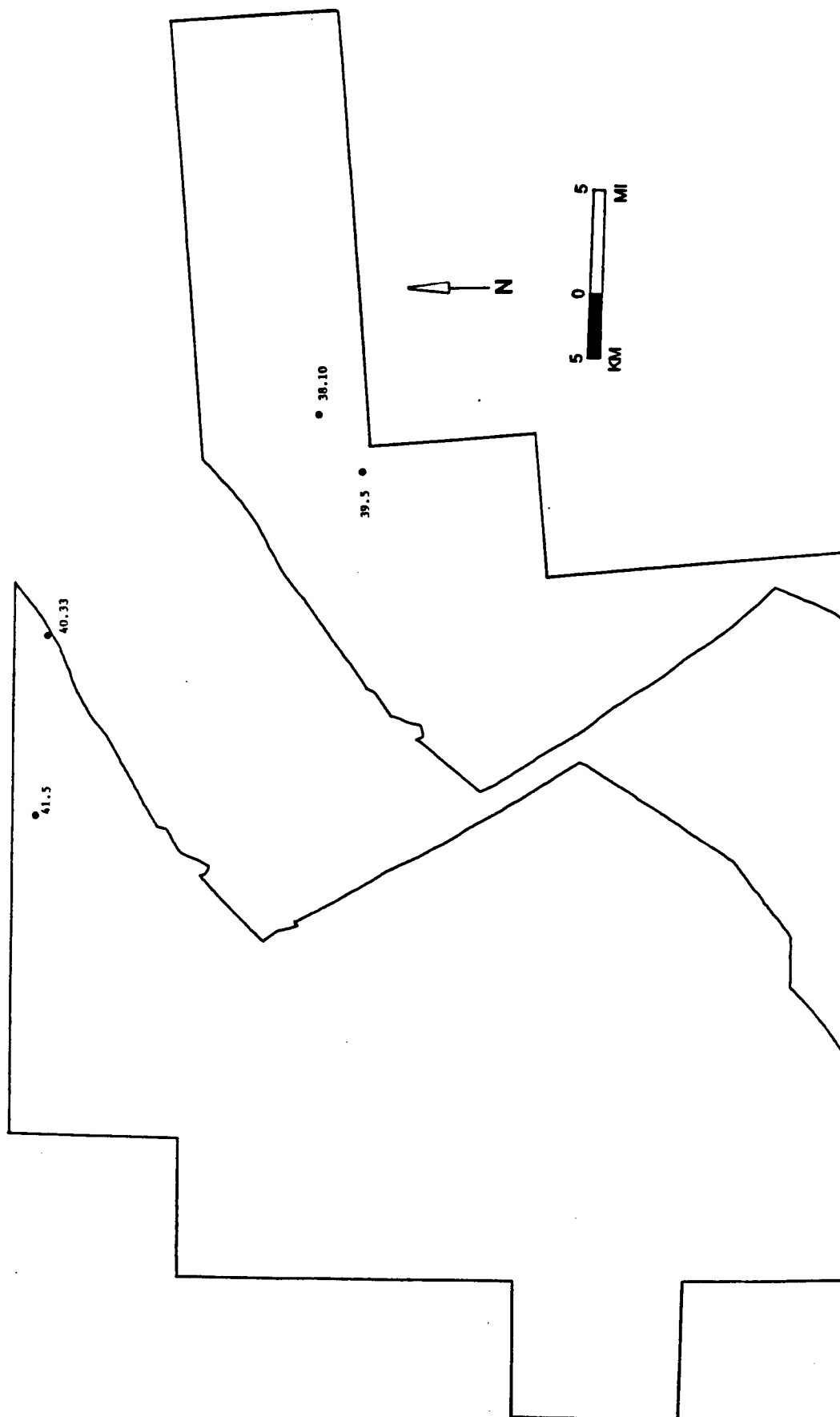


Figure 18. Volatile matter distribution in the B seam (%).

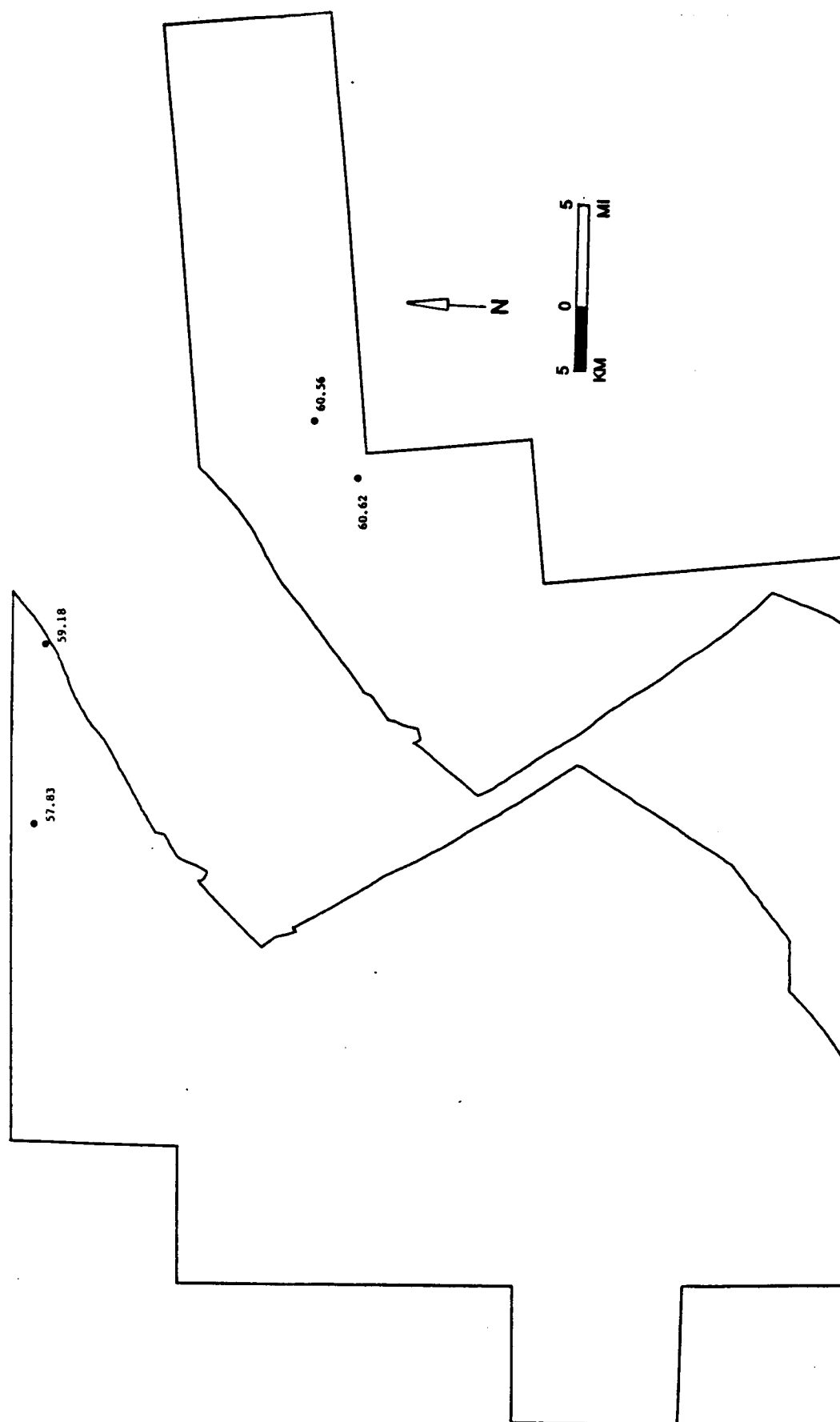


Figure 19. Dry mineral-matter free (dmmf) fixed carbon distribution (%) in the B seam.

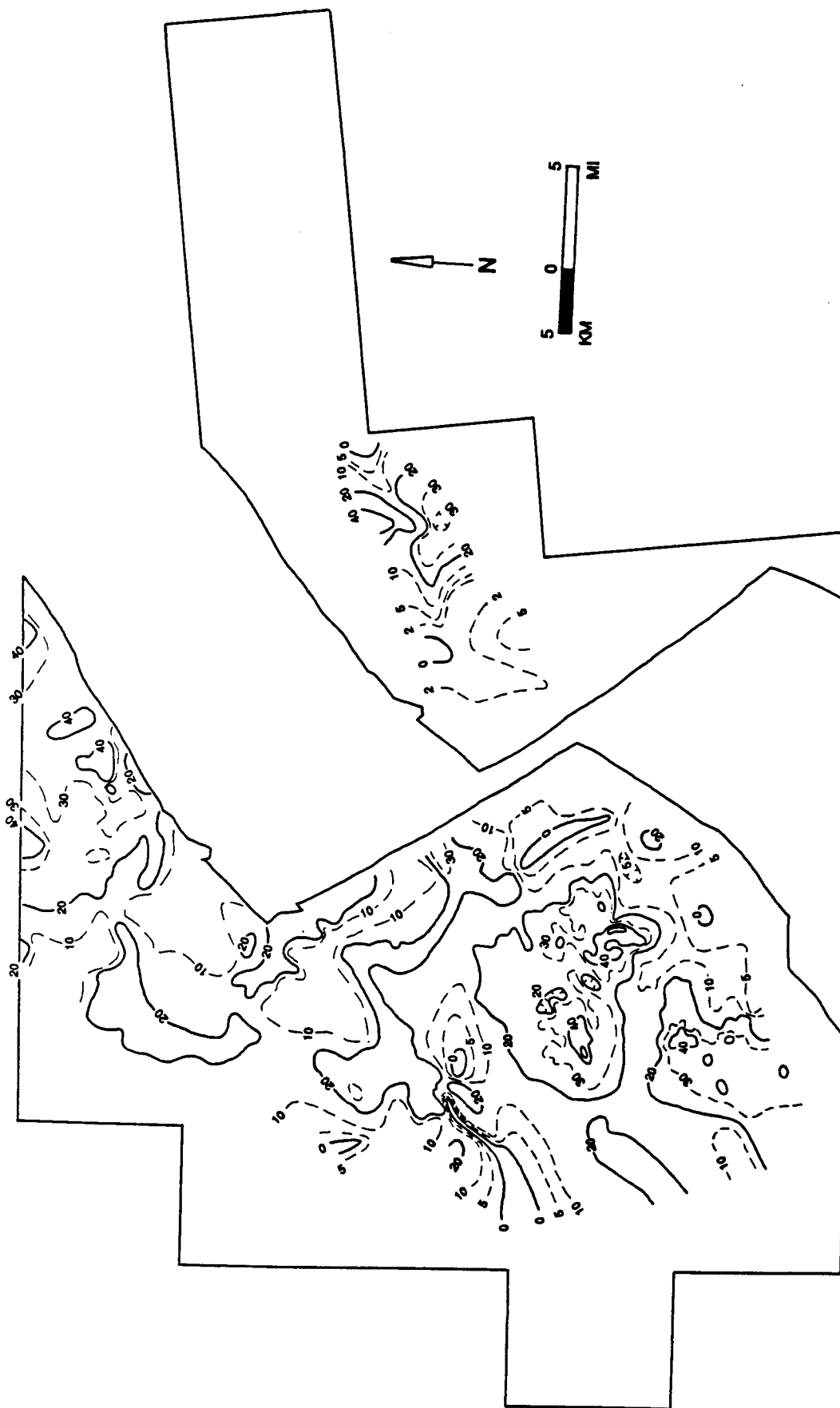


Figure 20. Isopachs of the C seam (contour interval 20 inches, intermediate intervals shown with dashed lines).

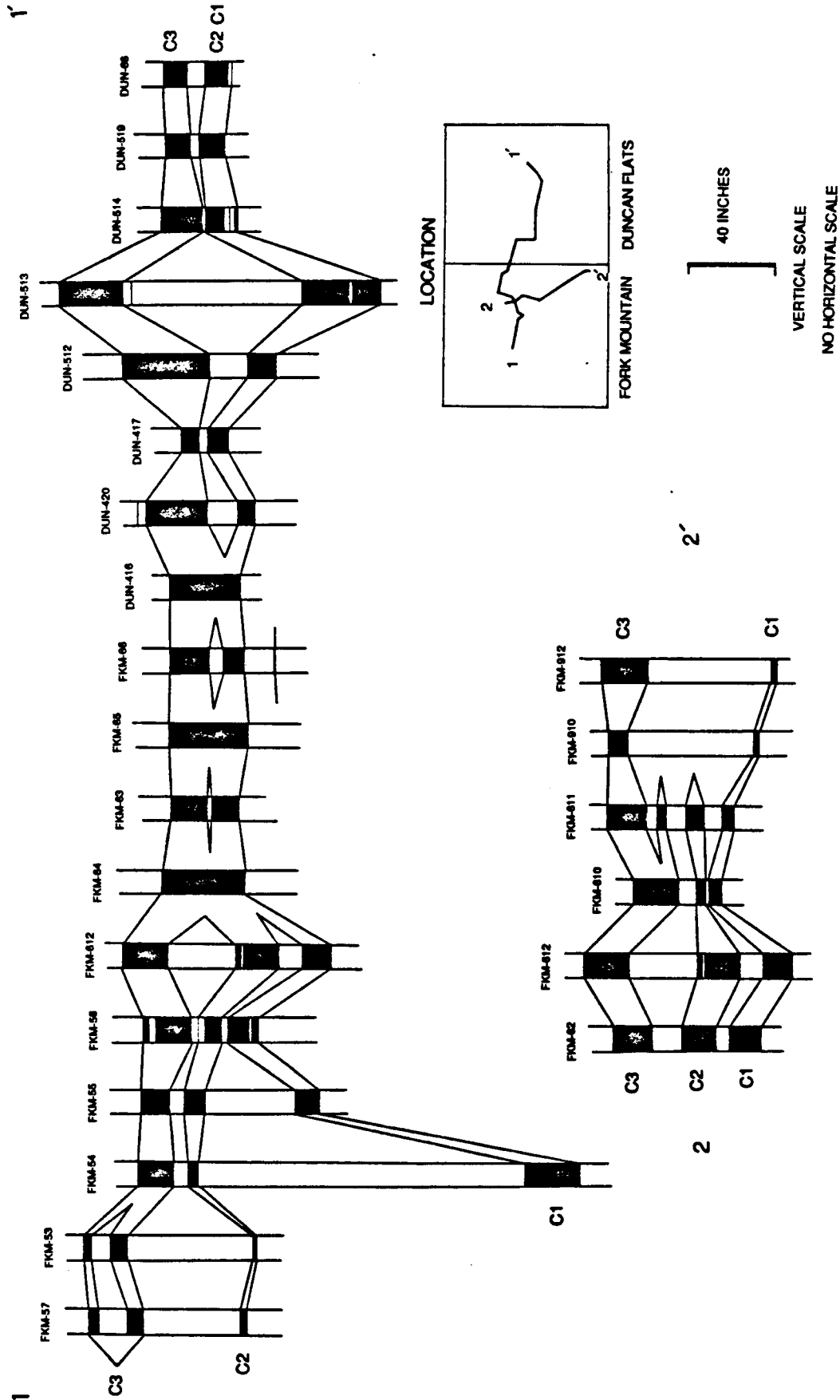


Figure 21. Cross-sections of the C seam.

and Fork Mountain areas, but in other areas it carries only the C designation. Note that the number designations used to subdivide the coal into splits pertains only to the stratigraphic level of the coal within that vicinity. As shown by cross-sections in Figure 21, the peat deposition was interrupted frequently by influxes of detrital clays and the peat swamp changed in size and shape.

Many chemical analyses of the C seam were available due to the extensive mining of the seam. Sulfur distribution of the C seam ranges from 0.19 percent to 5.21 percent (Figure 22). The sulfur distribution tends to increase to the southwest where concentrations range from 2 to >5 percent, although most concentrations are between 2 and 3 percent. Most of the coal in the remaining study area appears to have sulfur concentrations below 2 percent. The ash content of the C seam displays a wide range of concentrations (1.14% to 47.69%) (Figure 23). The widest range appears to be localized in the southwest portion of the study area while the remaining area appears to have ash concentrations between 0 to 9 percent. The volatile matter distribution of the C seam ranges from 22.3 percent to 40.2 percent with higher concentrations in the northern portion of the study area (Figure 24). The fixed carbon content (dmmf) of the C seam ranges from 57.74 percent to 75.39 percent. The fixed carbon concentration appears to be lower in the northern portion of the study area (Figure 25).

D Seam Character

The D seam (Plates 4 and 5) is located 5 to 50 feet above the C seam horizon. A thick, persistent sandstone body (up to 30 feet thick) lies

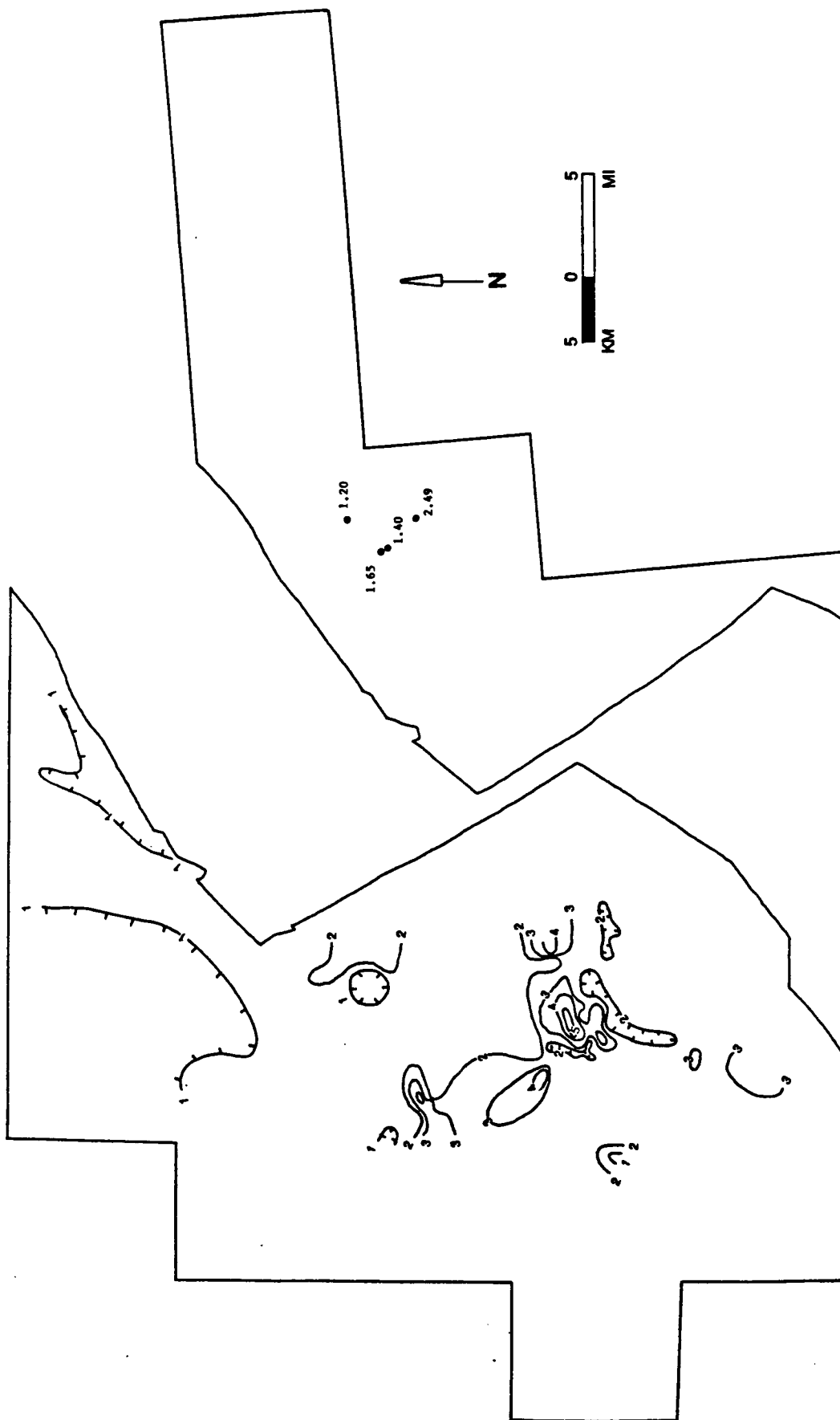


Figure 22. Sulfur distribution in the C seam (contour interval 1%).
(Insufficient data available to contour on the Pine Mountain thrust sheet).

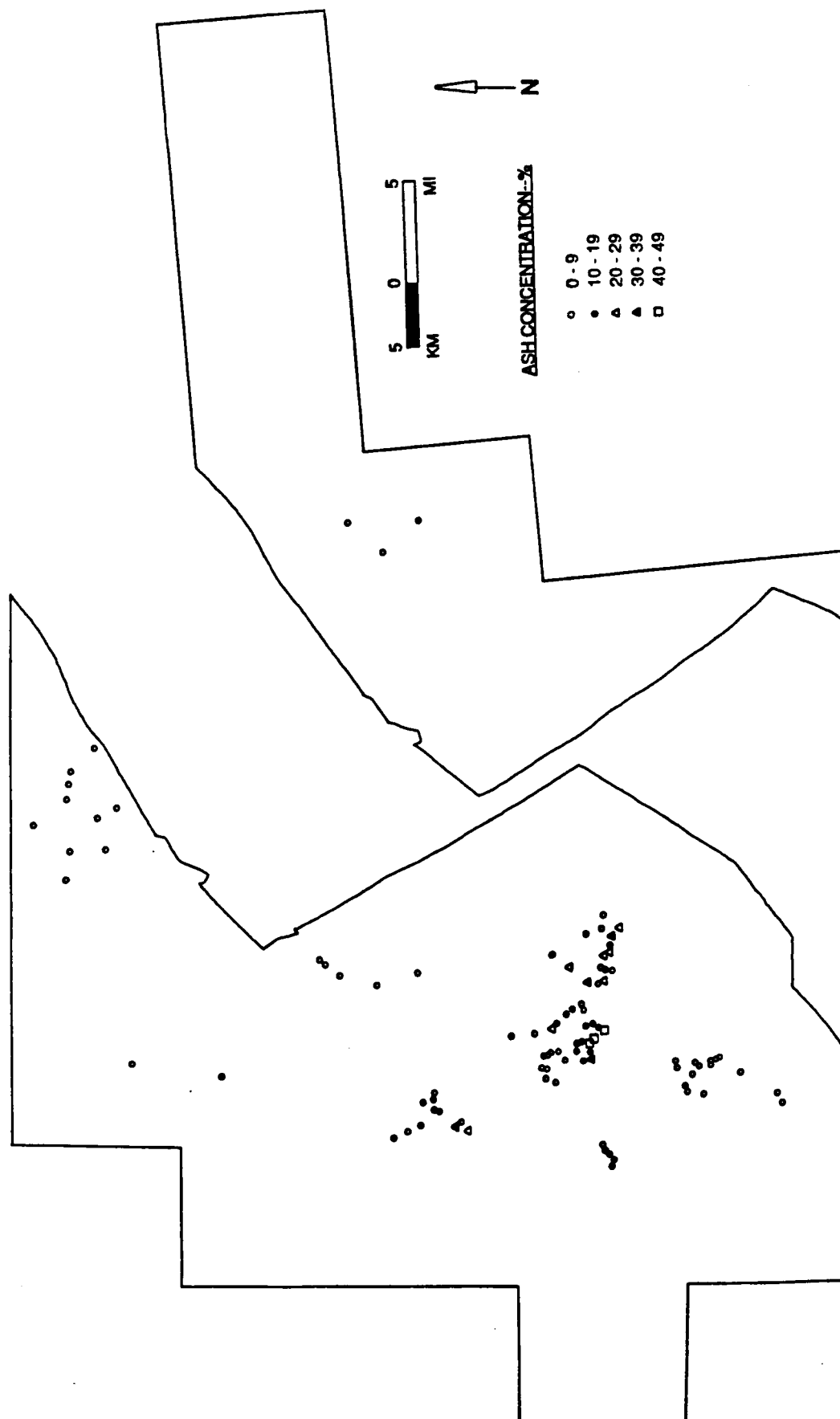


Figure 23. Ash distribution in the C seam (%).

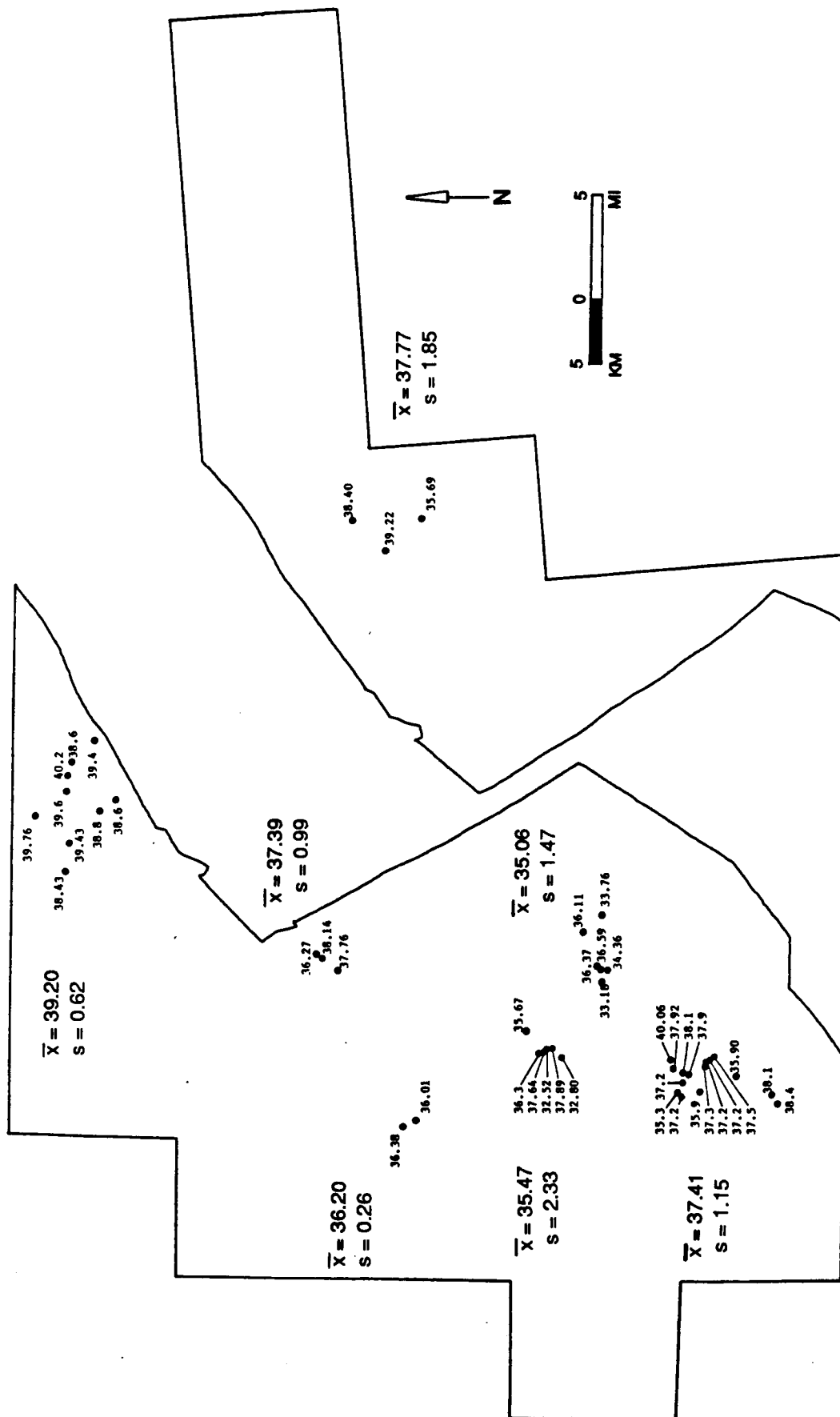


Figure 24. Volatile matter distribution in the C seam (%). ($\bar{x}$ = mean, s = standard deviation)

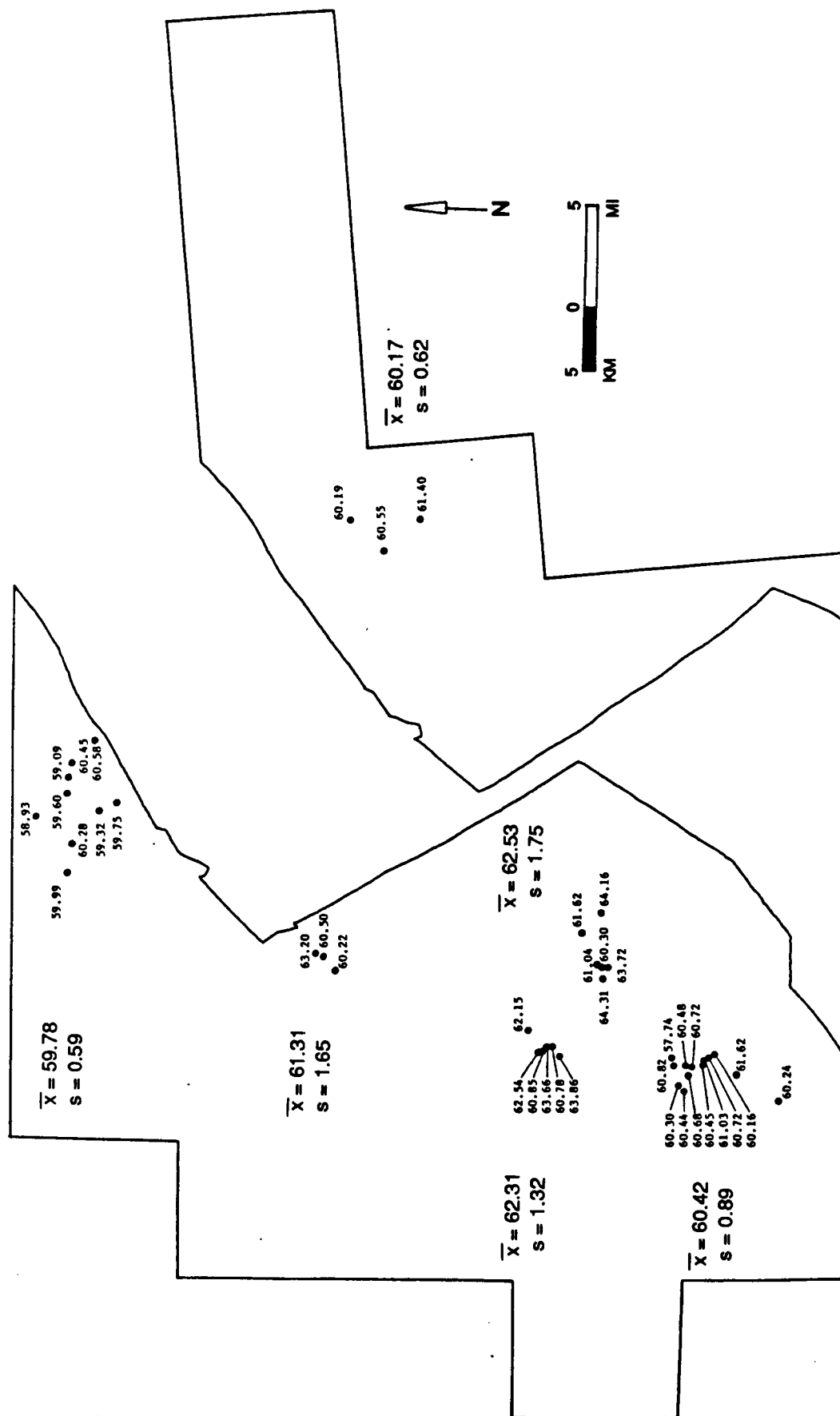


Figure 25. Fixed carbon distribution (dmmf) in the C seam (%). ($\bar{X}$ = mean, S = standard deviation)

between the C and D seam horizons in the southern portion of the study area (Plates 4 and 5). The D seam is laterally continuous in the eastern portion of the study area, but thins to the west (Figure 26). The D seam appears to have formed in peat mounds in the southern portion of the study area (Figure 26). It is uncertain whether these peat mounds are the result of erosional or depositional processes. Coal thickness of 60 to >80 inches have been observed in the extreme eastern portion of the Pine Mountain thrust sheet (Figure 26). In this area, the D seam contains several continuous partings and can be separated into different splits. The stratigraphically lowest split was denoted as D1 and the stratigraphically highest split was designated as D3 (Figures 27 and 28). The D seam was divided in this fashion in the Egan and Fork Mountain areas, but other areas carry only the D designation. The numerical designation used pertains only to the stratigraphic level. The cross-sections in Figures 27 and 28 also show that the peat deposition was interrupted occasionally by clay deposition and that the peat swamp changed shape where the peat had ceased deposition or where a great influx of clay had occurred. Wide variations in the thickness of the parting between the D2 and D3 splits can be observed in the Fork Ridge quadrangle. Up to 40 feet of parting has been observed between the D2 and D3 splits in some areas, while less than an inch of parting is present in other areas. The parting is very thin in the central and western portion of the Fork Ridge quadrangle and thickens in the remainder of the quadrangle. Extensive mining has taken place where this parting is only a few inches thick.

Chemical analyses of the D seam were available only for the thrust

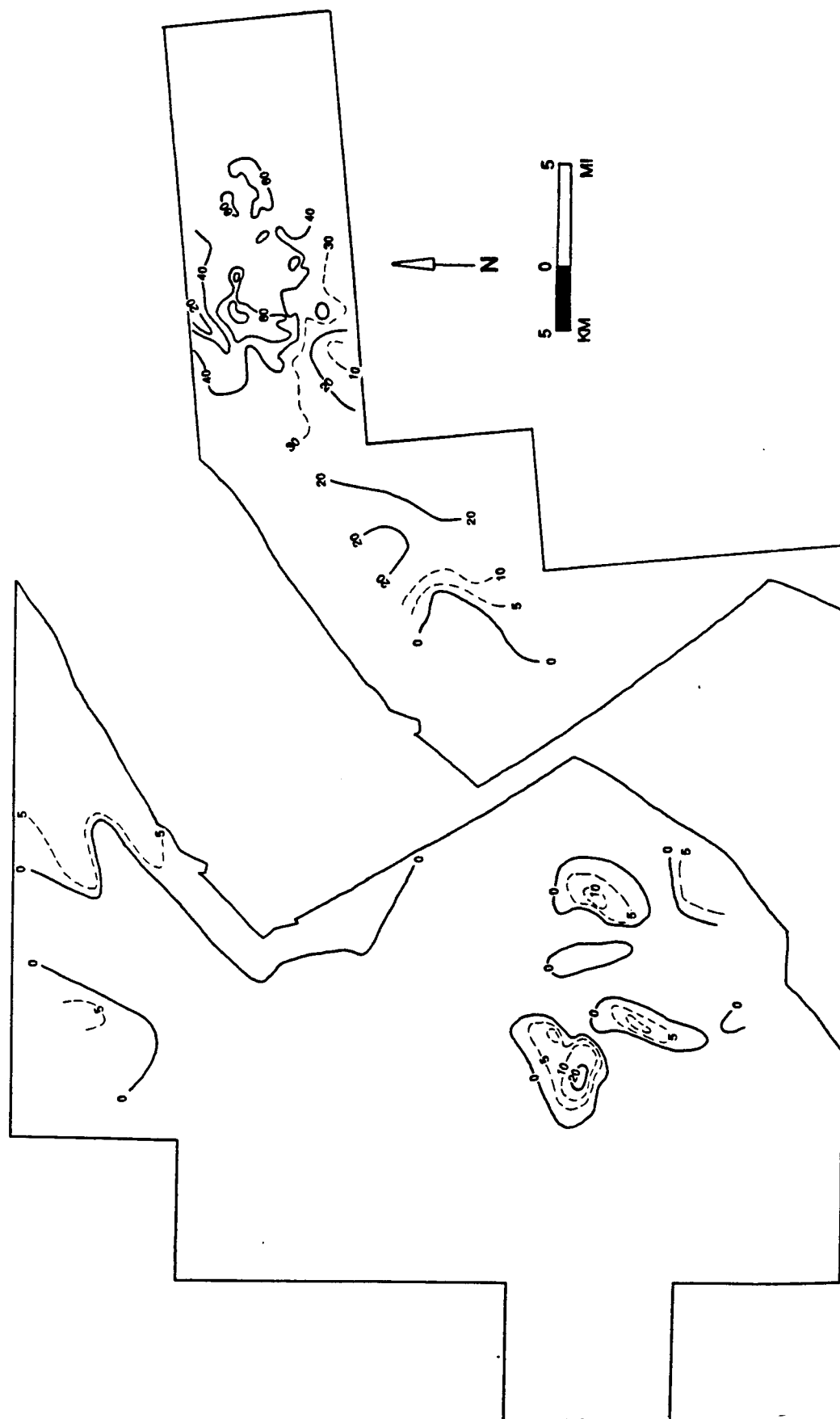


Figure 26. Isopachs of the D seam (contour interval 20 inches, intermediate intervals shown with dashed lines).

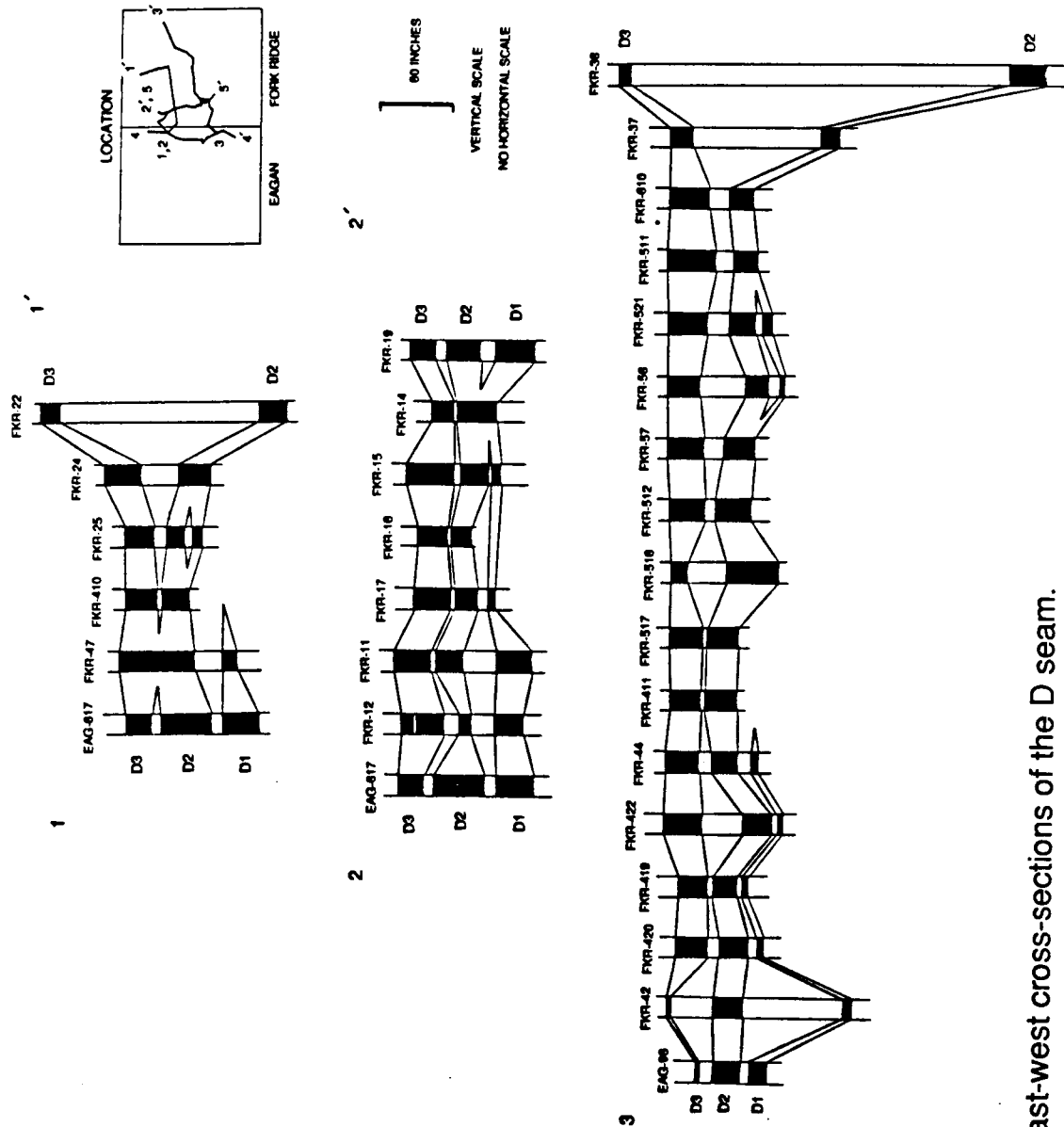


Figure 27. East-west cross-sections of the D seam.

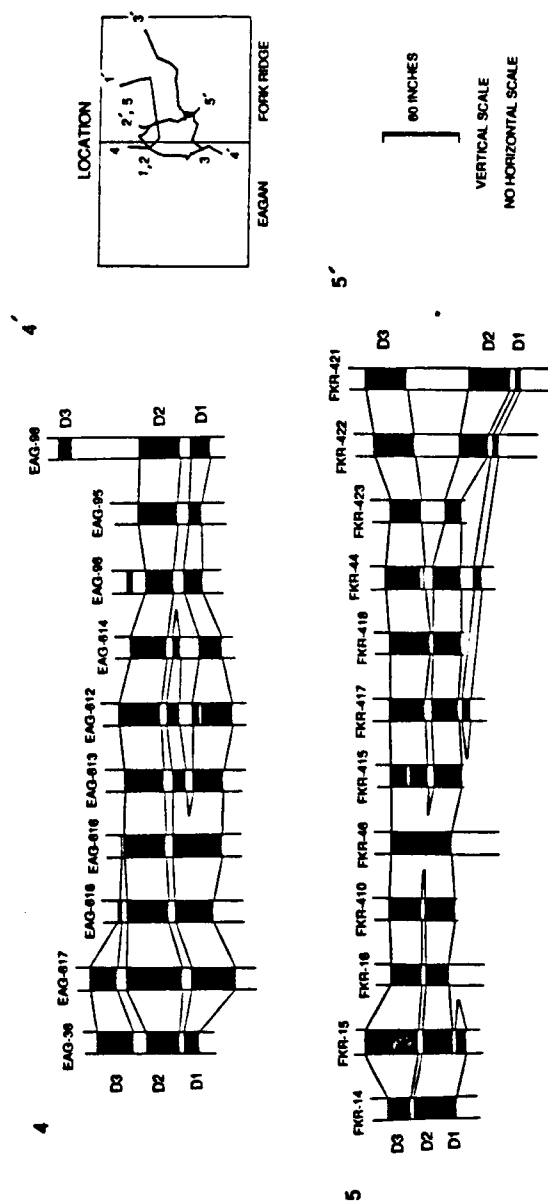


Figure 28. North-south cross-sections of the D seam.

sheet where the seam is mineable. Sulfur distribution of the D seam ranges from 0.67 percent to 1.86 percent (Figure 29). The ash content of the D seam varies from 3.22 percent to 13.16 percent (Figure 30). The volatile matter content of the D seam ranges from 35.67 percent to 41.05 percent (Figure 31) and the fixed carbon content (dmmf) varies from 57.99 percent to 61.15 percent (Figure 32). Individual chemical analyses of the splits (D2, D3) are included in Appendix E. The D2 and D3 splits appear to be similar in chemistry.

E Seam Character

The E seam (Plates 4 and 5) is located 10 to 50 feet above the D seam. A thick (up to 50 feet), persistent sandstone body lies between the D and E seam horizons on the Pine Mountain thrust sheet (Plates 4 and 5). The seam is laterally continuous on the thrust sheet and thins to the southwest (Figure 33). On the Cumberland Plateau, the seam is only observed in the extreme southern portion as a thin continuous sheet and in the central portion of the Plateau as a separate deposit.

Chemical analyses of the E seam are scarce. Sulfur concentrations in the E seam range from 0.58 percent to 1.68 percent (Figure 34) and the ash content ranges from 2.70 percent to 5.19 percent (Figure 35). The volatile matter content of the E seam ranges from 35.2 percent to 38.6 percent (Figure 36) and the fixed carbon content (dmmf) ranges from 60.21 percent to 64.10 percent (Figure 37).

F Seam Character

The F seam (Plates 4 and 5) is located 10 to 30 feet above the E seam.

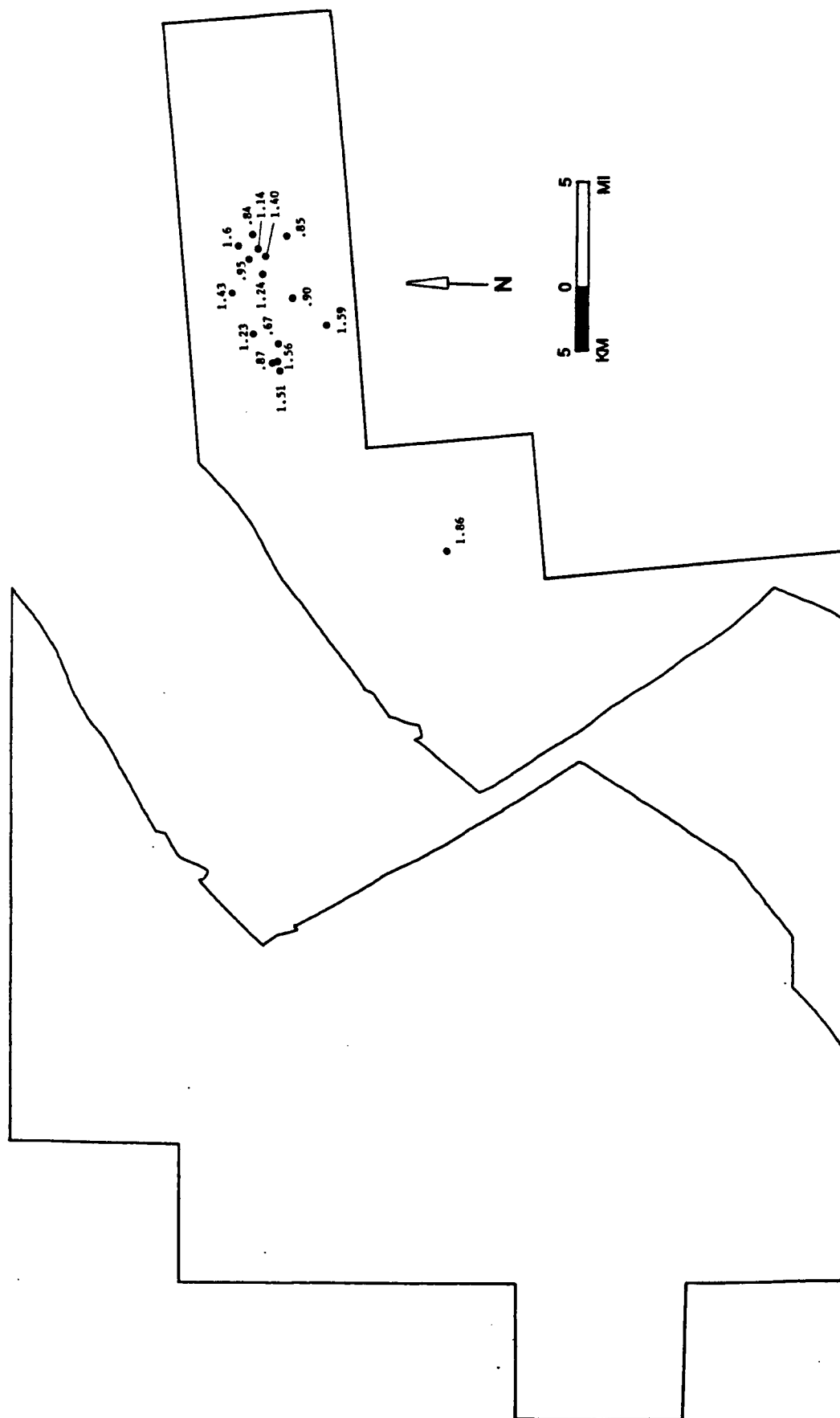


Figure 29. Sulfur distribution in the D seam (%).

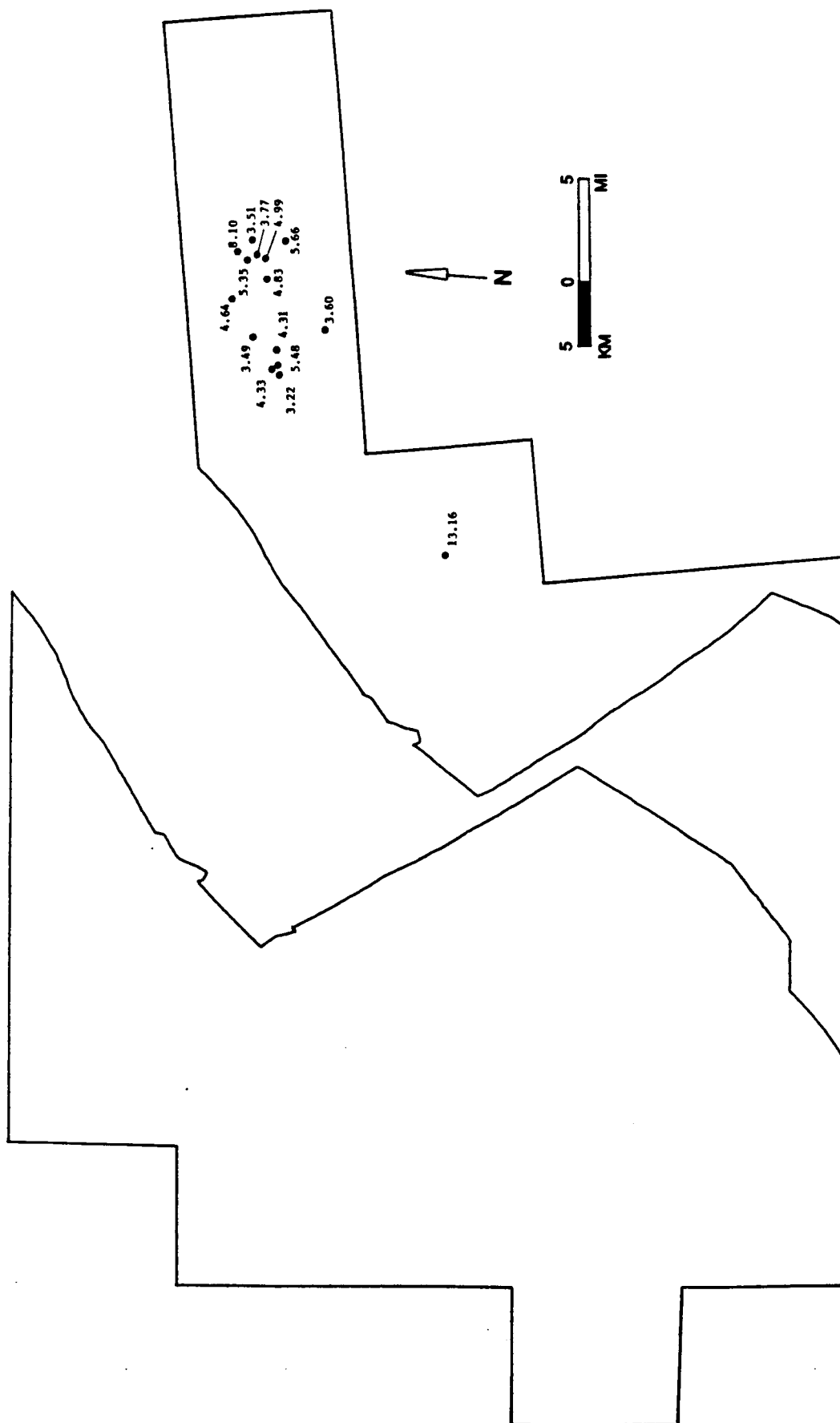


Figure 30. Ash distribution in the D seam (%).

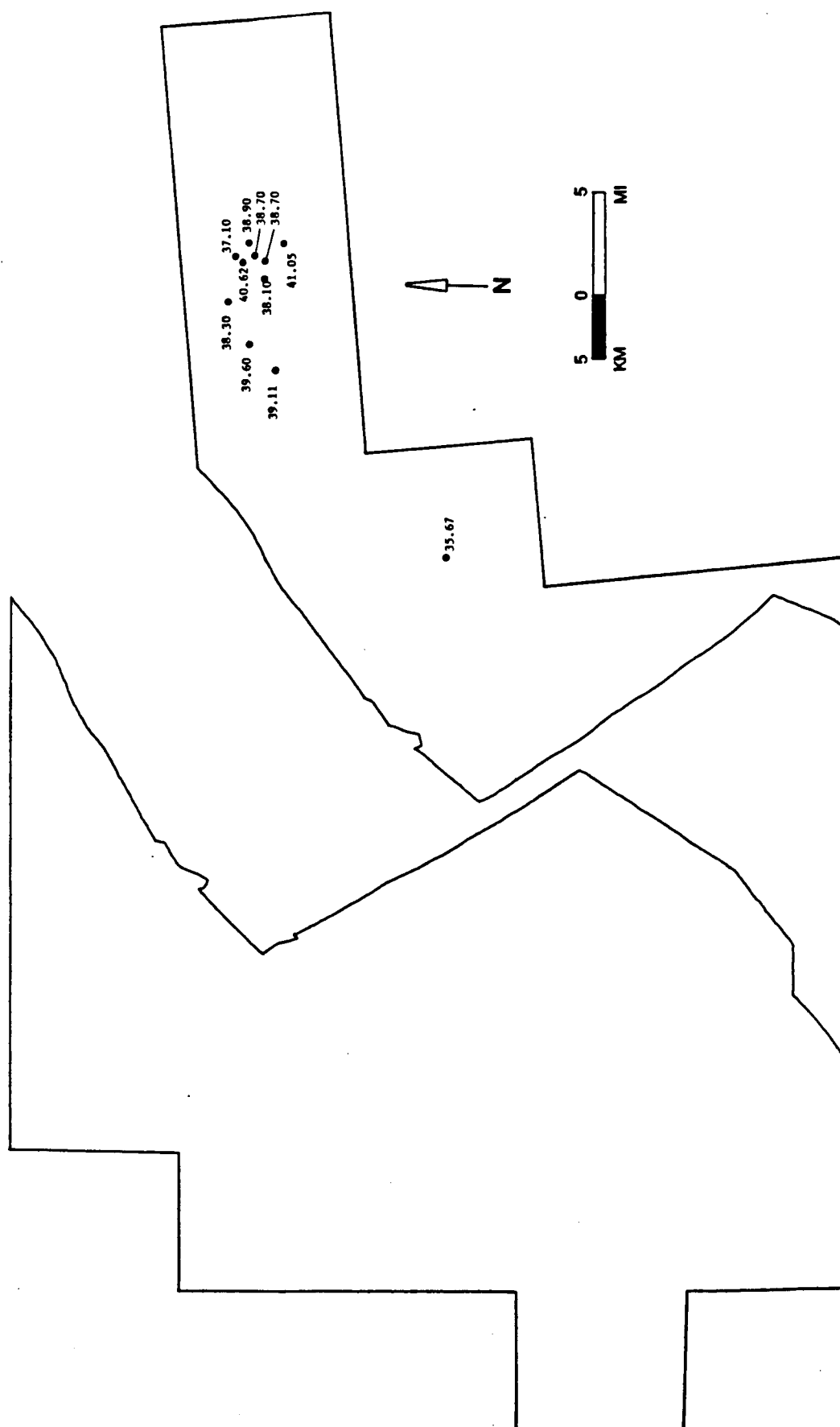


Figure 31. Volatile matter distribution in the D seam (%).

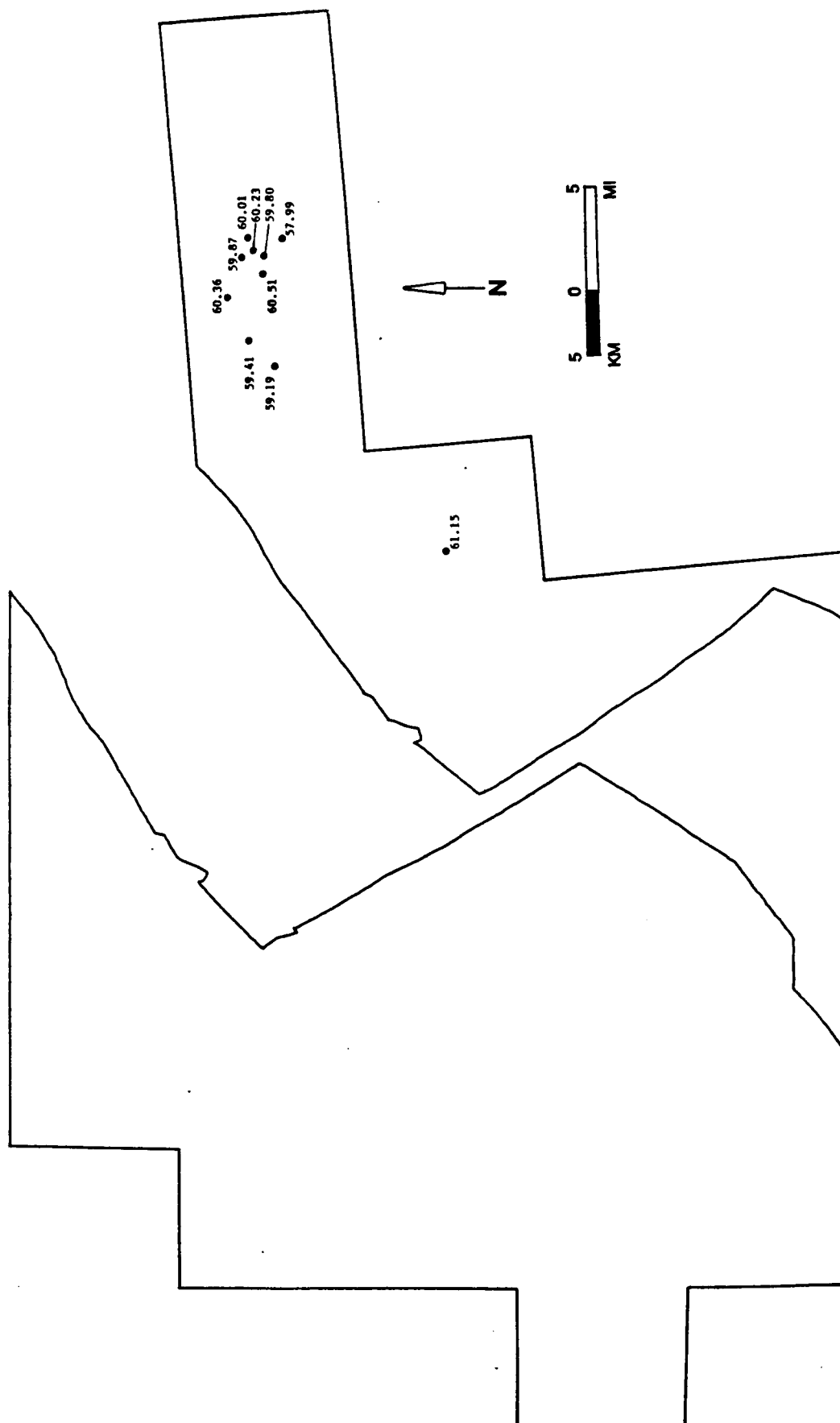


Figure 32. Fixed carbon distribution (dmmf) in the D seam (%).

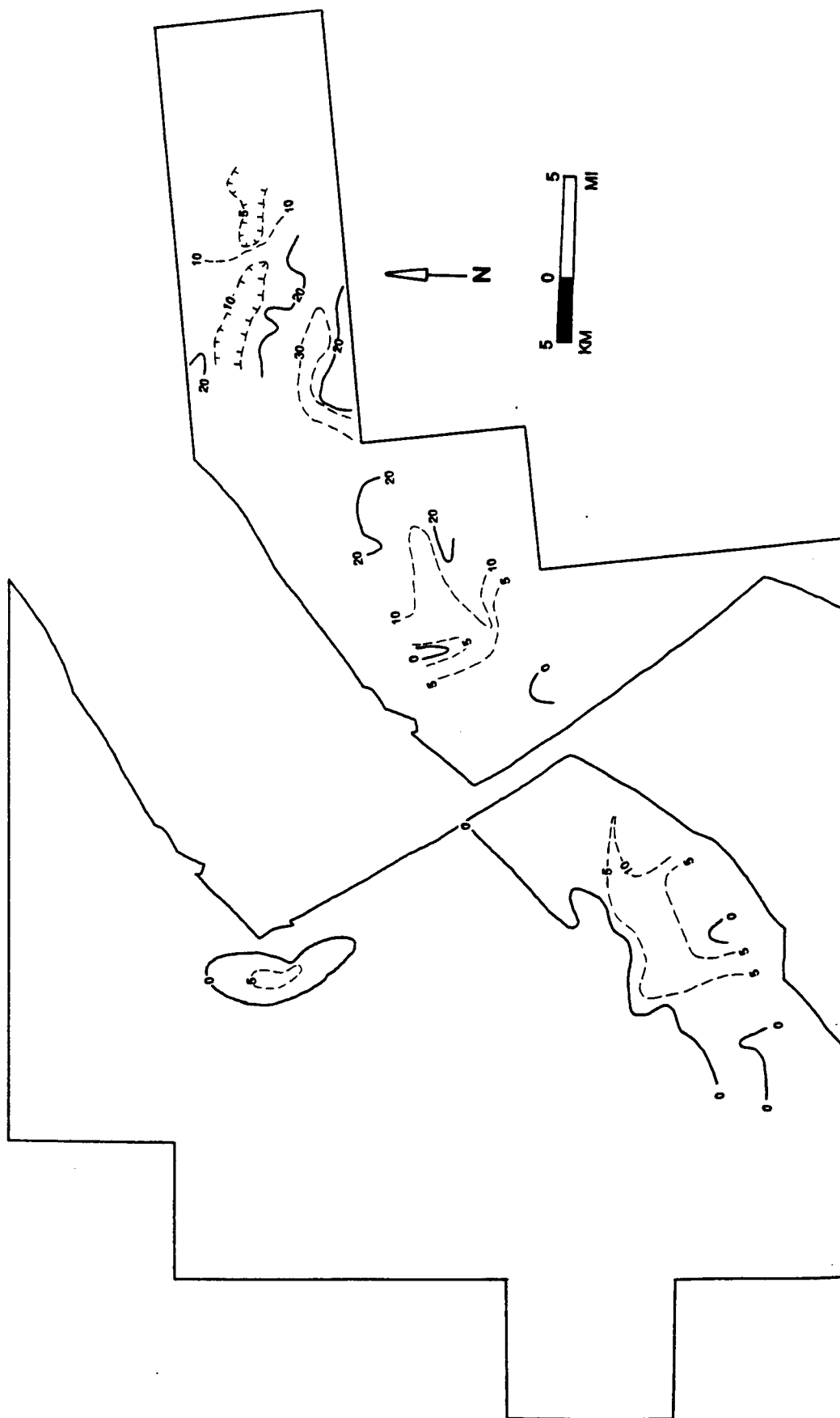


Figure 33. Isopachs of the E seam (contour interval 20 inches, intermediate intervals shown with dashed lines).

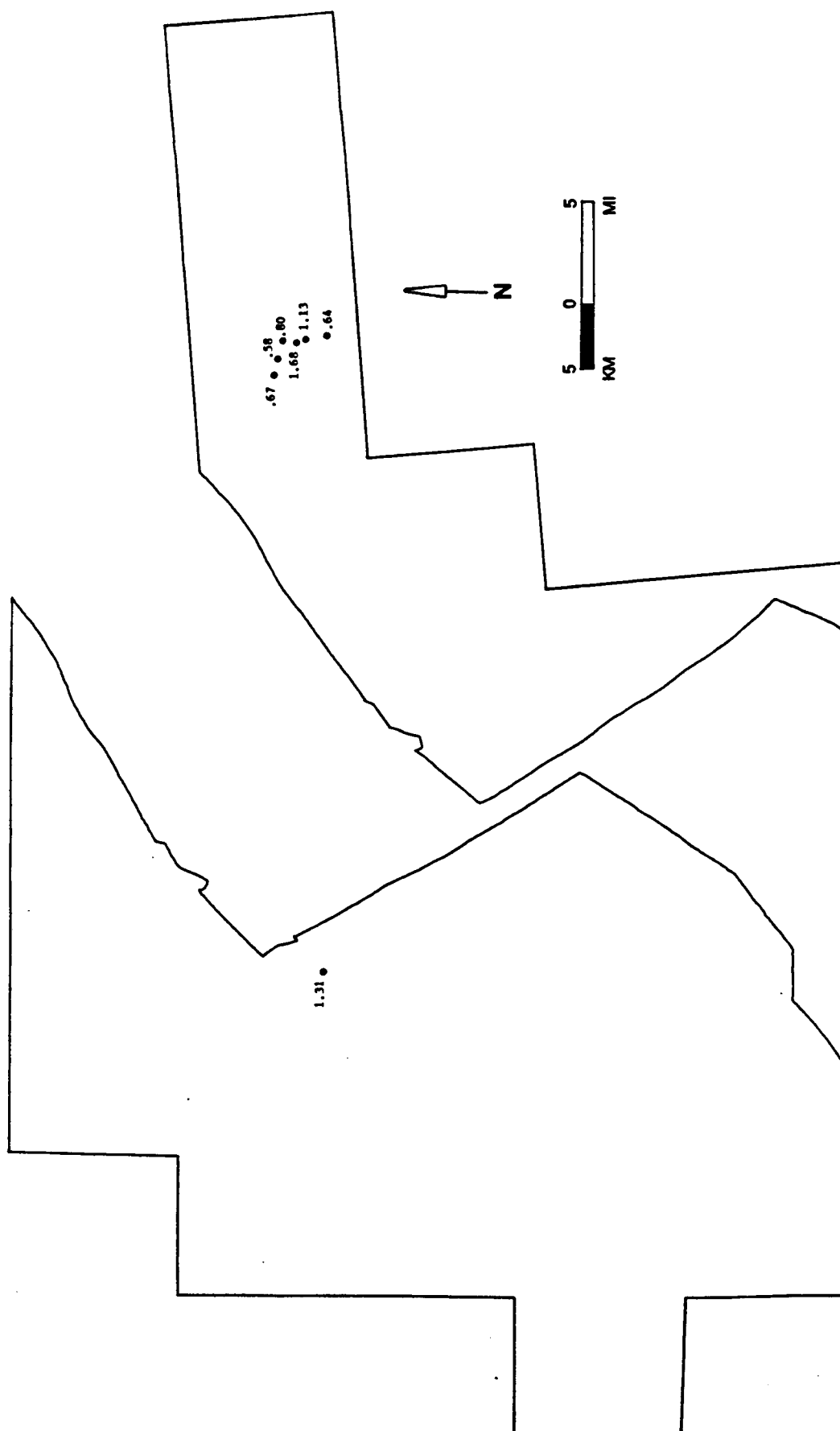


Figure 34. Sulfur distribution in the E seam (%).

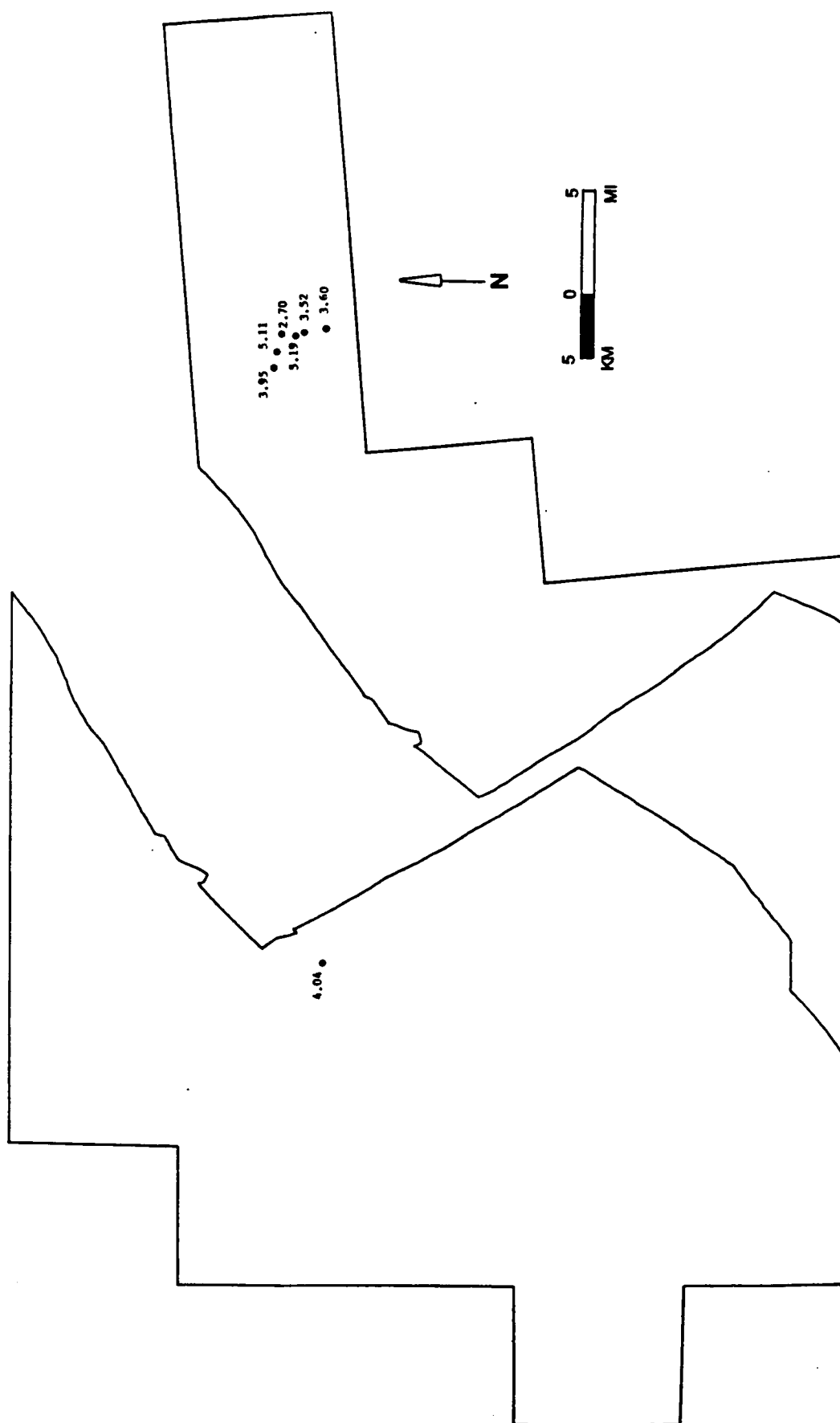


Figure 35. Ash distribution in the E seam (%).

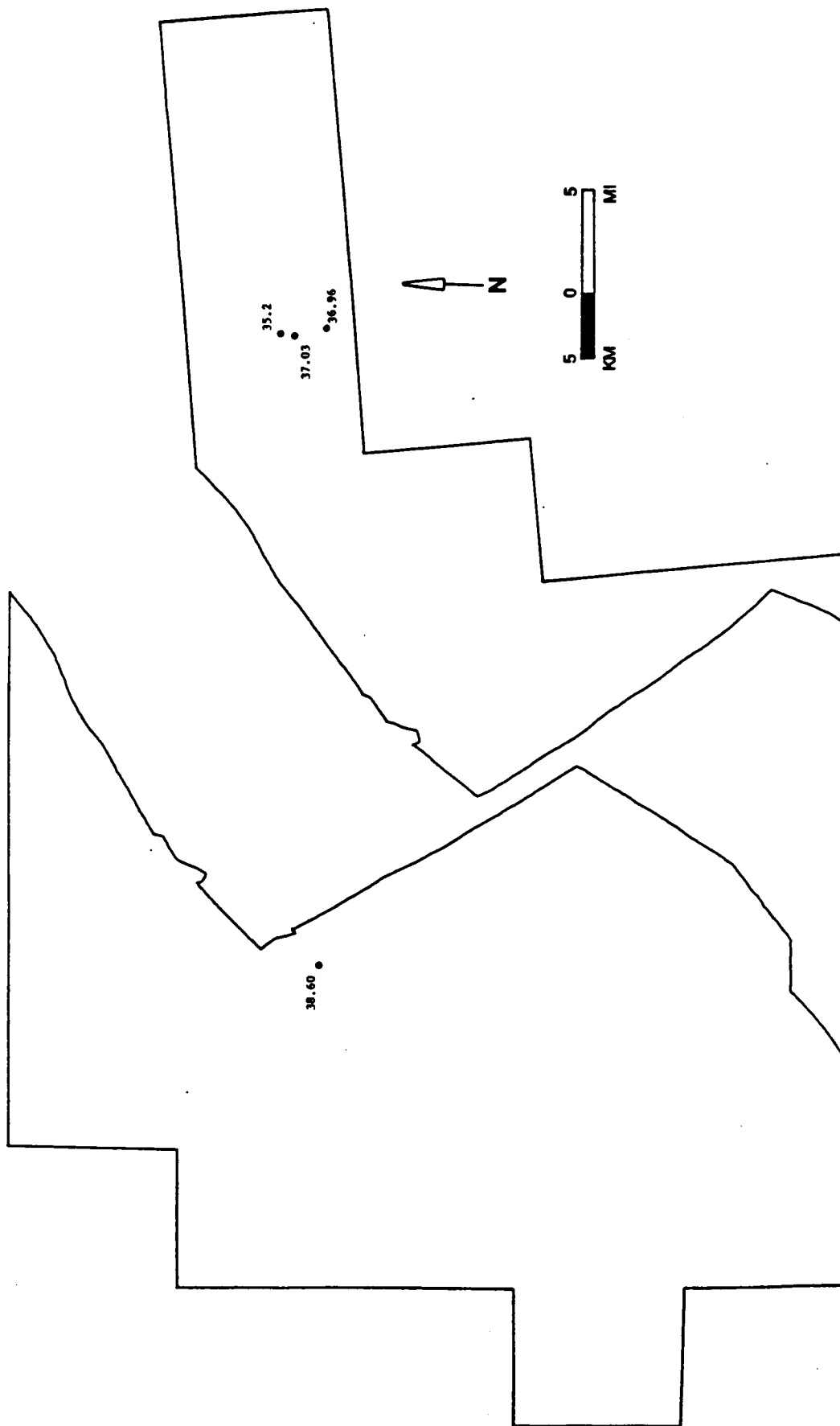


Figure 36. Volatile matter distribution in the E seam (%).

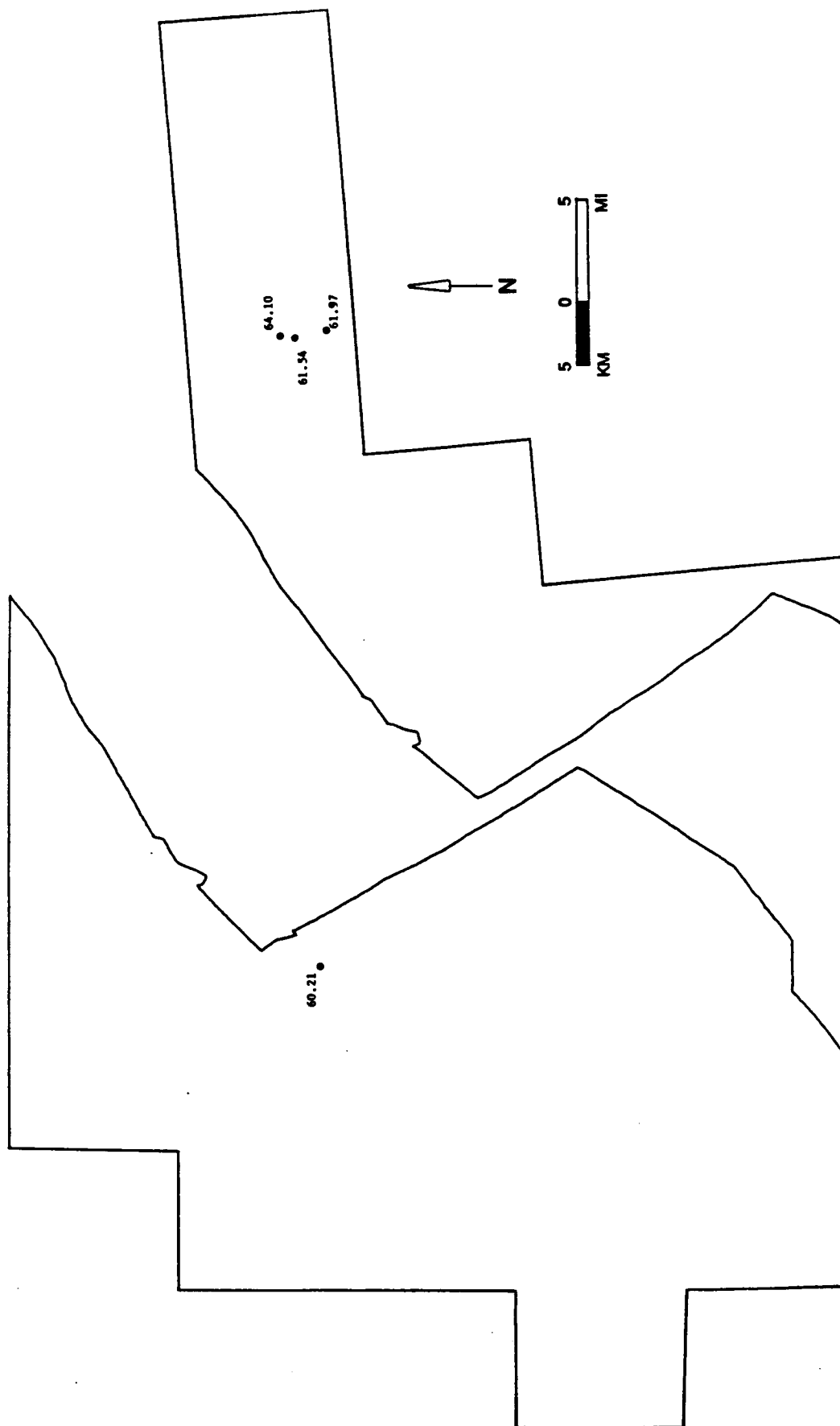


Figure 37. Fixed carbon distribution (dmmf) in the E seam (%).

The seam is generally thin and discontinuous on the thrust sheet and virtually non-existent on the plateau. The seam reaches a thickness of 12 to 24 inches in a small area in the Eagan and Fork Ridge quadrangles.

Only three analyses were available for the F seam and they were from samples in the Eagan quadrangle. Sulfur concentration ranges from 0.53 percent to 0.76 percent and ash content ranges from 1.22 percent to 7.09 percent. The volatile matter content of the F seam ranges from 34.01 percent to 34.08 percent and a single measurement of the fixed carbon content (dmmf) was 64.99 percent.

OVERLYING SEDIMENTARY ROCKS

The interval between the C seam datum and the overlying Joyner seam ranges from 60 feet in the western portion of the study area to 200 feet in the eastern portion (Plates 4 and 5). The C seam was chosen as the datum base for this measured interval due to its lateral continuity. This interval consists of an unnamed lower shale member, a middle sandstone member (Indian Flats (Seeber Flats) Sandstone), and an upper shale member to the base of the Joyner seam. In the extreme western portion of the study area, the lower shale and sandstone members directly overlie the C seam (Plates 4 and 5). In the eastern portion of the study area, the lower shale member includes the D, E and F seams and accompanying strata. The Indian Flats sandstone is a thick, laterally continuous sand body. This sandstone member is yellowish-gray to yellowish-brown, fine- to medium-grained, thin- to thick-bedded, and cross-bedded in part (Wilson et al. 1956).

The lower shale member of this interval consists of olive-gray to

very dark gray, clayey to sandy shale which is locally carbonaceous and commonly sideritic. Siderite bands or nodules in a very dark gray shale are very common above the C seam, particularly in the Huntsville, Pioneer, and Block quadrangles. This deposit averages 20 to 30 feet thick, but thins to less than 5 feet in other areas. A thick sandstone body (20 to 30 feet thick) lies directly above the C seam in the southern and northern portions of this study area (Plates 4 and 5). Plant fossils are common in the shale strata directly above the coal beds, although not as common as above the Blue Gem coal. This lower shale member, as described by Wanless (1946), has been shown to contain brackish-water fossils (Lingula) about 10 feet above the C seam in the Norma quadrangle (NOR-35 on Plate 5). Wanless' measured section in the Windrock quadrangle (WRK-22 on Plates 4 and 5) noted the presence of fresh-water fossils (Naiadites) in zones about 50 feet above, and directly above the C seam horizon. Fresh-water fossils were also observed directly above the C seam in the Ketchen quadrangle (KET-93).

JELLICO EQUIVALENTS

Cross-sections (Plates 1, 2, 3, 4, and 5) across the study area reveal that the other names used for the Jellico coal (seam or seams within the Jellico stratigraphic horizon) appear to be equivalent for the most part. The names Mingo, White Oak, Pruden, Westbourne, Log Mountain, State, Petros, and Brushy Mountain are usually given to the mineable portions of the section. Reference to the State, Petros, or Brushy Mountain coal on the Cumberland Plateau is probably a reference to the Jellico C seam. A reference to the Log Mountain, Westbourne, Pruden, or White Oak coals on

the Pine Mountain overthrust is a reference to the Jellico B, C, D, or E seams depending on which seam is thick enough to mine. The term Mingo coal is used as an equivalent for the Jellico near the Kentucky-Tennessee border on the Cumberland Plateau and on the Pine Mountain thrust sheet. The Mingo coal is equivalent to the Jellico C seam on the plateau and is equivalent to the Jellico D seam on the thrust sheet. In some of the older literature and mine maps the term Mason is used as an equivalent of the Jellico in the Eagan and Fork Ridge quadrangles. The true Mason lies approximately 650 feet below the Jellico (as mapped by the U.S.G.S.) and is not equivalent to the Jellico. The Kent seam is still referred to as the Jellico seam on the Pine Mountain thrust sheet as the result of miscorrelations across the sheet. The true position of the Kent seam is approximately 450 feet below the Jellico seam (as mapped by the Tennessee Division of Geology and the U.S.G.S.).

In a study of coal mining potential in Scott County, Dames and Moore (1976) stated that the geologic mapping by Luther and Avery (1970) in the Norma quadrangle was inaccurate. Dames and Moore based this on numerous core hole they drilled in Scott County (some drilled down to the Mississippian-Pennsylvanian boundary). According to Dames and Moore, the Blue Gem seam (as mapped by Luther and Avery) was actually the Jellico seam and the Jellico seam (as mapped by Luther and Avery) was actually the Joyner seam. The cross-sections (Plates 1, 2, 3, 4, and 5) produced in this thesis tend to agree with the mapping of Luther and Avery in that the type sections of the Jellico (Glenn, 1925; Wilson et al., 1956) are equivalent to the Jellico as mapped by Luther and Avery (1970).

CHAPTER IV

DISCUSSION AND CONCLUSIONS

DEPOSITIONAL MODELS

The Carboniferous strata of Pennsylvania, West Virginia, Kentucky, Tennessee, and Alabama have been interpreted as having been deposited in a series of five deltaic and littoral sedimentary environments. A deltaic model was developed by Ferm et al. (1971) and Ferm (1974; 1975) for the southeastern U.S. coal basins. Littoral models for the Upper Mississippian and Lower Pennsylvanian strata were developed by Milici (1974) in the Southern Cumberland Plateau of Tennessee and by Carlson (1978) in the Northern Cumberland Plateau of Tennessee. The five environments in these models were identified as: offshore bars and islands, barrier and lagoon, lower delta-plain, upper delta-plain, and alluvial plain. Horne et. al. (1978) subdivided the environments of a similiar depositional model into barrier, back barrier, lower delta-plain, transitional lower delta-plain, and upper delta plain-fluvial facies. The Ferm (1971; 1974) and Milici (1974) models were used to describe the Carboniferous strata of Scott County in a geologic investigation of coal mining potential for the R. L. Burns Corporation (Dames and Moore, 1976).

In the present study area, the Upper Mississippian limestone and shale strata are interpreted as offshore bar and island deposits, whereas the orthoquartzitic sandstone of the Lower Pennsylvanian are deposits of the barrier bars that protected tidal deltas and lagoons (Milici, 1974; Carlson, 1978). This barrier and lagoon sequence extends upward from

the base of the Pennsylvanian through the Crossville sandstone. The lower delta-plain environment begins where shale becomes more dominant in the stratigraphic sequence above the Crossville sandstone. The upper delta-plain facies begins where the sandstone strata are thicker and more coal seams are present. Dames and Moore (1976) interpreted all strata above the Windrock coal horizon as upper delta-plain deposits, whereas, Tisdale (1974), Minkin (1977), and Roberts (1978) interpreted the strata between the Windrock and Peewee coal horizons as lower delta-plain deposits while the strata above the Peewee coal horizon was interpreted as upper delta-plain deposits. White (1975) interpreted the strata above the Peewee seam to be of lower delta-plain origin. White's study area was to the west of Tisdale, Minkin, and Roberts and this may account for the difference of interpretation. The alluvial plain component of these models is absent in the strata of the study area (Figure 38) (Dames and Moore, 1976).

Based on these previous paleoenvironmental models, it is thought that the Jellico coal horizon formed in a lower delta-plain environment. Coal formed within this type of environment is generally thin, relatively widespread, and display irregular patterns of sulfur and trace element content (Horne et al., 1978). The coal bodies tend to be elongate parallel with the depositional dip and contain numerous splits caused by crevasse splays through poorly developed levees. Sandstone bodies tend to be the distributary mouth bar type in which the sand sequences grade upward from fine-grained, graded beds to fine- to medium-grained, multi-directional crossbeds and occasional downcutting channels. Shale makes up a major portion of this facies and tends to be found in

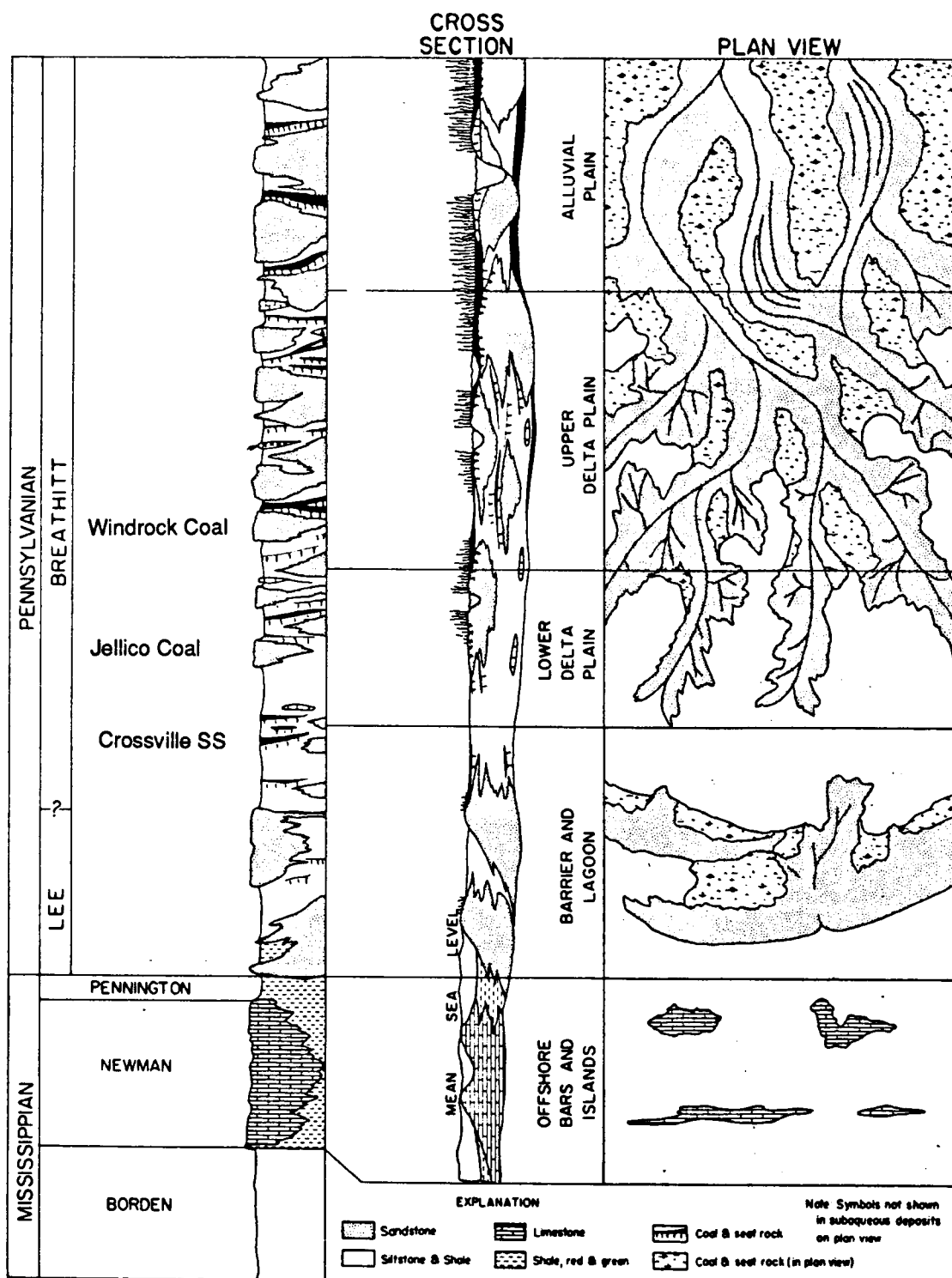


Figure 38. Dames and Moore (1976) interpretation of depositional environments for the Carboniferous strata in the study area. Modified from Ferm et al., 1974.

coarsening-upward bayfill deposits influenced by marine or brackish conditions. The shale commonly contains siderite bands and concretions in the lower portion of the sequence (Horne et al., 1978).

The Jellico coal displays many of the characteristics of the lower delta-plain environment. The coal is relatively widespread and thin. Over large parts of the study area, the coal beds are less than 20 inches thick (see Figures 15, 20, 26, and 33; pages 32, 38, 46, and 54). Coal thicknesses greater than 20 inches are limited to areas of approximately 10-15 miles wide. Those coal bodies display elongate patterns parallel to the depositional dip to the northwest. The depositional dip is based on previous paleogeographic models of the Carboniferous (Donaldson, 1974; Pryor and Sable, 1974; McKee 1975). These elongate patterns can be observed in the coal free areas of the B seam isopachs (Figure 15; page 32), the south-central portion of the C seam isopachs (Figure 20; page 38) and the peat mounds in the western portion of the D and E seam isopachs (Figures 26 and 33; pages 46 and 54). Random sulfur content patterns can be observed in the western portion of the sulfur distribution map of the C seam (Figure 22; page 41). Numerous splits in the coals can be observed in the cross-sections of the C and D seams (Figures 21, 27, and 28; pages 39, 47, and 48).

The Jellico coal horizon also displays some of the characteristics of the transitional lower delta-plain environment of Horne et al. (1978). This environment is described as a transition zone between the lower and upper delta-plain environments which exhibits features of both sequences. Coal formed within this type of environment are generally thick, commonly low in sulfur and display a high degree of lateral

continuity. The coal bodies tend to be elongate parallel to the depositional dip and contain numerous splits caused by crevasse splays through poorly developed levees. Coal seams tend to be more abundant throughout a typical vertical section of the transitional lower delta plain than a typical section of the lower delta-plain. The channel deposits exhibit lateral migration features and tend to be "single-storied" sequences. Shale sequences are thinner than those of the lower delta plain and tend to be bayfill deposits with marine to brackish influences, but they may contain fresh-water fossils (Horne et al., 1978). The northwest portion of the study area tends to display most of the lower delta-plain characteristics while the northeastern portion of the Pine Mountain thrust sheet displays many of the transitional lower delta plain characteristics.

Thus far in this study, the description of the depositional environments of the Jellico horizon has not taken into account the tectonic influences on those facies. The study area is located on the southern edge of the Appalachian basin. This basin has been described as a foreland basin which subsided in response to the thrust loads of successive deformations (Price and Hatcher, 1983; Quinlan and Beaumont, 1984; Beaumont et al., 1988). With each thrust-loaded event, the basin subsided and favored a marine transgression. Increased sedimentation from the uplifted orogens would slowly fill the basin until peat accumulation developed. Appalachian-type cyclothems are then repeated with each flexural event (Klein and Willard, 1989). This flexural basin is directly adjacent to an overthrust orogen and has an associated forebulge along the outer edge of the basin. The Nashville Dome-Cincinnati arch is

considered to be the associated forebulge of the Appalachian basin (Tankard, 1986).

Within the Appalachian basin, the Carboniferous sediment thickened greatly in response to the increased rate of subsidence. The facies tend to thicken and acquire additional coal seams toward areas of greater subsidence (Ferm and Weisenfluh, 1989). A large differential rate of subsidence has pronounced effects on the distribution of depositional environments and the quality of the enclosed coal seams. In areas of rapid subsidence, Horne et al., (1978) noted that depositional facies tend to be stacked on each other and exhibit slow rates of progradation such that the transition from upper delta plain to barrier environments occurs over a distance of 10 to 15 miles. On more stable platforms, the depositional environments prograde rapidly and the same transition occurs over a distance greater than 60 miles. Rapid subsidence tends to lower chemical activity so that coal within these areas are lower in sulfur and trace elements. Coal on stable platforms tend to have higher contents of chemically precipitated material (Horne et al., 1978).

The Carboniferous strata of the interval studied in the study area increase in thickness to the southeast and particularly to the northeast (Plates 1 and 3). The Jellico horizon also increases in thickness and acquires additional coal seams in these areas (Plates 4 and 5). These trends suggest increased subsidence in these southeast and northeast areas. The northwest portion of the study area is closer to the Nashville Dome-Cincinnati arch and appears to be somewhat more stable. In this more stable area, the Jellico horizon is much thinner, contains fewer coal seams, and displays characteristics of a lower delta-plain environment

(Plates 4 and 5). The effect of the subsidence is most pronounced in the Jellico horizon on the northwest portion of the Pine Mountain thrust sheet where all the coals exhibit low sulfur and ash contents and displays characteristics of a transitional lower delta-plain environment.

CONDITIONS PRIOR TO PEAT ACCUMULATION OF JELICO HORIZON

The accumulation of the Blue Gem peat was terminated by submergence in placid water indicated by dark shale with numerous plant fossils above the coal. Swamp re-establishment took place for a short time along the southeastern portion of the study area to form a thin rider seam (Plates 2 and 3). The dark, sideritic shale sequences grades upward into silty shale and siltstone, analogous to sequences formed in interdistributary bays of lower delta-plains (Horne et al., 1978). Brackish-water fossils are found to north (Winfield quadrangle) and fresh-water fossils found in the south (Windrock quadrangle) and the northeast (La Follette quadrangle) in these shale units. Although fossil information is very limited at this time, the available data suggest a marine/brackish-water influence toward the north and west. Due to the overthrusting of the Cumberland block, the original paleogeographic position of the fresh-water fossils in La Follette would have been approximately 70,000 feet to the southeast.

The discontinuous nature of the Sand Gap Sandstone suggests that it formed in lower delta distributary channels, which are described by Horne et al., (1978) as channels that are straight, with little tendency to migrate laterally. The Newcomb Sandstone would have been deposited as distributary mouth bars which overlie and are laterally equivalent to the

bayfill sequences (Horne et al., 1978). Cross-bed readings on the Newcomb Sandstone suggest a northwest to west direction of migration. After the channels distributing the sands (Newcomb Sandstone) were abandoned, a thin shale was deposited which became the platform upon which the Jellico peat swamps formed.

CONDITIONS DURING PEAT ACCUMULATION OF THE JELICO HORIZON

Swamps typically form on wide platforms between distributary channels and the interdistributary bay deep-water in the lower delta-plain environment. Paleotopographically, thicker peat accumulations occur in the topographic lows while thinner accumulations occur on topographic highs (Horne et al., 1978). The lower delta-plain is an active environment where shifts in the swamp environment will occur due to abandonment of channels, crevasse splays, and infilling of the interdistributary bays.

The Jellico A seam is a thin, narrow coal body which was terminated by submergence before it had an adequate environment in which to form extensively. The B seam (Figure 15; page 32) is also thin, but relatively widespread, which indicates deposition on topographic highs. The seam is thinnest (0-5 inches) over the thicker portions of the Newcomb Sandstone whereas thicker coal (>20 inches) occurs where the sandstone is thinner (<20 feet) (Figures 12 and 15; pages 26 and 32). Areas in which coal is absent are commonly occupied by sandstone. This would suggest that the thicker coal formed in the interdistributary areas bordering the distributary channels, which are represented by the thicker sandstone. The channel areas probably did not become sites for peat accumulation

until abandonment, after which they remained topographically high. Few splits occur in the coal, which indicates a low influx of detrital material during peat accumulation. Bay-fill shale appears to have been deposited on top to the B seam with very little sand deposition.

The distributary channel areas may have remained topographically high and/or active during the peat accumulation of the C seam (KET-82 on Plate 4, WRK-11, IVY-61, IVY-21, IVY-22, IVY-52, and IVY-51 on Plate 5). Areas of thin C seam (<20 inches) correspond very closely with the areas where the B seam is absent and the sandstone body is present (Figures 15 and 20; pages 32 and 38). Areas of thick C seam (>20 inches) tend to overlie places where the B seam is thick; however, some migration of the swamp may have occurred through time. The C seam appears to have had a similar depositional history as the B seam. Splits within the C seam appear to represent splays which had a source from the southwest (Figure 21; page 39).

The sulfur content of the C seam displays a wide range of values. Sulfur content of coal tends to increase with increased marine influence on the swamp during peat accumulation (Williams and Keith, 1963). The higher values of sulfur content in the southwestern portion of the study area (Figure 22; page 41) may be the result of a marine incursion from the southwest. To the northwest, a topographic high (with thin coal) probably corresponds to the topographic ridge observed on the palinspastic structure map (Figure 14; page 30) and may have acted as a barrier to the incursion for the rest of the study area.

The sulfur concentrations may have been influenced by the sand body that was deposited above the coal in this area (Plates 4 and 5 and Figure

39). In a study on the Pittsburg coal seam, Fraser and Crentz (1946) discovered that the sulfur content of the coal was highest where a sandstone roof occurs; however, in the present study the presence of a sandstone above the C seam in the north seems to have had little effect on sulfur values. fresh-water influence (Naiadites in the Windrock quadrangle) may have had a moderating effect on the extreme southern portion of this high sulfur area, where sulfur concentrations are less than 2 percent (Figure 22, page 41).

The ash content is very high where the C seam is >20 inches thick in the southern portion of the study area, whereas it remains low in coal of >20 inches to the north. White and Thiessen (1913) proposed, without supporting data, that coal influenced by marine conditions commonly are higher in ash than coals with no marine influence. No marine fossils have been observed within the study area.

As previously noted, a thick sand was deposited near, and at the top of the C seam in the north and south portion of the study area (Figure 39). The sandstone is interpreted to have been deposited in a distributary channel. To the north of this area, the C seam is overlain by a very dark shale with numerous siderite nodules which is interpreted to have been a interdistributary bay deposit. Plant fossils are common in the shale above the C seam which indicate a quiet-water environment after swamp submergence. fresh-water fossils were observed directly above the C seam horizon at WRK-22 (Plates 4 and 5) and KET-94, whereas brackish-water fossils were observed about 10 feet above the C seam at NOR-35 (Plate 5) (Wanless, 1946). Although fossil information is limited at this time, the available data suggest a marine/brackish-water

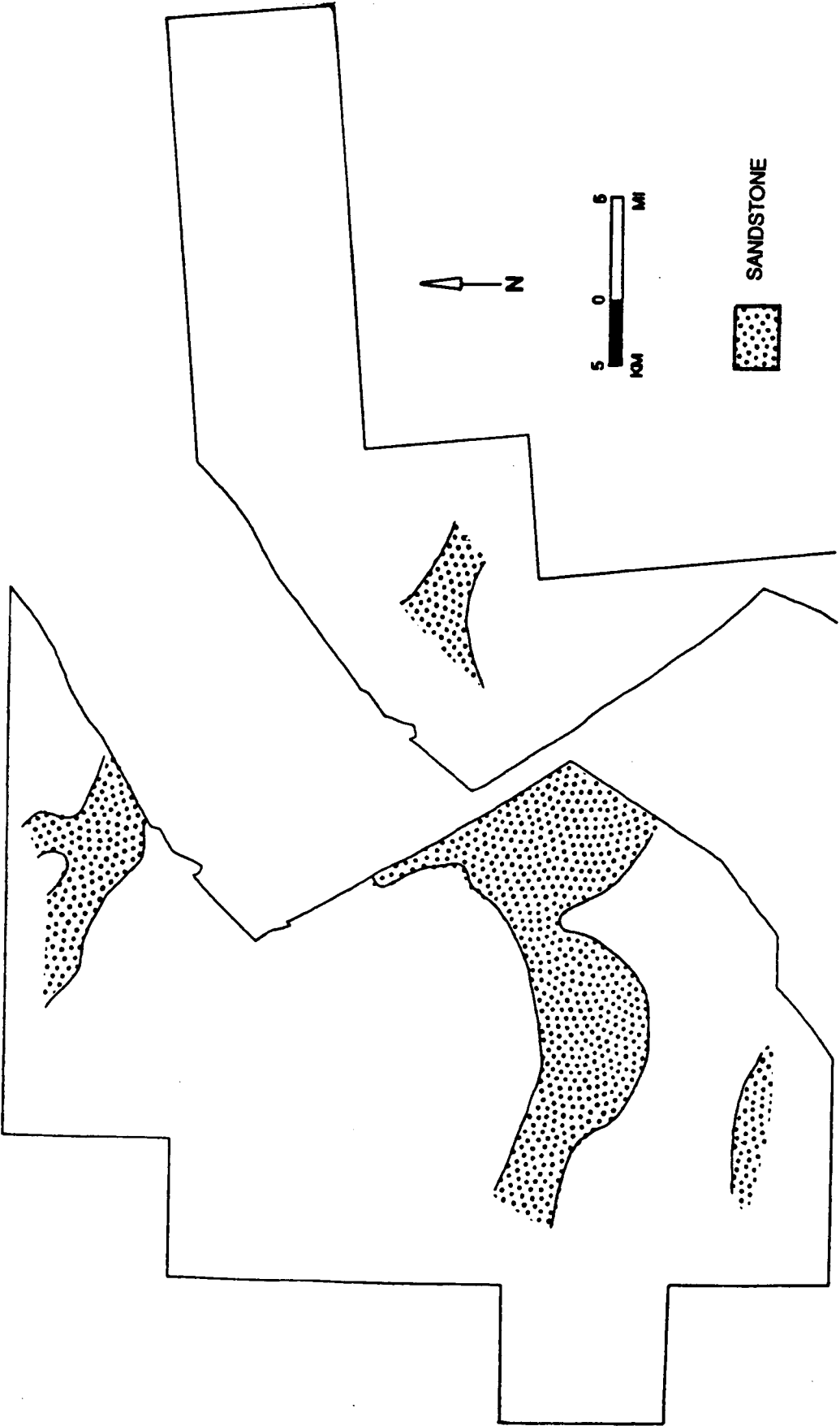


Figure 39. Sandstone distribution directly above the C seam.

influence from the west. This data is similar to features described above the Blue Gem horizon on pages 27 and 68.

The sandstone above the C seam appears to have influenced the peat accumulation of the D seam. The small peat mounds in the southern section appear to cluster around the sandstone trace (Figures 26 and 39; pages 46 and 72). The easternmost mound appears to fit into an embayment formed by the sandstone trace. These peat mounds are relatively small and thin which might indicate the existence of small platforms for peat accumulation and relatively rapid subsidence. At this time, the erosional and/or depositional influence of the sandstone is uncertain. The sandstone in the north section appears to have had minor effect on peat accumulation while the sandstone on the Pine Mountain thrust sheet had a great effect. Thick peat accumulated on a broad, interdistributary platform to the northeast of the sandstone. The coal tends to thin as it reaches the sandstone. This may indicate a topographic high which did not become a site for peat accumulation until total abandonment of the distributary channel.

The cross-sections of the D seam reveal that the coal contains several continuous partings interpreted as splay deposits (Figures 27 and 28; pages 47 and 48). Wide variations in the thickness of the parting between the D2 and D3 splits occur in the Fork Ridge quadrangle. Up to 40 feet of parting has been observed between the D2 and D3 splits in some areas, while less than one inch has been observed on the same parting in other areas. The parting remains very thin in the central and western portion of the Fork Ridge quadrangle and tends to thicken in the rest of the quadrangle. The source of the splay appears to be to the east and

northeast where the splay takes on the appearance and thickness of a mini-delta. FKR-35 (Plate 5) reveals interbedded siltstone and sandstone between the D2 and D3 seams. The shape of the swamp shifted through time during the peat accumulation of the D seam. The D1 seam appears to be thickest in the Eagan quadrangle and thins to nothing in the east. The thickness of the D2 seam remains relatively constant over the area. The D3 seam thins to the southwest and also to the northwest where it lies above the mini-delta (Figures 27 and 28; pages 47 and 48). The sulfur and ash contents remains relatively low on the Cumberland block which may indicate lack of marine influence. Plant fossils observed above the D seam in the Fork Ridge quadrangle suggest placid water deposition.

A thick sandstone (representing a former distributary) lies above the D seam on the Cumberland block. The effect of the sandstone body on peat accumulation of the E seam appears mixed. The sandstone is relatively persistent on the Cumberland block, while the E seam thins on the edges of the block and thickens toward the middle (Figure 33; page 54). The thick peat accumulation may be in response to subsidence caused by the weight of the underlying sandstone body. Information on the sandstone below the E seam on the Cumberland plateau is scarce. The relative thinness of the coal tends to point toward peat accumulation on a topographic high. Fresh-water fossils were observed by Wanless (1946) above the E seam at WRK-22 (Plates 4 and 5). Sulfur and ash contents are low; hence, there appears to have been little or no marine influence.

The F seam is a thin and discontinuous coal body which was terminated by submergence before there was adequate time to form an extensive area of peat accumulation. Dark, sideritic shale lies above the

E and F seam in the Eagan and Fork Ridge quadrangles and suggests bayfill deposition. Low sulfur and ash contents indicate a lack of marine influence.

CONDITIONS AFTER PEAT ACCUMULATION OF THE JELICO HORIZON

The various peat accumulations of the Jellico horizon were terminated by submergence in quiet-water indicated by dark shale, with numerous plant fossils above the seams. The dark, commonly sideritic shale strata grade upward into siltier shale and siltstone, and are analogous to sequences formed in interdistributary bays and prodeltas of lower delta-plains (Horne et al., 1978). The overlying Indian Flats (Seeber Flats) Sandstone is a thick, laterally continuous sand body that is analogous to distributary mouth bar deposits that generally cap the typically coarsening-upward sequence of a lower delta-plain deposit.

CONCLUSIONS

The character of the Jellico coal horizon as well as the other Carboniferous strata in the study area are the result of the interaction of tectonic influences and depositional environments. The Jellico accumulated in two areas: one of active subsidence and one of relative stability. The Jellico horizon and accompanying coal displays the result of this tectonic influence where a lower delta-plain environment is postulated for the relatively stable northwest while a transitional lower delta-plain environment is postulated for the subsiding southeast and northeast. The coal seams of the transitional lower delta-plain environment are thick and more numerous than the coals of the lower

delta-plain.

The character of the Jellico coal horizon was also influenced by the effects of the underlying lithology and paleotopography. The accumulation of the stratigraphically lower coal seams were affected by underlying topographic highs and lows which depended on the position and thickness of the underlying Newcomb Sandstone. Stratigraphically higher coal seams and lithologies were similarly influenced by underlying characteristics. In addition to influencing coal thickness, paleotopography influenced coal quality. A topographic ridge acted as a barrier to a marine encroachment which produced higher sulfur and ash contents in the coal in some parts of the study area.

The names used for the Jellico coal (seam or seams within the Jellico stratigraphic horizon) appear to be equivalent for the most part. The names Mingo, White Oak, Pruden, Westbourne, Log Mountain, State, Petros, and Brushy Mountain are usually given to the mineable portions of the section. For example, reference to the Mingo coal on the Pine Mountain thrust sheet is probably a reference to the Jellico D seam, while reference to the Mingo coal away from the thrust sheet is probably a reference to the Jellico C seam. The terms are equivalent in that they do occur within the Jellico stratigraphic horizon. The terms Mason and Kent are not equivalent terms with the Jellico and are often confusing. The term Mason is used in some of the older literature for the Jellico in the Eagan and Fork Ridge quadrangles. The true Mason seam lies approximately 650 feet below the Jellico. The Kent seam is still being referred to as the Jellico on the Pine Mountain thrust sheet as the result of miscorrelations across the sheet. Its true position is approximately

450 feet below the Jellico.

SUGGESTIONS FOR FUTHER STUDY

1) More precise identification of the depositional environments would be possible if there were more core (and outcrop) of the Jellico horizon. The study was hampered by the lack of core and by drillers logs consisting of only very rudimentary descriptions, which made identification of depositional environments difficult.

2) Data concerning trace element chemistry, and coal petrography of new and existing coal samples, would enhance current depositional environmental information and help to reveal the coalification history of the Jellico.

3) This study of the Jellico horizon should be expanded to include its equivalents in Kentucky, West Virginia, etc. This would render a large-scale overview of the interaction of various tectonic settings with the depositional environments of the Jellico. The results could enhance our understanding of how coal character changes with depositional environment and tectonic activity. New models could significantly aid in future exploration.

REFERENCES

REFERENCES

- American Commission on Stratigraphic Nomenclature, 1961, Code of stratigraphic nomenclature: American Association of Petroleum Geologists Bulletin, v. 45, no. 5, p. 645-665.
- Aresco, S. J., Haller, C. P., and Abernathy, R. F., 1956, Analyses of tippie and delivered samples of coal (collected during the fiscal year 1955): U. S. Bureau of Mines Report of Investigation 5270, 66 p.
- Aresco, S. J., Haller, C. P., and Abernathy, R. F., 1957, Analyses of tippie and delivered samples of coal (collected during the fiscal year 1956): U. S. Bureau of Mines Report of Investigation 5332, 67 p.
- Aresco, S. J., Haller, C. P., and Abernathy, R. F., 1959, Analyses of tippie and delivered samples of coal (collected during the fiscal year 1958): U. S. Bureau of Mines Report of Investigation 5489, 54 p.
- Ashley, G. H., and Glenn, L. C., 1906, Geology and mineral resources of part of the Cumberland Gap coal field, Kentucky: U. S. Geological Survey Professional Paper 49, 239 p.
- Barlow, J. A., 1969, Stratigraphy and paleobotany of the youngest Pennsylvanian strata in the Caryville, Tennessee area: Unpublished Ph.D. dissertation, University of Tennessee-Knoxville, 342 p.
- Beaumont, C., Quinlan, G., and Hamilton, J., 1988, Orogeny and stratigraphy: Numerical models of the Paleozoic in the eastern interior of North America: Tectonics, v. 7, no. 3, p. 389-416.
- Carlson, G. D., 1978, Depositional modelling of Carboniferous rocks applied to coal exploration, northern Cumberland Plateau, Tennessee: Unpublished M.S. thesis, University of South Carolina, Columbia, South Carolina, 75 p.
- Dames and Moore, 1976, Geologic investigation of the coal mining potential of the Brimstone Company property in Scott County, Tennessee for the R. L. Burns Corporation: Unpublished Atlas, 30 p.
- Donaldson, A. C., 1974, Pennsylvanian sedimentation of central Appalachians: in Briggs, G., ed., Carboniferous of the southeastern United States, Geological Society of America Special Paper 148, p. 47-78.
- Englund, K. J., 1964, Geology of the Middlesboro South quadrangle, Tennessee-Kentucky-Virginia: U.S. Geological Survey Geologic Quadrangle Map GQ-301, scale 1:24,000.
- Englund, K. J., 1968, Geology and coal resources of the Elk Valley area, Tennessee and Kentucky: U.S. Geological Survey Professional Paper 572, 59 p.

- Ferm, J. C., 1974, Carboniferous environmental models in eastern United States and their significance: *in* Briggs, G., ed., Carboniferous of the southeastern United States, Geological Society of America Special Paper 148, p. 79-96.
- Ferm, J. C., 1975, Pennsylvanian cyclothems of the Appalachian Plateau: a retrospective view: *in* Paleotectonic investigations of the Pennsylvanian system in the United States, Part II: U.S. Geologic Survey Professional Paper 853, p. 57-96.
- Ferm, J. C., Horne, J. C., Swinchatt, J. P., and Whaley, P. W., 1971, Carboniferous depositional environments in northeastern Kentucky, Kentucky Geological Society Guidebook Annual Spring Field Conference, Lexington, Kentucky, 30 p.
- Ferm, J. C., Whaley, P. W., and Pedersen, D. E., 1974, Upper delta-plain transition deposits in the vicinity of Ashland, Kentucky: *in* Ferm J. C. and Horne J. C., eds., Carboniferous depositional environments in the Appalachian region: University of South Carolina, Columbia, South Carolina, p. 211-217.
- Ferm, J. C. and Weisenfluh, G. A., 1989, Evolution of some depositional models in late Carboniferous rocks of the Appalachian coal fields; *International Journal of Coal Geology*, 12, p. 259-292.
- Fraser, T. and Crentz, W. L., 1946, Washing characteristics of the Pittsburgh coal in a high sulfur area in Green County, Pennsylvania: U.S. Bureau of Mines Technical Paper 689, 85 p.
- Finlayson, C.P., Powell, R. L., and Kronman, G., 1985, Geologic map and mineral resources summary of the Pilot Mountain quadrangle Tennessee: Tennessee Division of Geology Geologic Map GM 122-NW, scale 1:24,000.
- Garman, R. K., Furguson, C. C., and James, M. L., 1975, Geologic map and mineral resources summary of the Fork Mountain quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 129-NW, scale 1:24,000.
- Glenn, L. C., 1925, The northern Tennessee coal field: Tennessee Division of Geology Bulletin 33-B, 478 p.
- Hardeman, W. D., and others, 1966, Geologic map of Tennessee: Tennessee Division of Geology, 4 sheets, scale 1:250,000.
- Hershey, R. E., Williams, L., Crentz, W. L., Miller, J. W., and Reynolds, D. A., 1956, Estimate of known recoverable reserves and preparation and carbonizing properties of coking coal in Claiborne County, Tennessee: U. S. Bureau of Mines Report Investigation 5229, 44 p.

- Horne, J. C., Ferm, J. C., Caruccio, F. T., and Baganz, B. P., 1978, Depositional models in coal exploration and mine planning in the Appalachian region: American Association of Petroleum Geologists Bulletin 62, p. 2379-2411.
- Johnson, R. C., and Luther, E. T., 1972, Strippable coal in the northern Cumberland Plateau area of Tennessee: Tennessee Division of Geology Report of Investigation 34, 41 p.
- Keith, A., 1896b, Description of the Briceville quadrangle, Tennessee: U.S. Geological Survey Geologic Atlas, Folio 33, 4 p.
- Klein, G. deV. and Willard, D. A., 1989, Origin of the Pennsylvanian coal-bearing cyclothems of North America: *Geology*, v. 17, p. 152-155.
- Luther, E. T., 1959, The coal reserves of Tennessee: Tennessee Division of Geology Bulletin 63, 294 p.
- Luther, E. T., 1967, Geologic map and mineral resources summary of the Block quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 128-SE, scale 1:24,000.
- Luther, E. T., and Avery, G. G., 1970, Geologic map and mineral resources summary of the Norma quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 128-SW, scale 1:24,000.
- McDowell, R. C., Grabouski, G. J., Jr., and Moore, S. L., 1981, Geologic map of Kentucky: U. S. Geological Survey, scale 1:250,000.
- McKee, E. D., 1974, Interpretation of Pennsylvanian history: in Paleotectonic investigations of the Pennsylvanian system in the United States, Part II: U.S. Geologic Survey Professional Paper 853, p. 1-12.
- Milici, R. C., 1974, Stratigraphy and depositional environments of Upper Mississippian and Lower Pennsylvanian rocks in the southern Cumberland Plateau of Tennessee: Geologic Society of America Special Paper 148, p. 115-133
- Minkin, S. C., 1977, Pennsylvanian deltaic sediments of the northern Cumberland Plateau, Tennessee: Unpublished M.S. thesis, University of Tennessee-Knoxville, 141 p.
- Mitra, S., 1988, Three-dimensional geometry and kinematic evolution of the Pine Mountain thrust system, southern Appalachians: *Geological Society of America Bulletin*, v. 100, p. 72-95
- Nelson, W. A., 1945, Analyses of Tennessee coals (including Georgia): U.S. Bureau of Mines Technical Paper 671, 243 p.

- Newell, W. L., 1975, Geologic map of the Frakes quadrangle and part of the Eagan quadrangle, southeastern Kentucky: U.S. Geological Survey Geological Quadrangle Map GQ-1249, Scale 1:24,000.
- Pryor, W. A., and Sable, E. G., 1974, Carboniferous of the Eastern Interior Basin: in Briggs, G., ed., Carboniferous of the southeastern United States: Geological Society of America Special Paper 148, p. 281-314.
- Price, R. A., and Hatcher, Jr., R. D., 1983, Tectonic significance of similarities in the evolution of the Alabama-Pennsylvanian Appalachians and the Alberta-British Columbia Canadian Cordillera, in Hatcher, Jr., R. D., Williams, H., and Zietz, I., eds., Contributions to tectonics and geophysics of mountain chains: Geological Society of America Memoir 158, p. 149-160.
- Quinlan, G. M., and Beaumont C., 1984, Appalachian thrusting, lithospheric flexure, and the Paleozoic stratigraphy of the eastern interior of North America: Canadian Journal of Earth Sciences, v. 21. p. 973-996.
- Roberts, T. A., 1978, Transitional lower delta plain-upper delta plain sediments in Middle Pennsylvanian coal-bearing strata eastern Wartburg basin, Tennessee: Unpublished M.S. thesis, University of Tennessee-Knoxville, 272 p.
- Rose Jr., W. D., 1953, Geology of the northern part of the Camp Austin quadrangle, Morgan County, Tennessee: Unpublished M.S. thesis, Vanderbilt University, Nashville, Tennessee, 48 p.
- Rice, C. L., 1984, Stratigraphic framework and nomenclature problems in the Pennsylvanian of the Cumberland overthrust sheet, Kentucky and Tennessee: Geological Society of America Bulletin, v. 95, p. 1475-1481.
- Rice, C. L., and Maughan, E. K., 1978, Geologic map of the Kayjay quadrangle and part of the Fork Ridge quadrangle, Bell and Knox Counties, Kentucky: U. S. Geological Survey Geologic Quadrangle Map GQ-1505.
- Safford, J. M., 1869, Geology of Tennessee: Nashville, Tennessee, 550p.
- Snyder, N. H., and Aresco, S. J., 1953, Analyses of tippie and delivered samples of coal (collected during the fiscal years 1948 to 1950 inclusive): U. S. Bureau of Mines Bulletin 516, 133 p.
- Statler, A. T., and Sykes, C. R., 1970, Geologic map and mineral resources summary of Duncan Flats quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 129-NE, scale 1:24,000.

- Stearns, R. C., 1954, The Cumberland Plateau overthrust and geology of the Crab Orchard Mountains area, Tennessee: Tennessee Division of Geology Bulletin 60, 47 p.
- Swingle, G. D., 1960, Geologic map of the Lake City quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 137-NW, Scale 1:31,680.
- Swingle, G. D., 1960, Geologic map of the Jacksboro quadrangle, Tennessee: Tennessee Division of Geology Geologic Map GM 136-SW, scale 1:31,680.
- Tankard, A. J., 1986, Depositional response to foreland deformation in the Carboniferous of eastern Kentucky: American Association of Petroleum Geologists Bulletin, v. 70, p. 853-868.
- Tisdale, R. M., 1974, Field characteristics and recognition of upper delta-plain sediments, Vowell Mountain and Cross Mountain Formations, Windrock Quadrangle, Tennessee: Unpublished M.S. thesis, University of Tennessee-Knoxville, 128 p.
- Wanless, H. R., 1946, Pennsylvanian geology of a part of the southern Appalachian coal field: Geological Society of America Memoir 13, 162 p.
- White, D., and Thiessen, R., 1913, The origin of coal: U.S. Bureau of Mines Bulletin 38.
- White, J. F., 1975, Depositional environments of Pennsylvanian Redoak Mountain Formation, Northern Cumberland Plateau, Tennessee: Unpublished M.S. thesis, University of Tennessee-Knoxville, 115 p.
- Williams, E. G. and Keith, M. L., 1963, Relationship between sulfur in coals and the occurrence of marine roof beds: Economic Geology, v. 58, p. 720-729.
- Williams, L., Gibbs, H. K., Crentz, W. L., and Miller, J. W., 1956, Estimates of known recoverable reserves and preparation characteristics of coking coal in Scott County, Tennessee: U. S. Bureau of Mines Report of Investigation 5232, 36 p.
- Williams, L., Gibbs, H.K., Crentz, W. L., Miller, J. W., and Reynolds, D. A., 1956, Estimate of known recoverable reserves and preparation and carbonizing properties of coking coal in Campbell County, Tennessee: U. S. Bureau of Mines Report of Investigation 5258, 78 p.
- Williams, L., James, C., Crentz, W. L., and Miller, J. W., 1956, Estimate of known recoverable reserves and the preparation characteristics of coking coal in Morgan County, Tennessee: U. S. Bureau of Mines Report of Investigation 5266, 43 p.

- Williams, L., James, C., Gandrond, B. W., and Reynolds, D. A., 1955, Estimate of known recoverable reserves and the preparation and carbonizing properties of coking coal in Anderson County, Tennessee: U. S. Bureau of Mines Report of Investigation 5185, 52 p.
- Wilson, C. W., Jr., Jewell, J. W., and Luther, E. T., 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Division of Geology Report of Investigation 8, 21 p.

APPENDICES

APPENDIX A

PREVIOUS GEOLOGIC MAPPING IN STUDY AREA

GEOLOGIC MAPPING-quadrangle and other

Keith, 1896b- Briceville folio

Ashley and Glenn, 1906- Cumberland Gap coal field

Rodgers, 1953- Geologic map of east Tennessee

Rose, 1953- Geology of the northern part of Camp Austin

Swingle, 1960- Geology of Jacksboro

Swingle, 1960- Geology of Lake City

Englund, 1964- Geology of Middlesboro South

Luther, 1967- Geology of Block

Englund, 1968- Geology of Elk Valley (Jellico West, Pioneer, Ketchen, and Ivydell)

Luther and Avery, 1970- Geology of Norma

Statler and Sykes, 1970- Geology of Duncan Flats

Garman, Furguson, and Jones, 1975- Geology of Fork Mountain

Newell, 1975- Geology of Frakes and part of Eagan

Rice and Maughan, 1978- Geology of Kayjay and part of Fork Ridge

Finlayson, Powell, and Kronman, 1985- Geology of Pilot Mountain

NOTE: Other quadrangles in study area are in various states of compilation and editing by the Tennessee Division of Geology and the U.S. Geologic Survey.

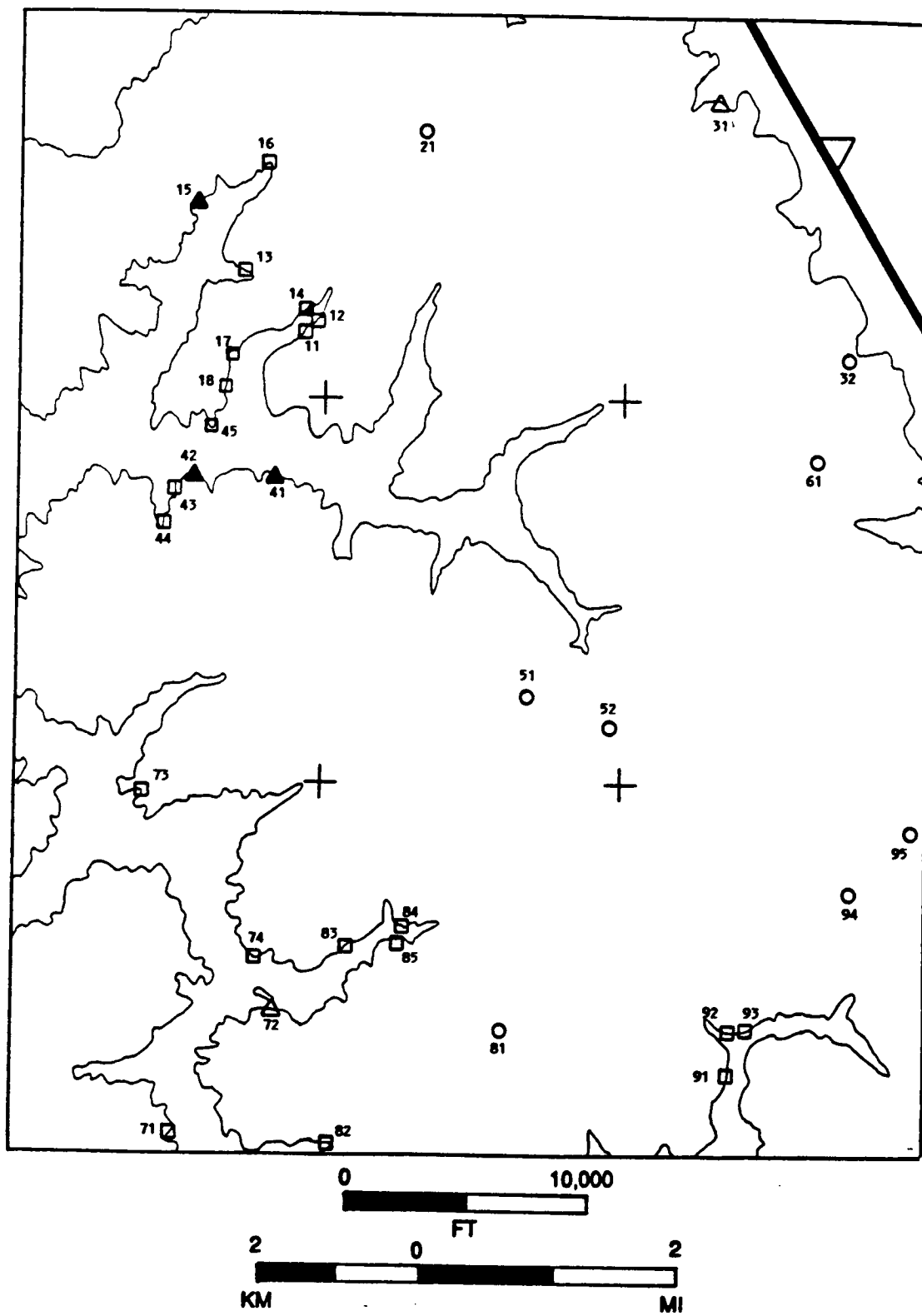
APPENDIX B

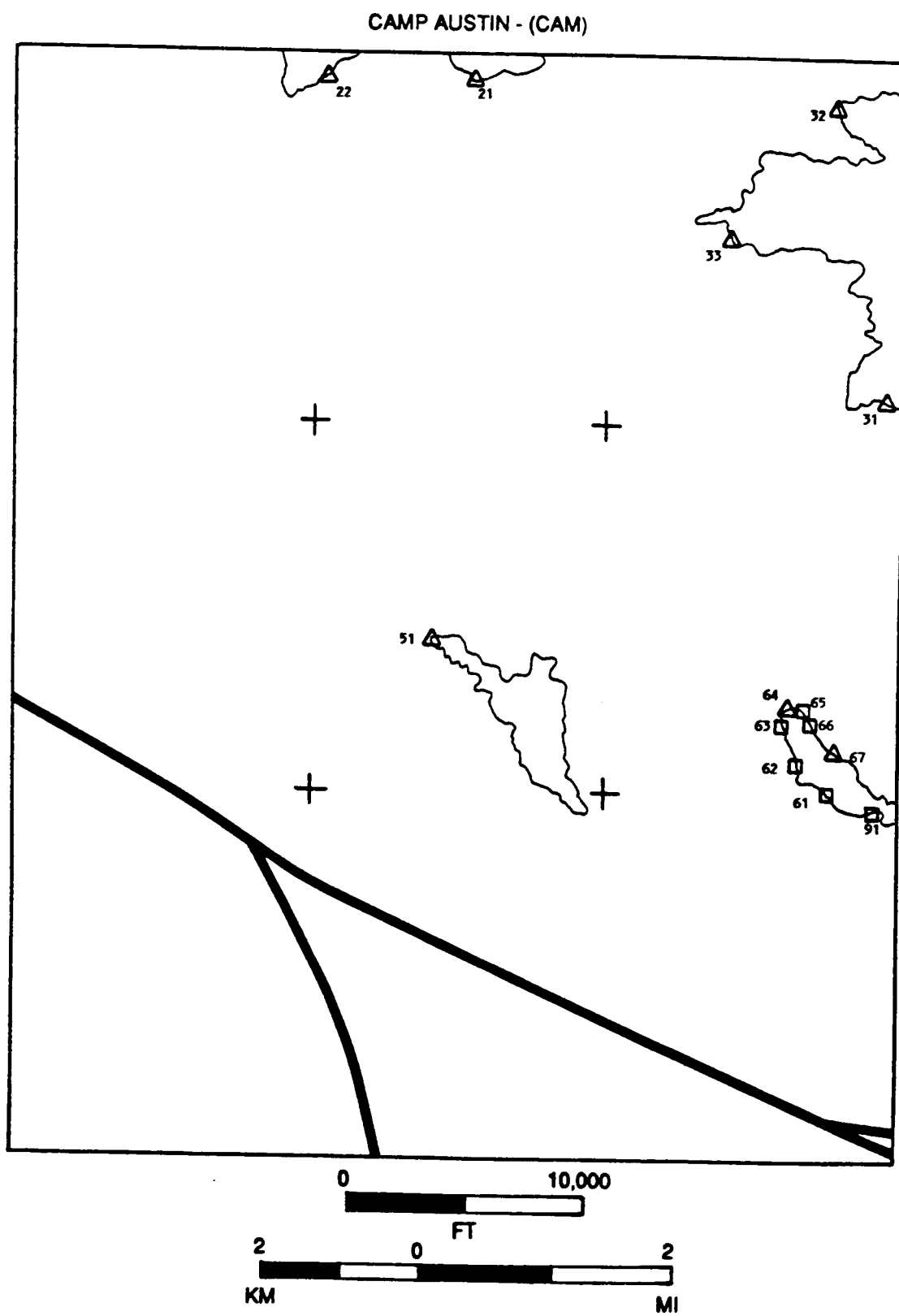
DATA POINT MAPS

QUADRANGLE ABBREVIATIONS IN ()

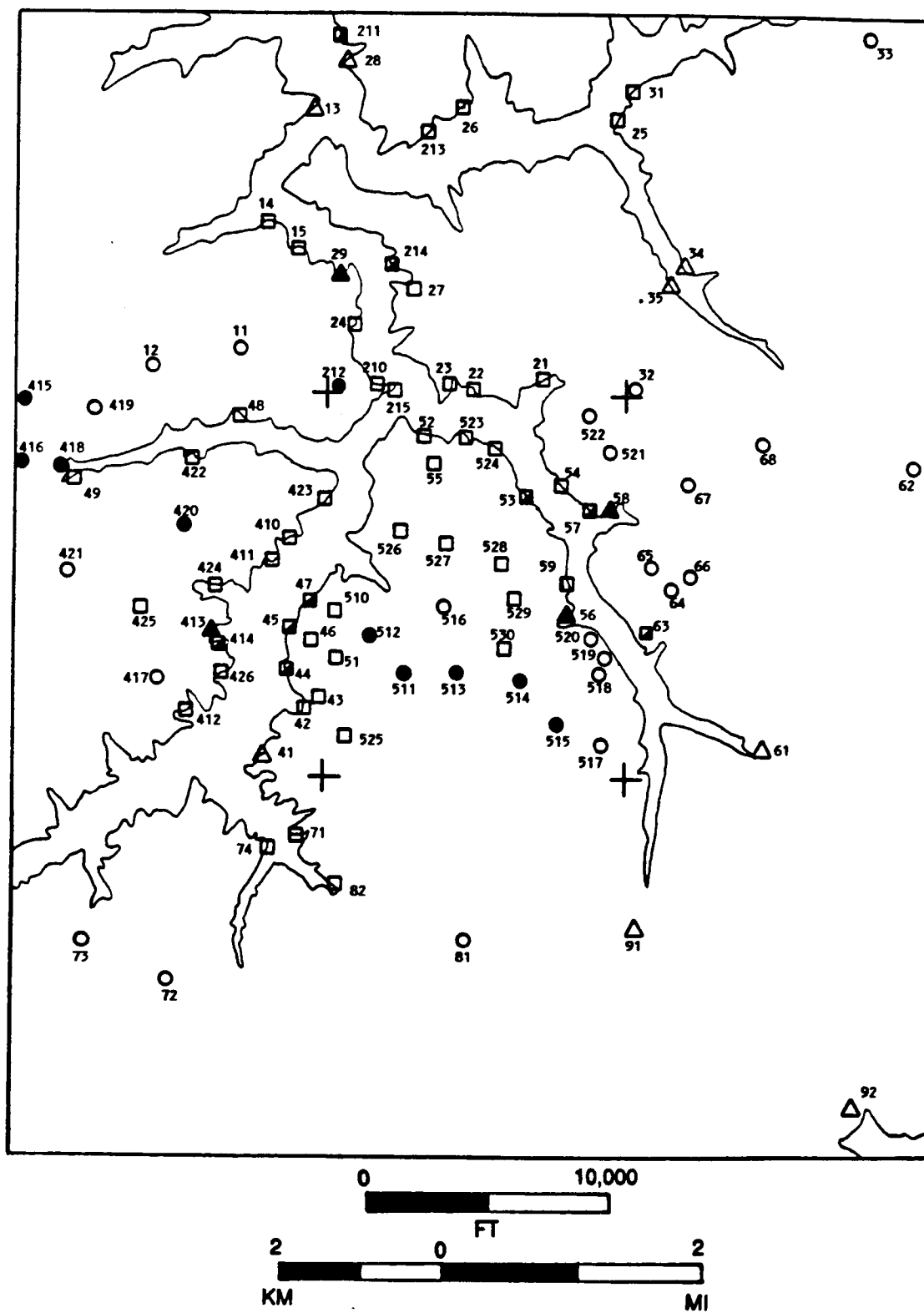
MAP LEGEND GIVEN IN APPENDIX C

BLOCK - (BLK)

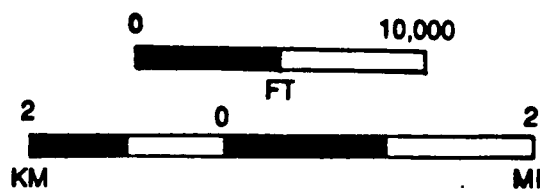
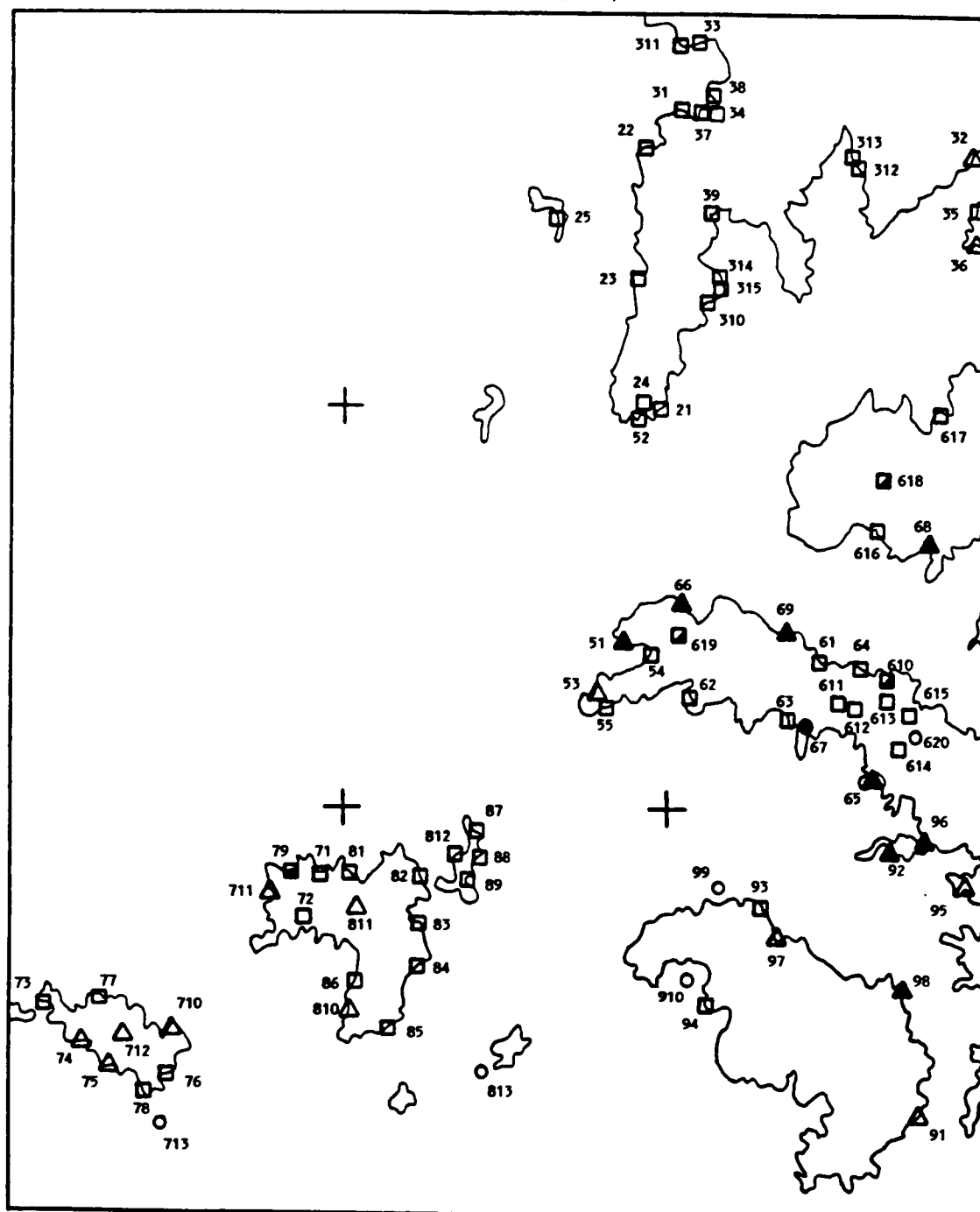




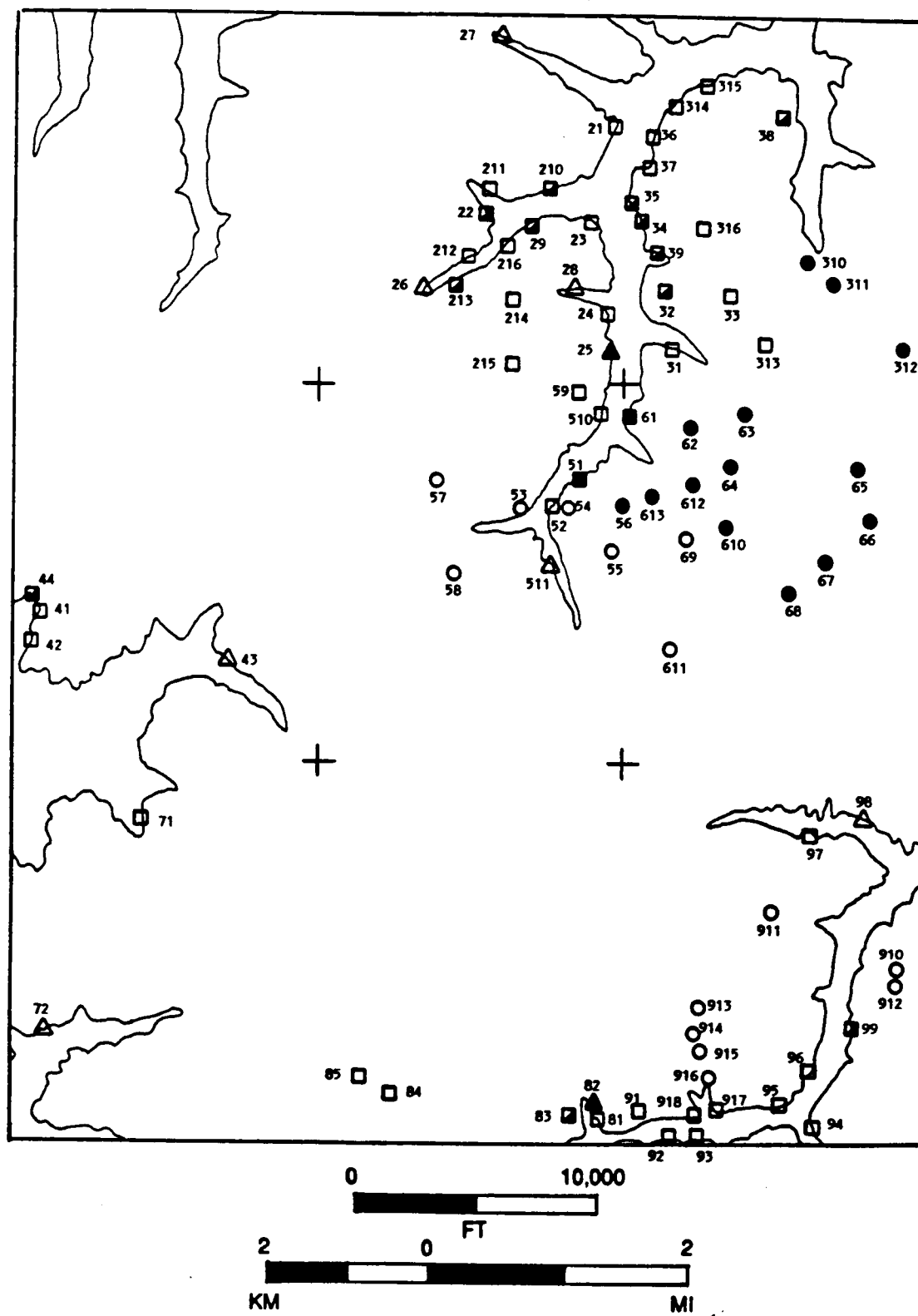
DUNCAN FLATS - (DUN)



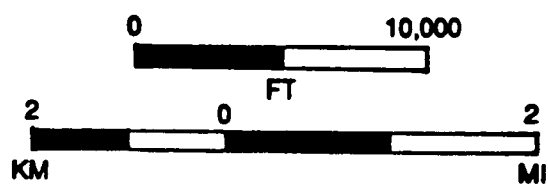
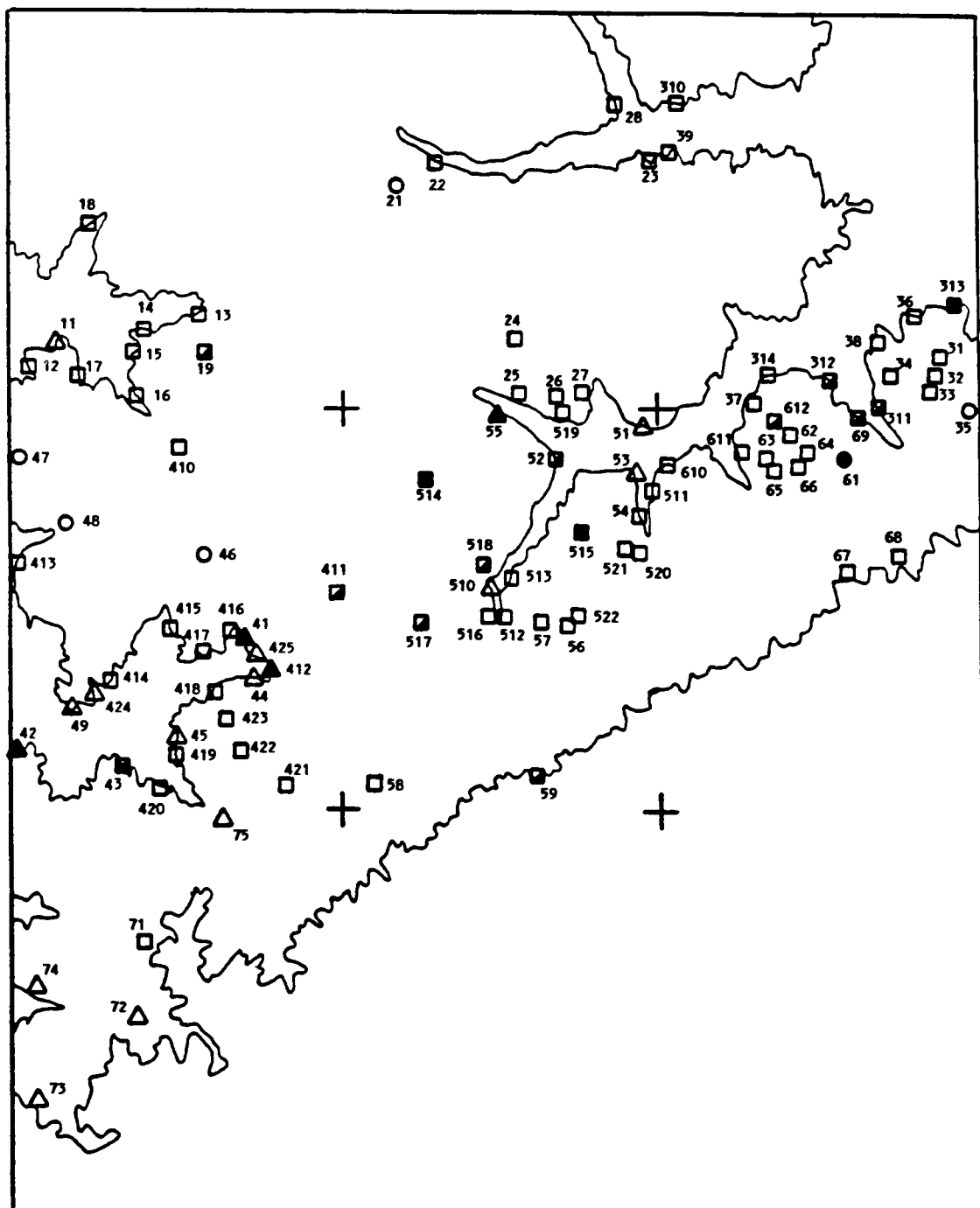
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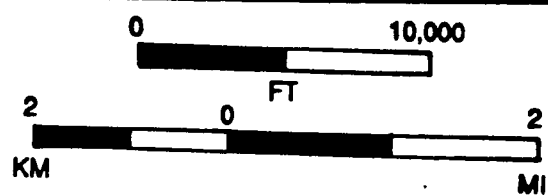
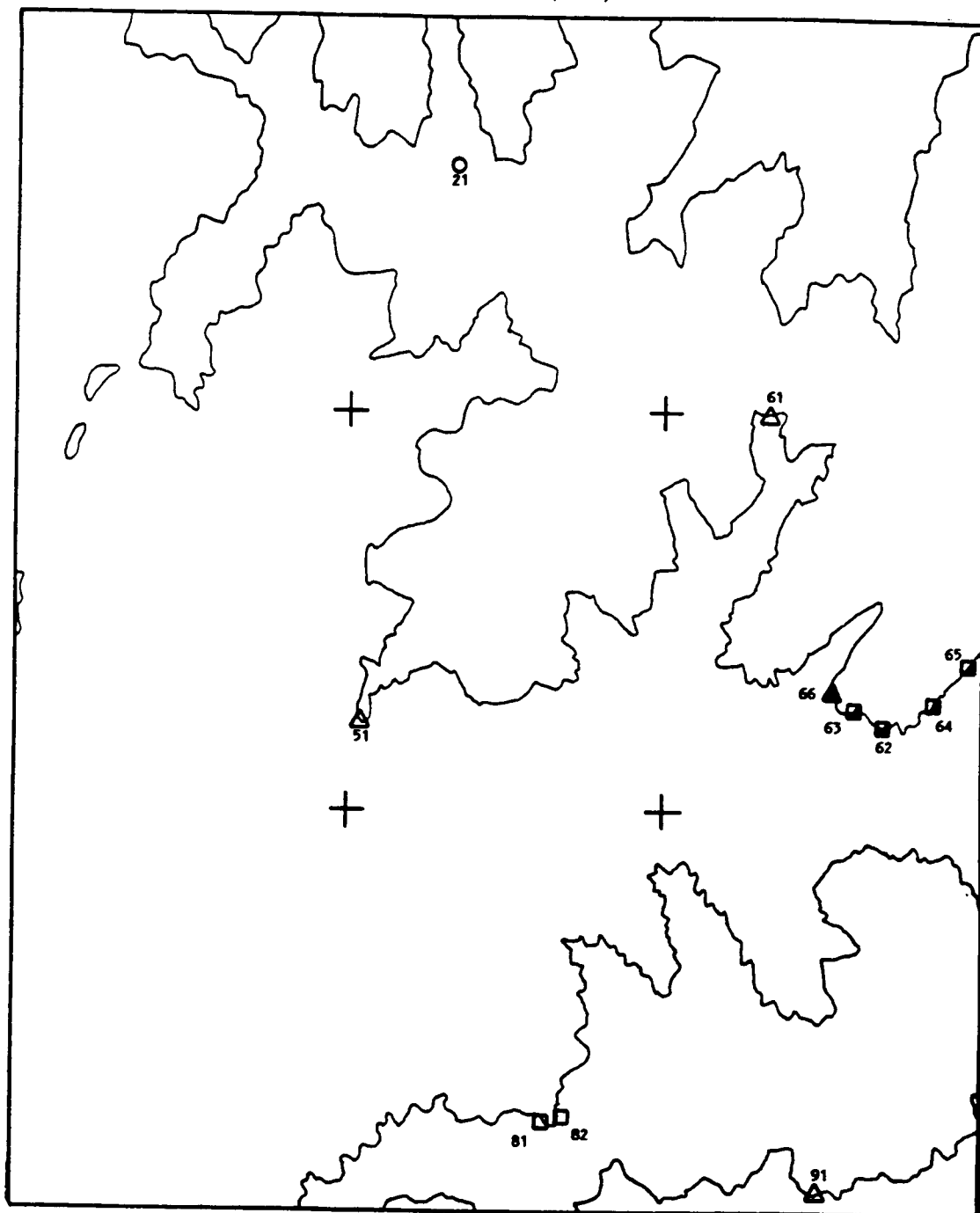
FORK MOUNTAIN - (FKM)



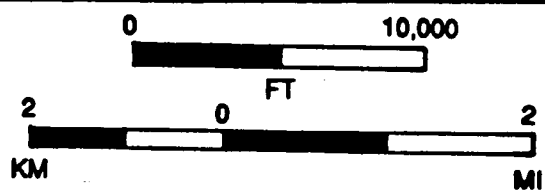
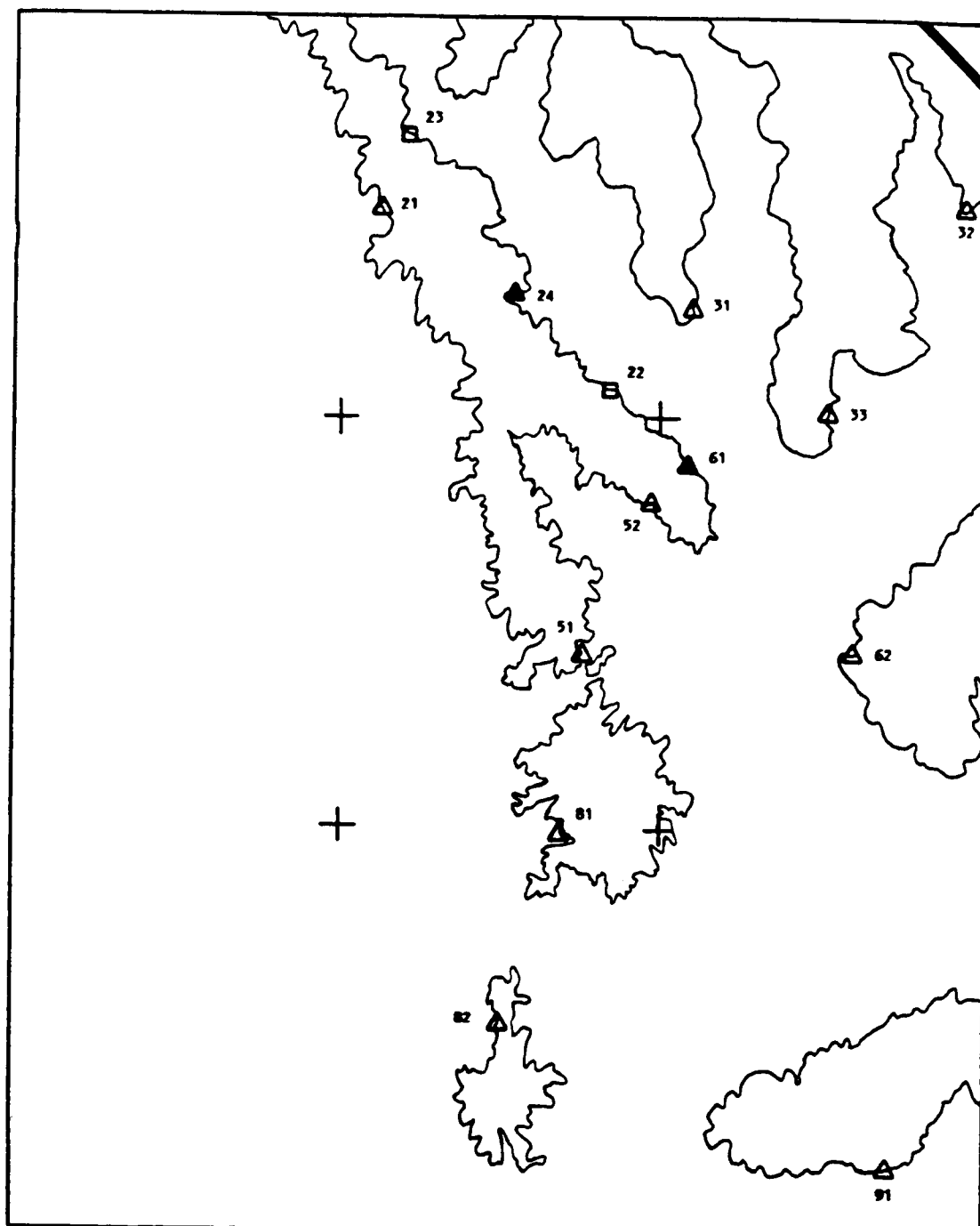
FORK RIDGE - (FKR)



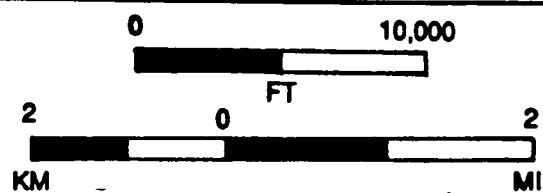
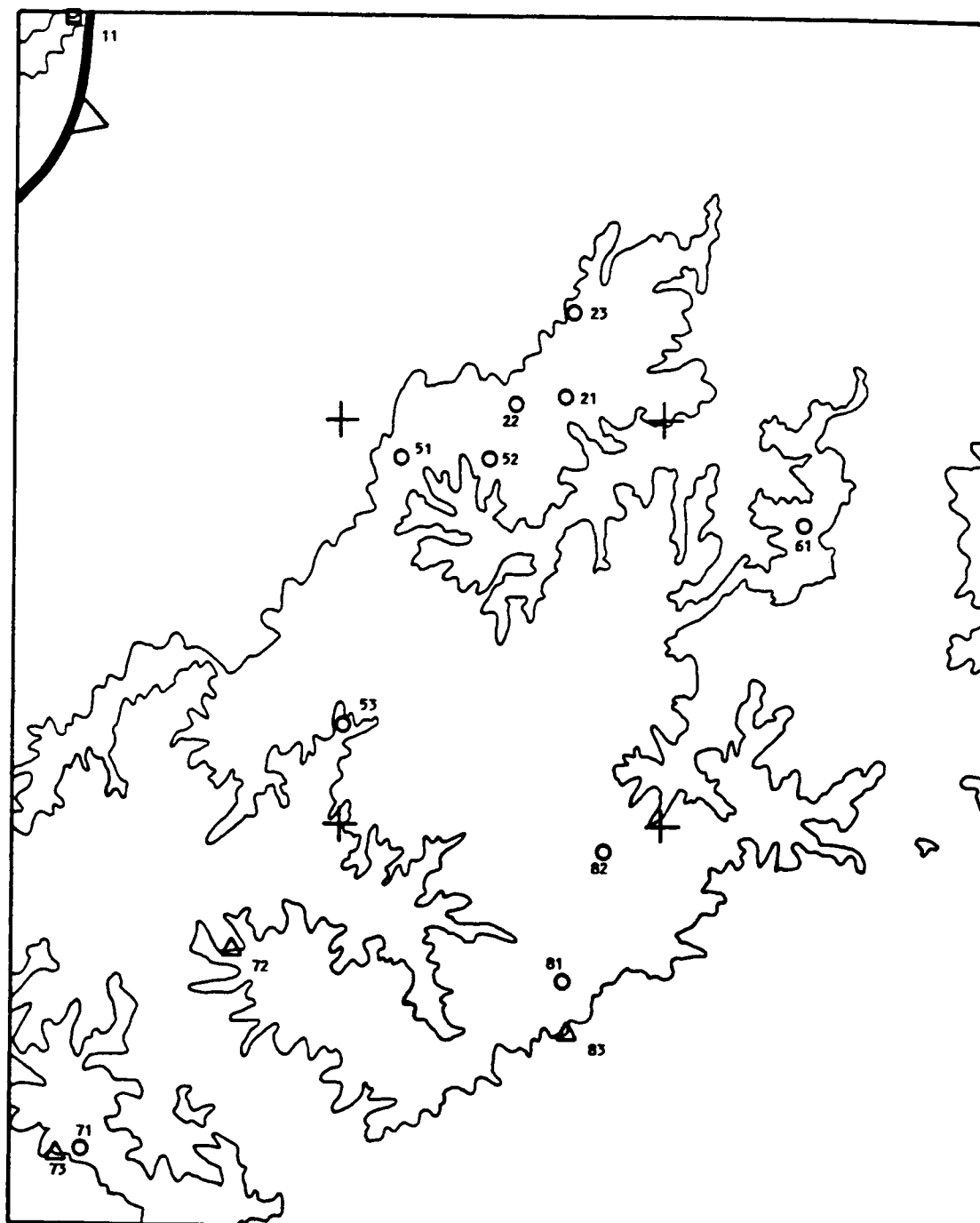
GOBEY - (GOB)



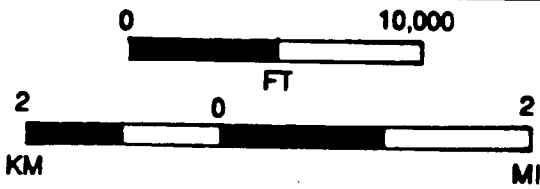
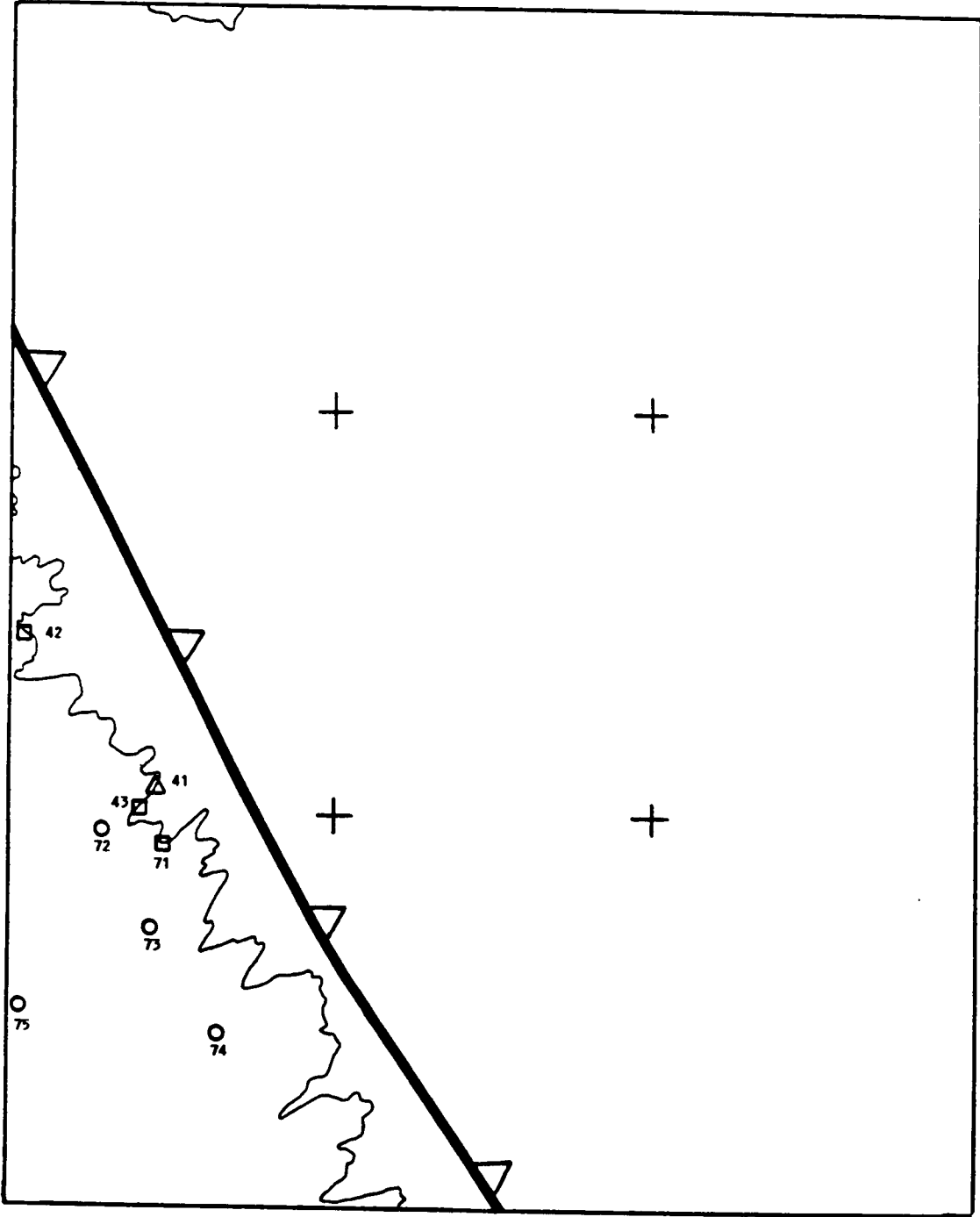
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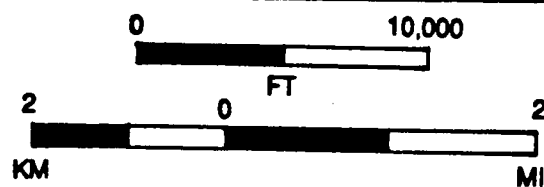
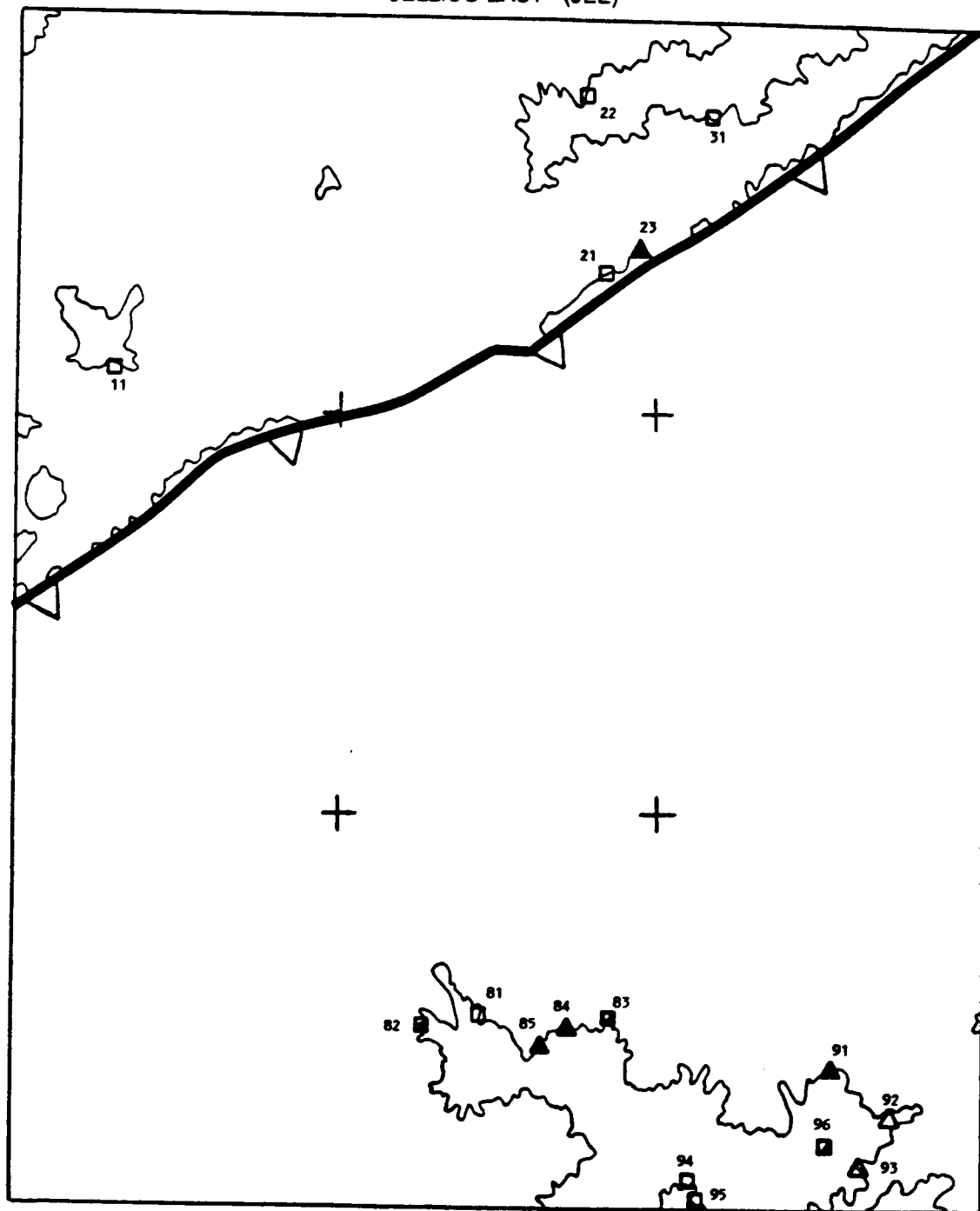
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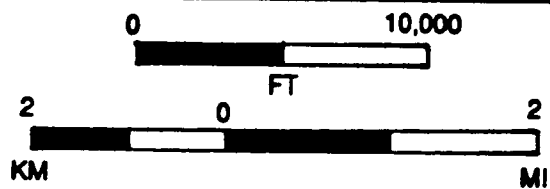
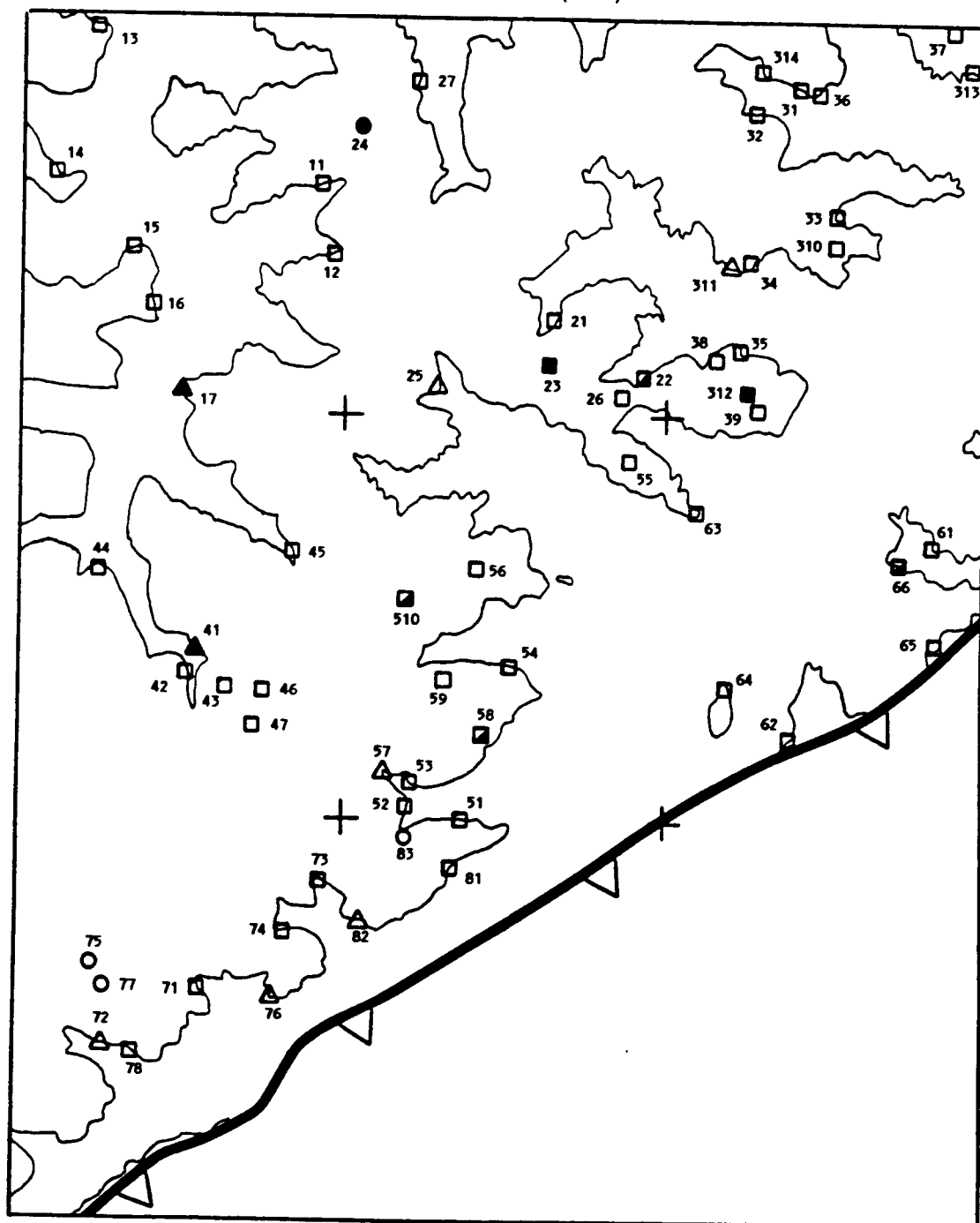
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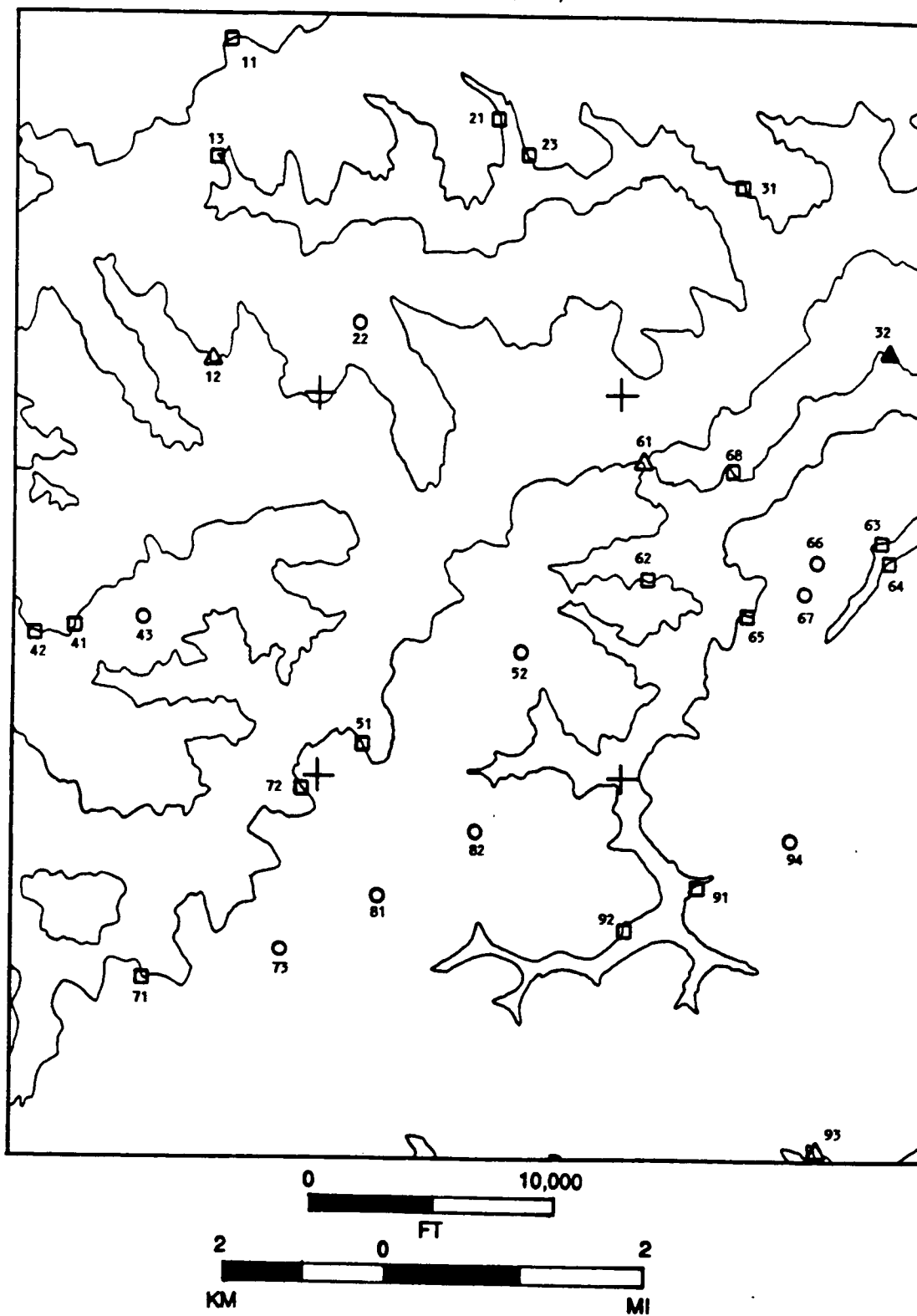
JELICO EAST - (JEE)



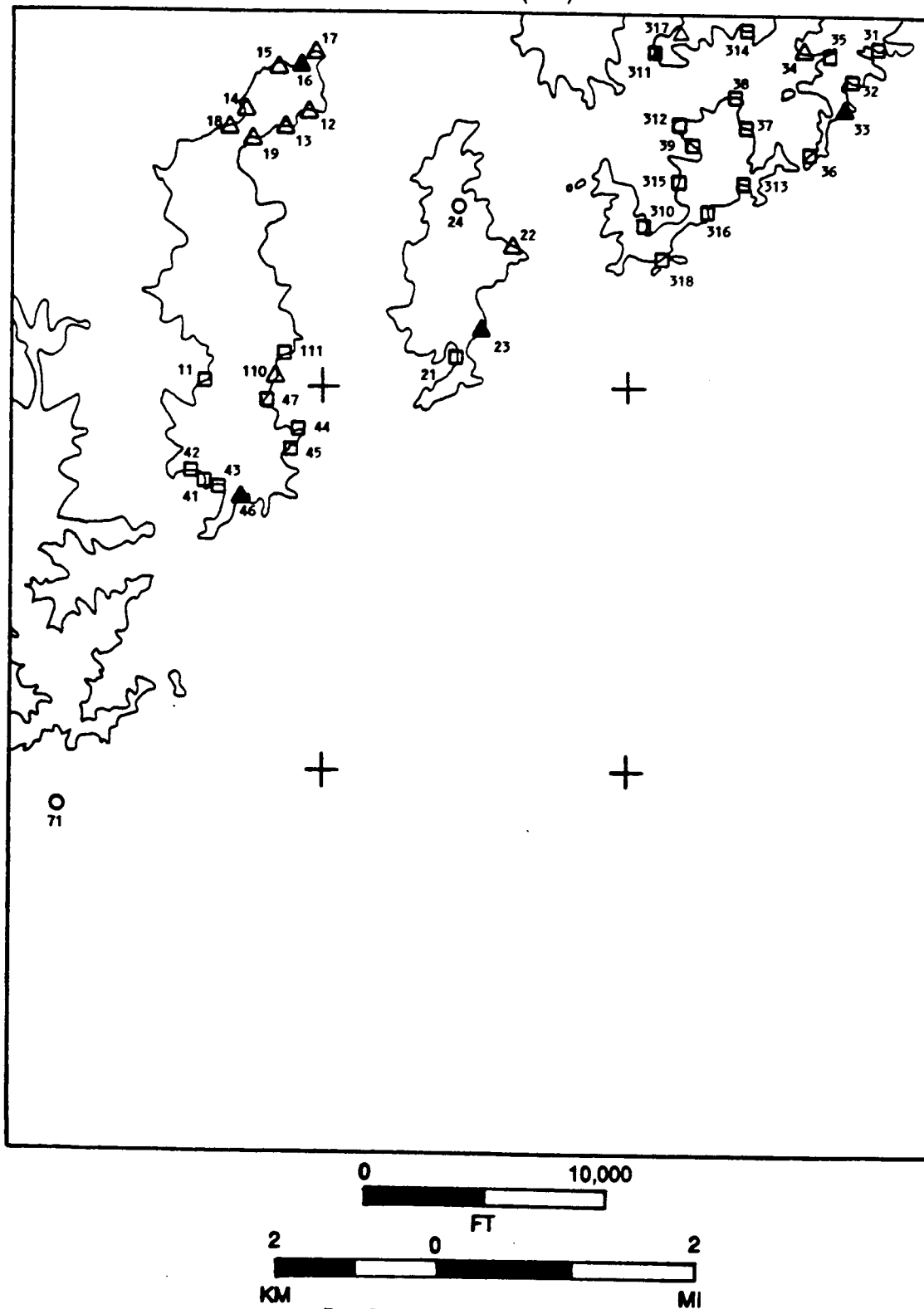
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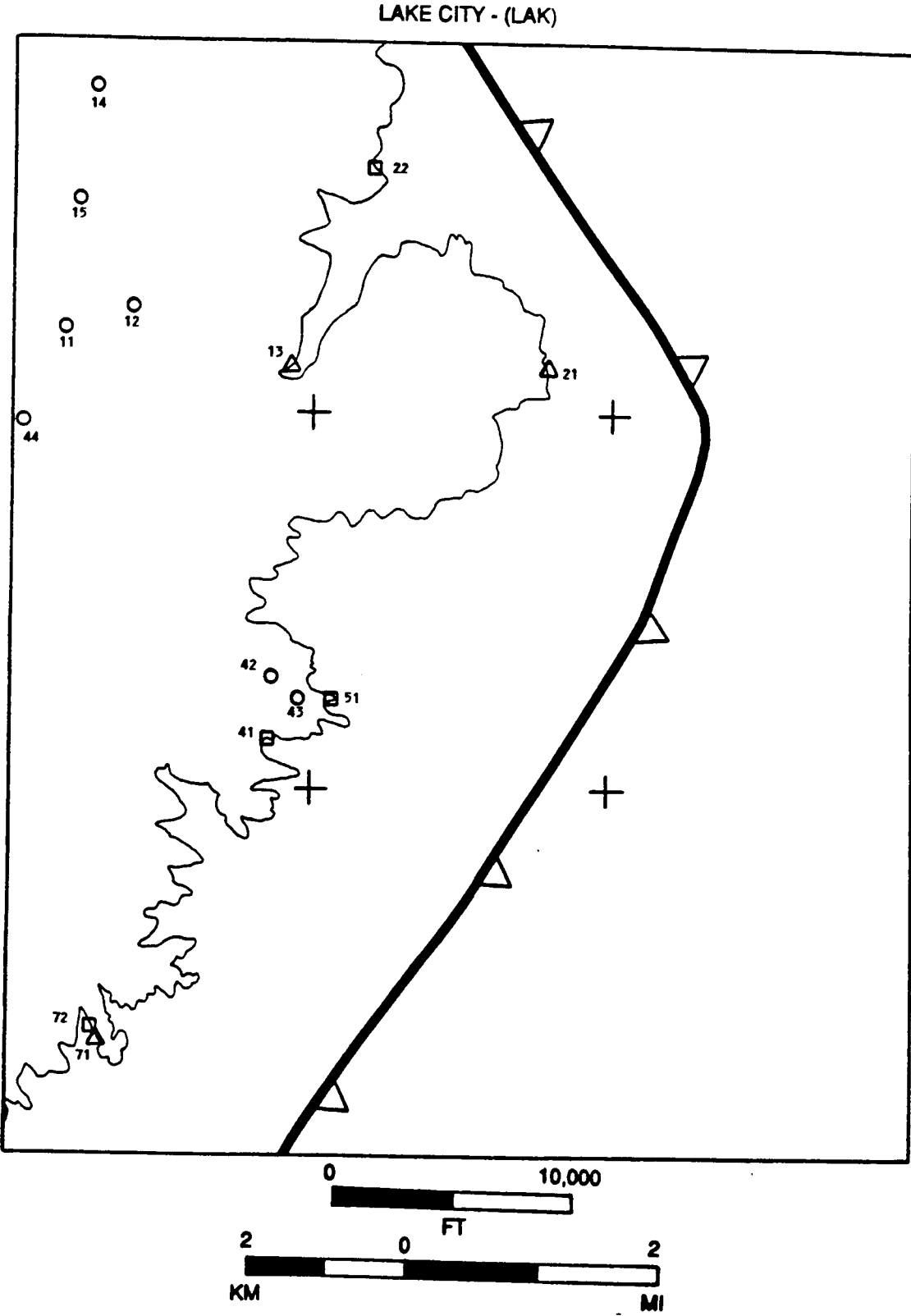


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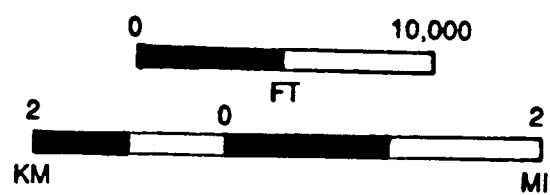
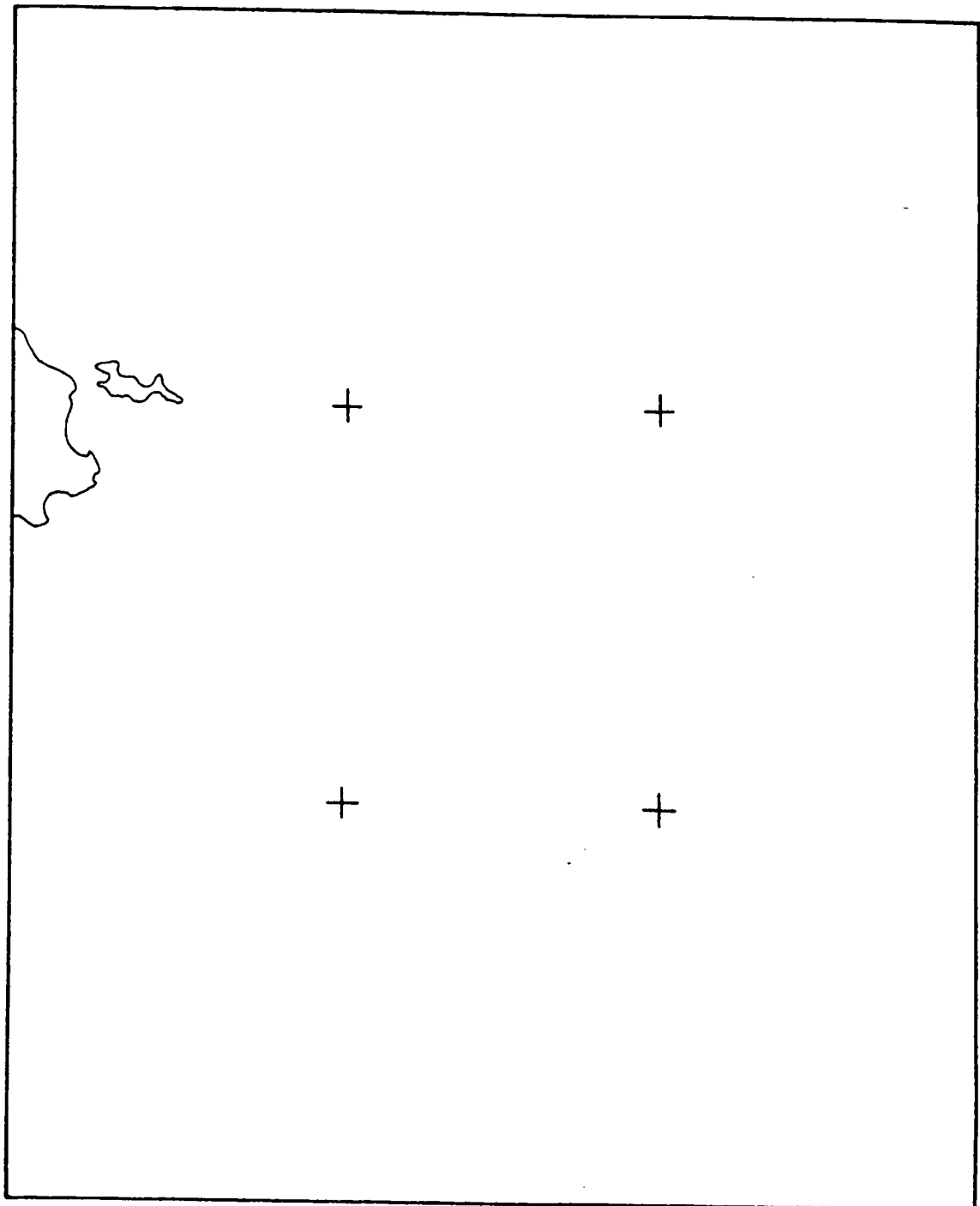


LAFOLLETTE - (LAF)

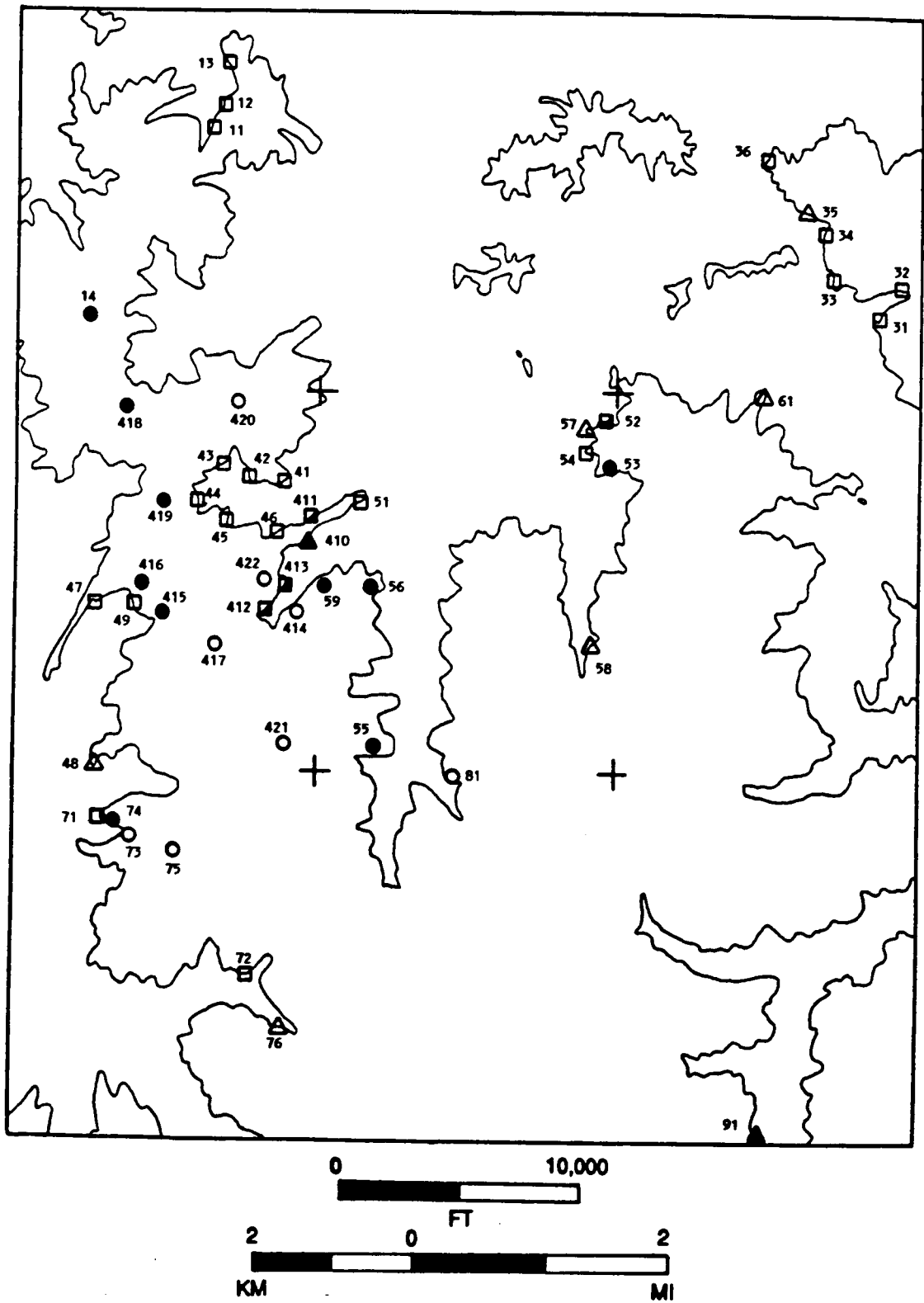




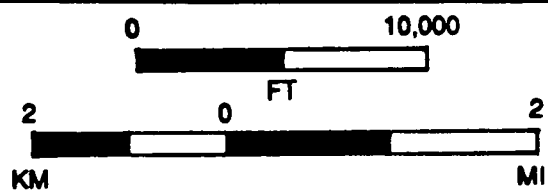
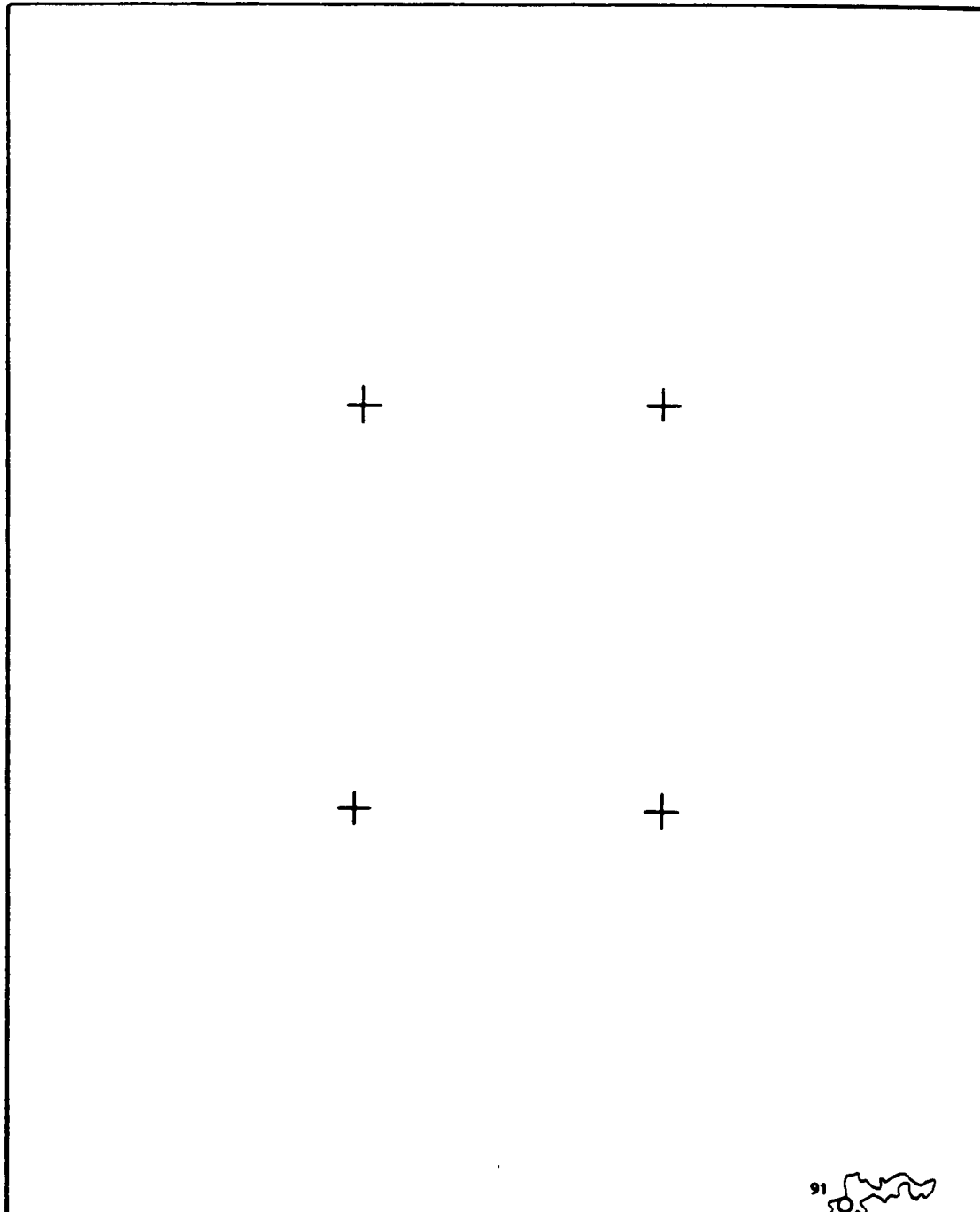
MIDDLESBORO SOUTH - (MID)



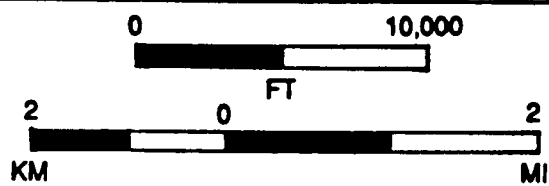
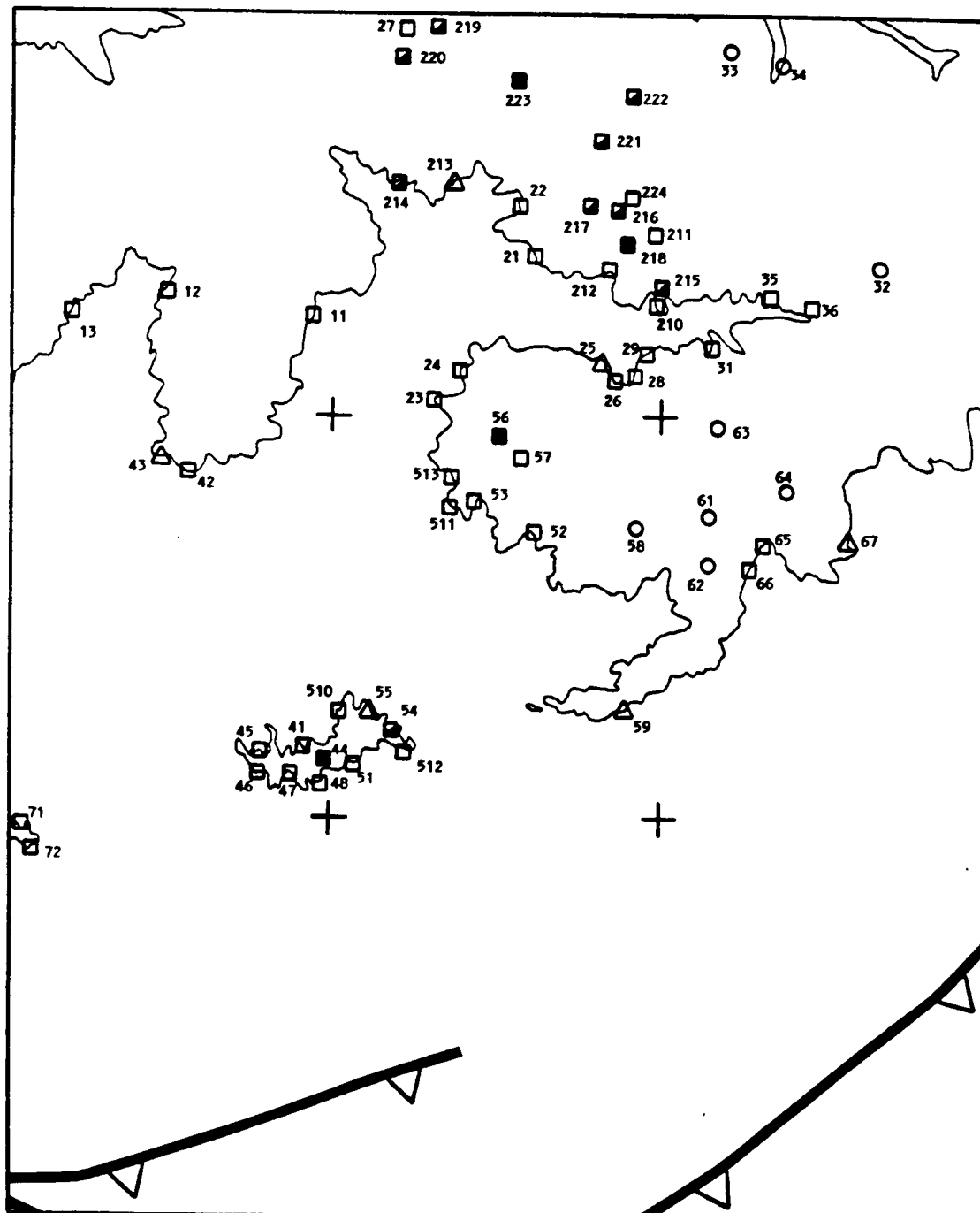
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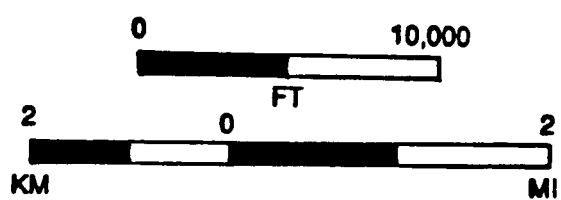
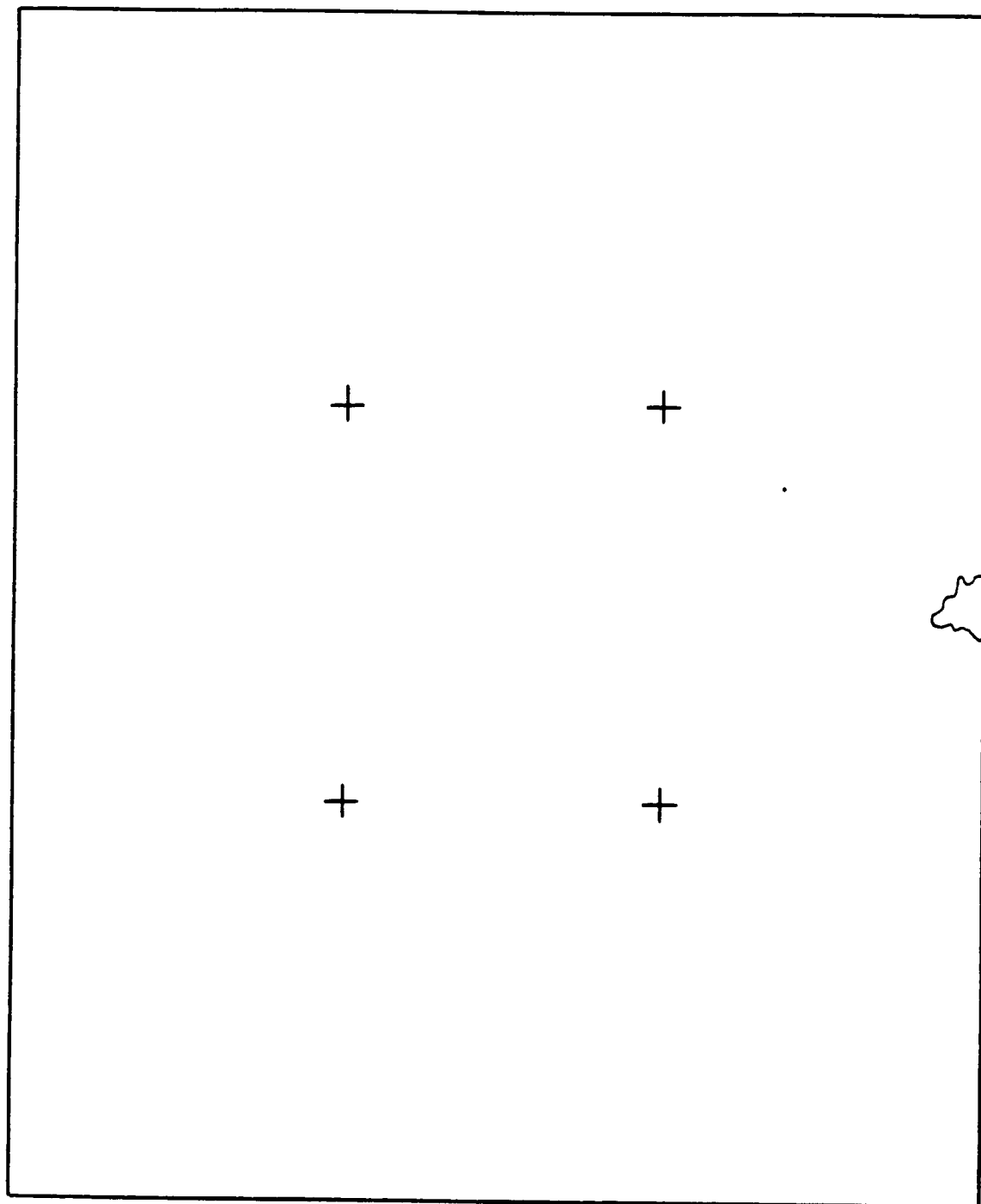
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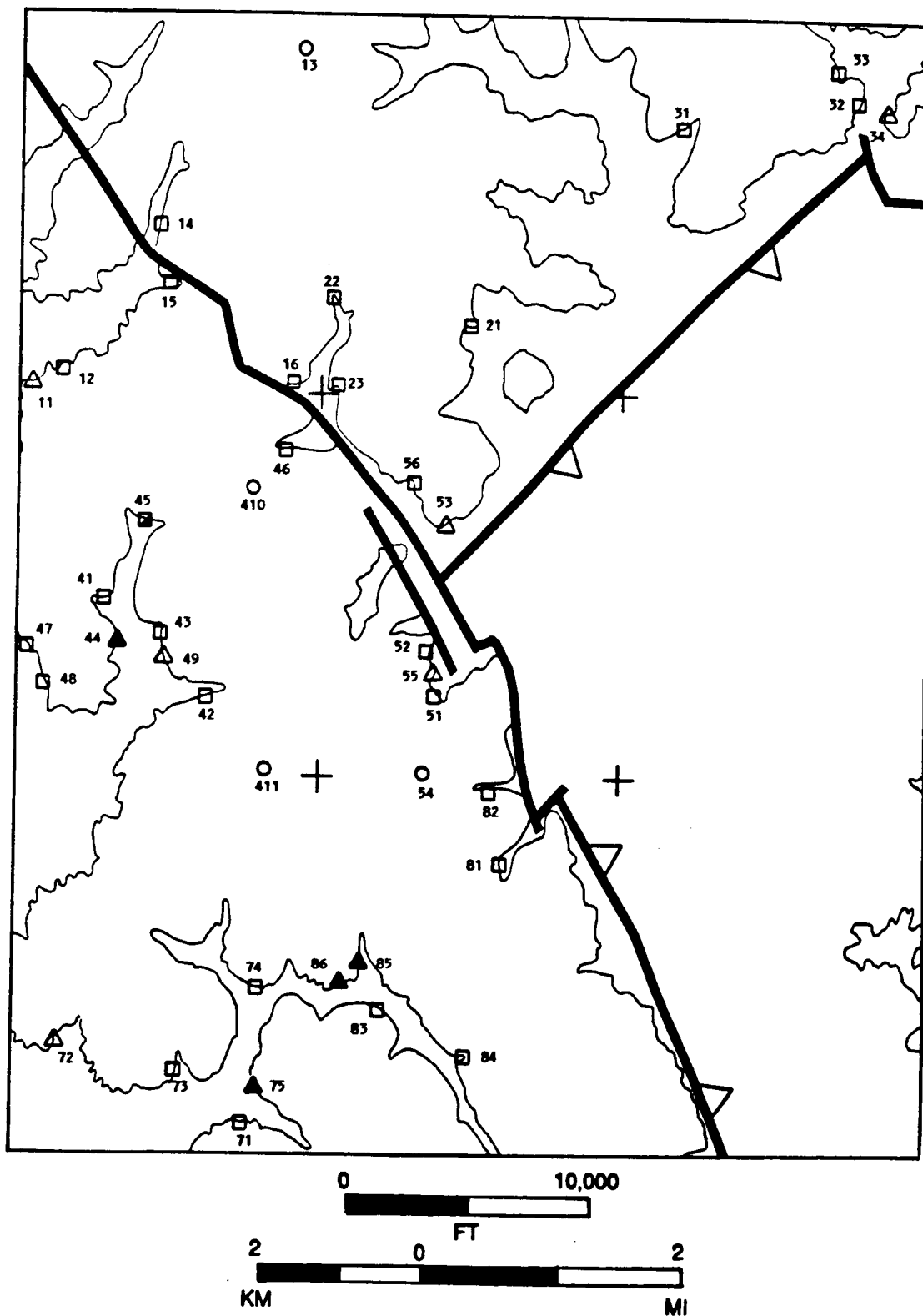
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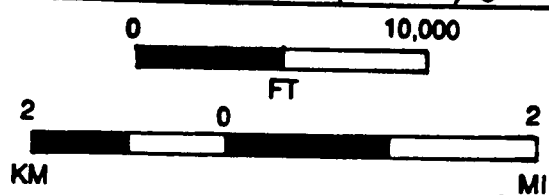
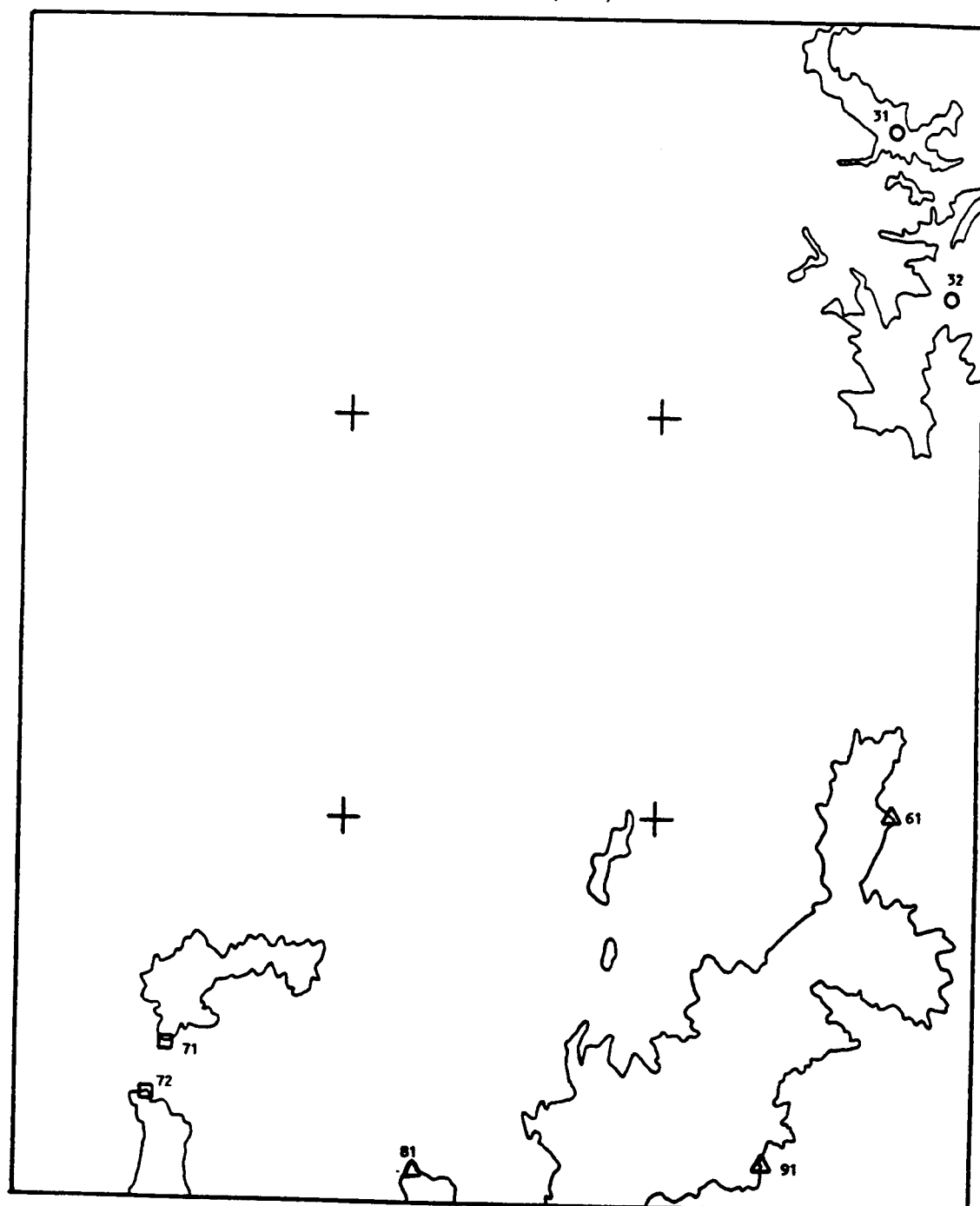
PILOT MOUNTAIN - (PIL)



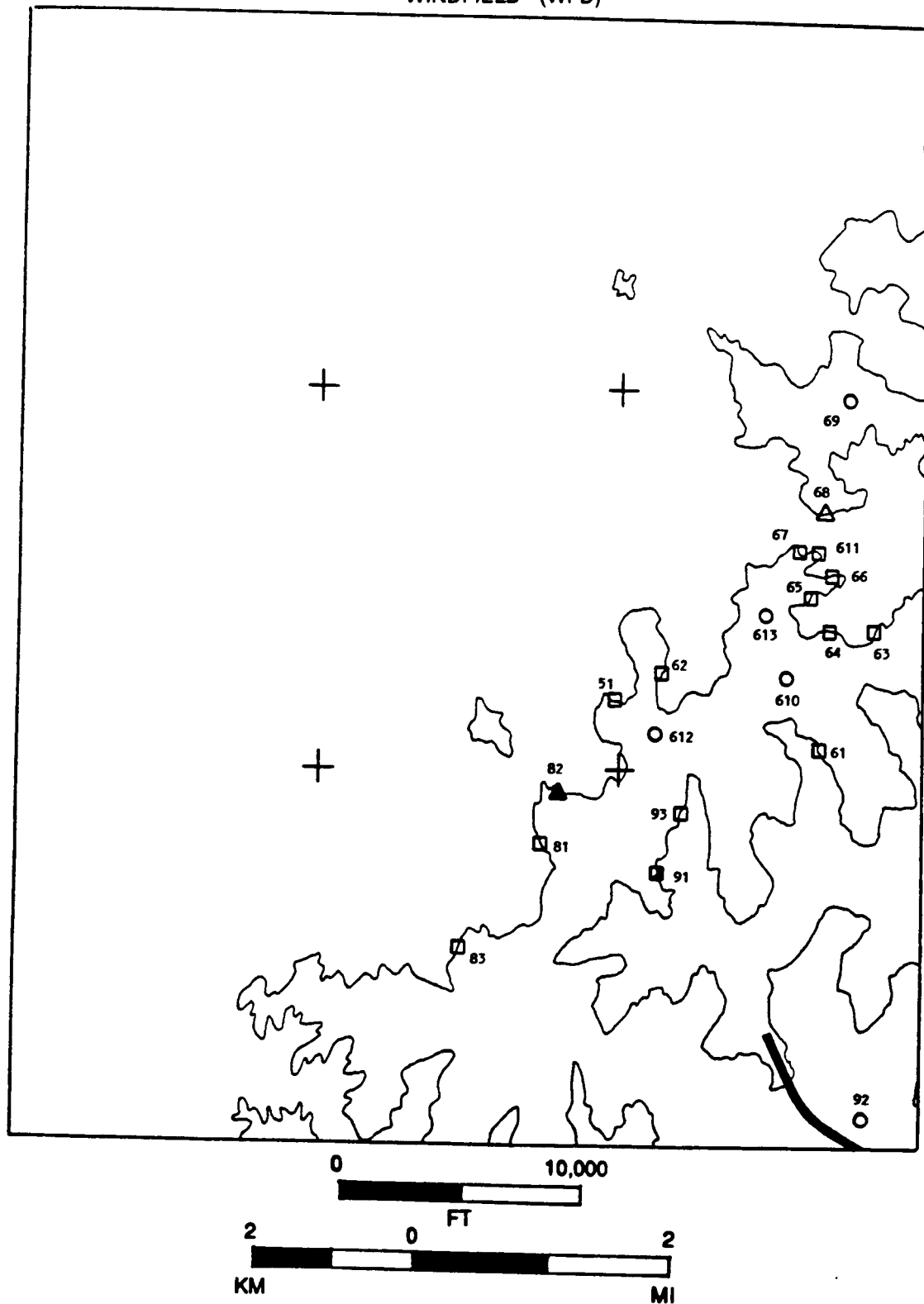
PIONEER - (PIO)



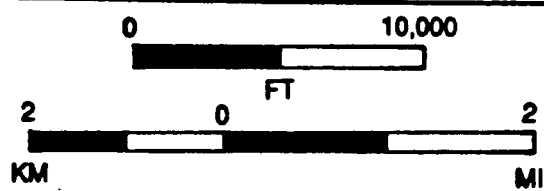
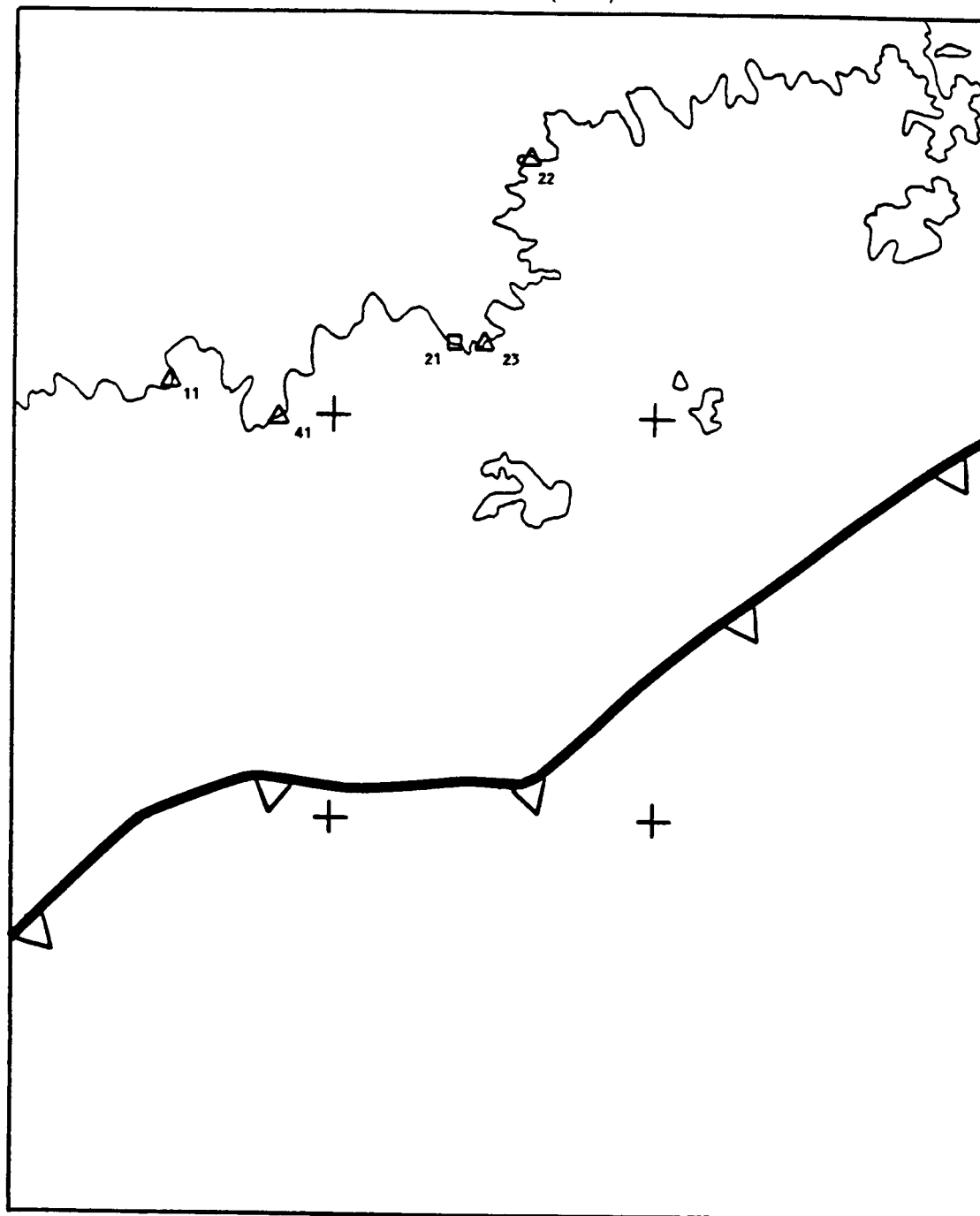
ROBBINS - (ROB)



WINDFIELD - (WFD)



WINDROCK - (WRK)



APPENDIX C

DATA POINT MAP LEGEND
QUADRANGLE ABBREVIATIONS
DATA POINT DESIGNATIONS

DATA POINT MAPS LEGEND

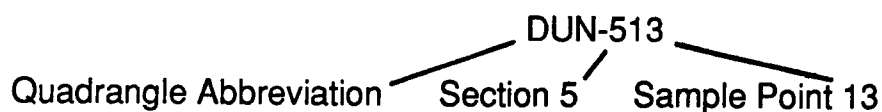
114

- Drill Hole
- Drill Hole with Coal Analysis
- Coal Seam Measurement Only
- ▣ Coal Seam Measurement with Coal Analysis
- Coal Analysis Only
- △ Measured Strata Section
- ▲ Measured Strata Section with Coal Analysis

QUADRANGLE ABBREVIATIONS

Block--BLK	Ketchen--KET
Camp Austin--CAM	La Follette--LAF
Duncan Flats--DUN	Lake City--LAK
Eagan--EAG	Middlesboro South--MID
Fork Mountain--FKM	Norma--NOR
Fork Ridge--FKR	Onieda South--ONS
Gobey--GOB	Petros--PET
Huntsville--HUN	Pilot Mountain--PIL
Ivydell--IVY	Pioneer--PIO
Jacksboro--JAK	Robbins--ROB
Jellico East--JEE	Windrock--WRK
Jellico West--JEW	Winfield--WFD

DATA POINT DESIGNATIONS



APPENDIX D

COAL ANALYSES

LOCATIONS FOUND IN APPENDIX B

SAMPLE NUMBER	* SAMPLE CONDITION	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
DUN-29	U					1.75					13,150				SEAM C
DUN-211	U					1.20					13,000				SEAM C
DUN-212	MF				20.01	2.46					13,300				SEAM C
DUN-214	AR MF	.7 22.1 22.3	58.2 58.6	19.0 19.1	4.4 4.4	68.7 69.2	2.2 1.6	1.2 1.2	2.2 1.6	2.2 1.6	12,350 12,430	3.65 3.68	.02 .02	.88 .89	SEAM C
DUN-44	AR MF	3.32 34.36	54.61 56.49	8.85 9.15	2.35 2.43	73.44 75.96	8.62 5.87	1.69 1.75	8.62 5.87	8.62 5.87	13,052 13,500				SEAM C2,C1
DUN-45	AR MF	2.45 35.70 36.59	51.83 53.12	10.04 10.29	2.48 2.54	72.35 74.15	8.14 6.14	1.72 1.76	8.14 6.14	8.14 6.14	13,059 13,384				SEAM C2,C1
DUN-47	AR MF	4.01 34.91 36.37	52.68 54.88	8.40 8.75	2.01 2.09	72.98 76.03	9.67 6.37	1.74 1.81	9.67 6.37	9.67 6.37	13,007 13,550				SEAM C2,C1
DUN-413	AR MF	2.06 32.50 33.18	56.50 57.69	8.94 9.13	1.36 1.38						12,875 13,146				SEAM C
DUN-414	U				23.61	2.1					11,292	3.7			SEAM C
DUN-415	MF				11.10	4.63									SEAM C
DUN-416	MF				7.03	3.36					13,976				SEAM C
DUN-418	MF				8.68	2.25					13,496				SEAM C

* AR - AS RECEIVED
MF - MOISTURE FREE
U - UNKNOWN

SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
DUN-420	MF				38.07	1.85									SEAM C2,C1
DUN-53	AR MF	2.18	35.32 36.11	54.50 55.71	8.00 8.18	2.27 2.32	5.16 5.03	74.60 76.27	1.88 1.93	8.09 6.27	13,324 13,621				SEAM C2,C1
DUN-56	U				7.5	2.0					12,800	2			SEAM C
DUN-57	U					2.55					13,571				SEAM C
DUN-58	U				16	2.50					12,200	1.35			SEAM C
DUN-511	MF				26.35	2.57									SEAM C2,C1
DUN-512	MF				21.53	1.83									SEAM C2,C1
DUN-513	MF				19.26	2.61									SEAM C2,C1
DUN-514	MF				34.40	1.60									SEAM C2,C1
DUN-515	MF				21.19	2.06									SEAM C2,C1
DUN-63	AR MF	2.0	33.1 33.76	57.2 58.37	7.7 7.86	1.7 1.7	5.4 5.28	75.3 76.84	1.8 1.84	8.0 6.35	13,610 --	.62 .63	.07 .07	1.05 1.07	SEAM C

* AR - AS RECEIVED
MF - MOISTURE FREE
U - UNKNOWN

SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
EAG-51	AR MF	5.88			3.03 3.22	1.42 1.51					13,701 14,557				SEAM D2,D1
EAG-65	AR MF	2.73	36.02 37.03	56.20 57.78	5.05 5.19	1.63 1.68					13,651 14,035				SEAM E2,E1
EAG-66	AR				4.33	.87					13,979	.67			SEAM D2,D1
EAG-66	AR MF	2.54			3.85 3.95	.65 .67					14,085 14,452	.26			SEAM E
EAG-67	U											.68			SEAM E
EAG-67	U											1.44			SEAM D2,D1
EAG-68	AR MF	3.36	34.08	64.70	1.22	.616									SEAM F
EAG-68	AR MF	3.17	32.93 34.01	60.27 62.24	3.64 3.76	.51 .53					13,608 14,053				REPEAT OF ANALYSIS SEAM F FROM ANOTHER SOURCE
EAG-69	U				7.09	.76					13,734	.53			SEAM F
EAG-69	U				5.11	.58					14,328	.87			SEAM E
EAG-69	U				4.31	.67					14,072	.41			SEAM D2,D1
EAG-610	AR MF	2.4	34.4 35.2	60.6 62.1	2.6 2.7	.80 .80	5.7 5.6	78.8 80.7	1.4 1.4	10.7 8.8	14,180 14,520	.23 .24	.03 .03	.50 .51	SEAM E

* AR - AS RECEIVED
MF - MOISTURE FREE
U - UNKNOWN

SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
EAG-618	AR MF	3.2	38.3 39.6	55.1 56.9	3.43 3.49	1.19 1.23	5.66 5.48	78.10 80.65	1.94 2.00	9.73 7.15	14,070 14,530				SEAM D2,D1
EAG-619	AR MF	3.29	37.82 39.11	53.59 55.41	5.30 5.48	1.53 1.56	5.47 5.27	75.57 78.14	1.76 1.82	10.39 7.73	13,609 14,072				SEAM D2,D1
EAG-79	AR MF	3.9	38.8	55.9	5.3	1.7					14,210				SEAM B
EAG-79	AR MF	3.2	36.88 38.10	55.68 57.52	4.24 4.38	.92 .98	5.5 5.4	79.7 81.8	1.9 2.0	9.7 7.4	13,972 14,432	.092	.014	.529	SEAM B - REPEAT OF ANALYSIS FROM ANOTHER SOURCE
EAG-92	U				3.52	1.13					13,815	.47			SEAM E
EAG-92	U				3.81	1.41					13,650	.48			SEAM D2
EAG-92	U				3.62	1.33					13,732	.50			SEAM B
EAG-96	AR MF	2.15	32.70 33.42	58.62 59.91	6.53 6.67	1.43 1.47					13,288 13,580				SEAM D2
EAG-96	AR MF	2.17	34.65 35.42	59.19 60.51	3.98 4.07	.97 .99					13,765 14,071				SEAM D1
EAG-98	AR MF	3.50			3.47 3.60	1.54 1.59					13,990 14,498	.71			SEAM D2,D1
EAG-98	AR MF	3.76	35.57 36.96	57.20 59.43	3.47 3.60	.62 .64					13,655 14,188				SEAM E

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MF - MOISTURE FREE
U - UNKNOWN

SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	S.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
FKM-22	U				8.09	4.25									SEAM C
FKM-25	AR MF	1.89	32.80	61.55	5.65	.782									SEAM C RUN OF MINE SAMPLE
FKM-25	AR MF	2.00	29.84 30.44	49.00 50.00	19.16 19.55	1.83 1.87					11.409 11.642				SEAM C REPEAT OF ANALYSIS FROM ANOTHER SOURCE RUN OF MINE SAMPLE
FKM-29	U				6.41	3.00									SEAM C
FKM-210	U				4.28	2.05									SEAM C
FKM-213	U				9.01	2.69									SEAM C
FKM-32	AR MF	2.52	36.94 37.89	55.82 57.27	4.72 4.84	1.78 1.83	5.46 5.31	77.26 79.26	1.91 1.96	8.87 6.80	13.942 14.502				SEAM C
FKM-34	AR MF	2.19	36.82 37.64	55.55 56.80	5.44 5.56	2.11 2.16	5.42 5.30	77.01 78.73	1.92 1.96	8.10 6.29	13.842 14.152				SEAM C
FKM-35	AR MF	2.8	35.2 36.3	57.2 58.8	4.8 4.9	1.8 1.9	5.4 5.2	76.9 79.1	2.0 2.0	9.1 6.9	13.840 14.240				SEAM C
FKM-38	AR MF	3.76	34.33 35.67	54.55 56.68	7.36 7.65	1.69 1.76					13.205 13.721				SEAM C
FKM-39	AR MF	1.59	32.52	60.69	6.52	1.966									SEAM C
FKM-39	AR MF	2.25	30.41 31.11	49.90 51.04	17.45 17.85	1.65 1.69					11.746 12.016				SEAM C - REPEAT OF ANALYSIS FROM ANOTHER SOURCE

* AR - AS RECEIVED
MF - MOISTURE FREE
U - UNKNOWN

SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
PKM-310	MF				26.36	3.20					13,322				SEAM C
PKM-311	AR	2.01			14.96	3.80					11,999				SEAM C
	MF				15.27	3.88					12,245				
PKM-312	MF				10.95	5.04					13,248				SEAM C
PKM-44	U				8.88	2.68									SEAM C
PKM-51	U				16.0	2.50					12,200	1.35			SEAM C
PKM-56	MF				35.54	1.75									SEAM C
PKM-61	U					1.40					12,860				SEAM C
PKM-62															
PKM-62	MF				12.16	3.77					13,122				SEAM C
PKM-63	MF				10.83	5.21					13,218				SEAM C
PKM-64															
PKM-64	MF				13.72	4.00					12,730				SEAM C
PKM-65	MF				13.33	2.61									SEAM C
PKM-66	MF				10.50	3.08									SEAM C

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
FKM-67	MF				18.0	3.16									SEAM C
FKM-68	MF				42.4	1.39									SEAM C
FKM-610	MF				47.69	4.19									SEAM C
FKM-612	MF				45.78	1.59									SEAM C
FKM-613	MF				17.32	2.07									SEAM C
FKM-82	AR MF	2.32	39.14 40.06	52.29 53.53	6.26 6.41	1.22 1.25					13,732 14,058	.94			SEAM C
FKM-83	AR MF	2.72	36.89 37.92	55.42 56.98	4.96 5.10	2.65 2.72	5.42 5.26	76.63 78.78	1.82 1.87	8.52 6.27	13,781 14,166				SEAM C
FKM-99	U					2.50					12,500				SEAM C

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SAMPLE NUMBER	* SAMPLE CONDITION	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
FKR-19	AR MF	3.1	37.1 38.3	55.3 57.1	4.50 4.64	1.39 1.43	5.58 5.41	77.24 79.70	1.79 2.05	9.30 6.77	13,870 14,320				SEAM D3, D2, D1
FKR-311	AR MF	2.63	37.08 38.08	56.40 57.92	3.89 4.00	.68 .70					13,917 14,293				SEAM D2
FKR-312	AR MF	5.05	35.12 36.99	49.56 52.20	10.27 10.82	1.31 1.38					12,669 13,343				SEAM D2
FKR-313	AR MF	4.81			6.85 7.20	1.04 1.09					13,263 13,934				SEAM D3
FKR-313	AR MF	3.53			12.15 12.60	1.12 1.16					12,554 13,014				SEAM D2
FKR-41	U				2.97	.86					13,712	.13			SEAM D2
FKR-42	U					.87					11,300				SEAM E
FKR-42	U					1.15					12,900				SEAM D2
FKR-42	U					.91					13,900				SEAM B
FKR-43	U					.90					13,500				SEAM D3, D2
FKR-411	AR MF	3.9	36.6 38.1	54.9 57.1	4.64 4.83	1.19 1.24	5.61 5.39	76.38 79.44	1.86 1.93	10.32 7.17	13,690 14,240				SEAM D3, D2
FKR-412	AR MF	2.41	36.02 36.91	58.73 60.18	2.84 2.91	.65 .67					13,816 14,157				SEAM D3

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
FKR-52	U					.80					13,750				SEAM D3
FKR-55	AR MF	2.40	37.1	54.8	8.1	1.6					13,840				SEAM D3,D2
FKR-59	AR MF	2.71	39.94 41.05	52.83 54.30	5.51 5.66	.83 .85					13,847 14,233				SEAM D3,D2
FKR-514	AR MF	2.16	39.74 40.62	55.03 56.25	5.23 5.35	.93 .95					14,262 --				SEAM D3,D2
FKR-515	AR MF	2.50	37.93 38.90	56.15 57.59	3.42 3.51	.82 .84					14,158 14,521				SEAM D3,D2
FKR-517	AR MF	3.6	37.3 38.7	54.3 56.3	4.81 4.99	1.35 1.40	5.64 5.44	76.33 79.14	1.69 1.75	10.18 7.28	13,700 14,210				SEAM D3,D2
FKR-518	AR MF	3.6	37.3 38.7	55.5 57.5	3.63 3.77	1.10 1.14	5.70 5.50	78.28 81.22	1.70 1.76	9.59 6.61	13,980 14,500				SEAM D3,D2
FKR-69	AR MF	3.04	37.96 39.15	55.82 57.57	3.19 3.29	.80 .83					14,223 14,670				SEAM D2
FKR-611	AR MF	2.2	38.3 39.2	57.9 59.2	1.6 1.6	.8 .8	5.7 5.6	81.2 83.0	1.9 1.9	8.6 6.8	14,620 14,950	.07 .07	.00 .00	.78 .80	SEAM D3
FKR-612	AR MF	2.10	37.20 38.00	57.60 58.84	3.10 3.17	.70 .72					14,420 14,730				SEAM D3

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[illegible]

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
JEE-23	AR MF	4.18	38.64 40.33	55.53 57.95	1.65 1.72	.70 .73					13,809 14,411				SEAM B
JEE-82	U					1.10					11,250				SEAM B
JEE-83	U					1.20					13,550				SEAM B
JEE-84	AR MF	3.44	37.34 38.67	56.06 58.06	3.16 3.27	.89 .92					13,625 14,110				SEAM D
JEE-85	AR MF	2.40	37.48 38.40	55.58 56.95	4.54 4.65	1.18 1.20					13,495 13,826				SEAM C
JEE-91	U				7.00	.76					13,776	.21			SEAM B
JEE-96	AR MF	2.6	39.5	56.8	3.70	.90					14,520				SEAM B
JEE-96	AR MF	5.92	36.30 38.58	55.11 58.58	2.67 2.84	.95 1.01	5.54 5.19	76.07 80.85	1.91 2.03	12.86 8.08	13,412 14,256				SEAM B REPEAT OF ANALYSIS FROM ANOTHER SOURCE

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
JEW-17	AR MF	2.40	38.49 39.43	57.75 59.17	1.36 1.40	1.11 1.14					14,113 14,459				SEAM C
JEW-22	AR MF	3.0	39.0 40.2	55.9 57.6	2.0 2.2	.8 .8	5.7 5.5	78.9 81.3	2.0 2.1	10.5 8.1	14,010 --				SEAM C
JEW-23	AR MF	3.9	38.0 39.6	55.2 57.4	2.92 3.04	1.09 1.13	5.76 5.54	77.23 80.34	1.97 2.05	11.03 7.90	13,840 14,390				SEAM C
JEW-24	AR MF	3.77	38.26 39.76	53.70 55.84	4.27 4.44	1.65 1.71	5.55 5.33	76.66 79.66	1.77 1.84	10.10 7.02	13,780 --	1.44 1.50	.01 .01	.20 .21	SEAM C
JEW-24	AR MF	3.50	40.0 41.5	53.9 55.9	2.6 2.7	1.7 1.8	5.8 5.6	78.3 81.1	1.9 2.0	9.7 6.8	14,111 --	1.31 1.36	.01 .01	.38 .39	SEAM B
JEW-312	AR MF	4.7	36.8 38.6	55.3 58.1	3.16 3.22	1.36 1.43	5.78 5.52	76.39 80.15	2.00 2.10	11.31 7.48	13,680 14,350				SEAM C
JEW-41	AR MF	3.78			8.72 9.06	.99 1.03					13,044 13,556	.58			SEAM C
JEW-58	AR MF	4.6	36.8 38.6	53.7 56.3	4.88 5.11	.83 .87	5.57 5.30	75.59 79.20	1.77 1.85	11.36 7.67	13,490 14,130				SEAM C
JEW-510	AR MF	3.2	37.6 38.8	53.3 55.1	5.93 6.13	1.85 1.91	5.52 5.33	72.25 77.75	1.96 2.03	9.49 6.85	13,480 13,930				SEAM C
JEW-66	AR MF	4.3	37.7 39.4	56.1 58.6	1.9 2.0	.9 .9	5.7 5.5	77.2 80.7	1.9 2.0	12.4 9.2	13,760 --				SEAM C

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
LAF-12	U					1.40					11,800				SEAM C
LAF-16	AR MF	2.10	38.40 39.22	57.99 59.24	1.51 1.54	1.62 1.65					13,997 14,297				SEAM C
LAF-23	AR MF	6.22	33.47 35.69	50.91 54.28	9.40 10.03	2.33 2.49					12,220 13,030				SEAM C
LAF-33	AR MF	2.89	34.20 35.22	60.64 62.45	2.26 2.33	.74 .76					13,596 14,001				SEAM B
LAF-46	AR MF	4.28			4.27 4.46	1.38 1.44					13,641 14,250				SEAM E2
LAF-46	AR MF	4.94			12.43 13.16	1.78 1.86					11,632 12,237				SEAM D
LAF-46	AR MF	5.40			7.63 8.07	3.20 3.38					12,929 13,667				SEAM E1
LAF-46	AR MF	2.27	38.06 38.94	56.29 57.60	3.37 3.45	1.75 1.79					13,688 14,006				SEAM E2 - REPEAT OF ANALYSIS FROM ANOTHER SOURCE
LAF-46	AR MF	2.13	37.86 38.69	53.68 54.85	6.33 6.46	3.45 3.53					13,278 13,567				SEAM E1 - REPEAT OF ANALYSIS FROM ANOTHER SOURCE
LAF-46	AR MF	2.96	34.61 35.67	52.40 54.00	10.03 10.34	1.69 1.74					12,531 12,913				SEAM D - REPEAT OF ANALYSIS FROM ANOTHER SOURCE

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
NOR-14	U				17.27	.97					11,850				SEAM C
NOR-410	U					2.86					13,300				SEAM C
NOR-411	AR MF	2.57			11.37 11.67	4.25 4.36					12,817 13,155				SEAM C
NOR-412	AR MF	4.53			15.07 15.78	2.26 2.37					11,650 12,202				SEAM C
NOR-413	AR MF	6.36			13.07 13.96	3.72 3.97					11,924 12,734				SEAM C
NOR-415	AR MF	3.78			8.72 9.06	2.98 3.10									SEAM C
NOR-416	AR MF	2.41			31.81 32.60	3.09 3.17									SEAM C
NOR-418	MF		36.38	55.78	7.84	1.47					13,719				SEAM C
NOR-419	MF		36.01	49.57	14.42	1.37					12,752				SEAM C
NOR-52	U					1.10					13,000				SEAM C
NOR-53	U					1.60					13,509				SEAM C
NOR-55	AR MF	.2			14.34 14.37	1.5 1.5					12,600 --				SEAM B2

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SAMPLE NUMBER	SAMPLE CONDITION *	MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	SULPHUR	HYDROGEN	CARBON	NITROGEN	OXYGEN	B.T.U.	PYRITIC SULPHUR	SULPHATE	ORGANIC SULPHUR	COMMENTS
PET-214	AR MF	1.7	35.9	51.6	12.5	2.3					13,170				SEAM C2,C1
PET-215	AR MF	2.2	36.7 37.5	53.3 54.5	7.8 8.0	2.61 2.67					13,570 13,880				SEAM C
PET-216	AR MF	2.3	36.4 37.2	55.0 56.3	6.3 6.5	2.56 2.62					13,840 14,160				SEAM C
PET-217	AR MF	2.2	36.5 37.3	53.8 55.0	7.5 7.7	2.31 2.36					13,640 13,950				SEAM C
PET-218	AR MF	2.3	36.4 37.2	54.2 55.4	7.11 7.37	2.51 2.57	5.43 5.30	75.60 77.34	1.92 1.96	7.43 5.56	13,680 14,000				SEAM C
PET-219	AR MF	2.1	34.6 35.3	50.0 51.1	13.3 13.6	2.05 2.09					12,750 13,120				SEAM C
PET-220	AR MF	2.2	36.4 37.2	53.6 54.8	7.8 8.0	2.32 2.37					13,560 13,870				SEAM C
PET-221	AR MF	2.4	37.0 37.9	54.8 56.2	5.8 5.9	3.60 3.69					13,910 14,250				SEAM C
PET-222	AR MF	2.2	37.2 38.1	55.0 56.2	5.6 5.7	2.69 2.75					14,000 14,312				SEAM C
PET-223	AR MF	2.3	36.3 37.2	53.3 54.5	8.10 8.29	2.61 2.67	5.36 5.23	74.94 76.66	1.89 1.93	7.10 5.22	13,590 13,900				SEAM C
PET-44	AR MF	2.9	37.3 38.4	54.7 56.4	5.10 5.25	2.63 2.71	5.61 5.45	77.44 79.72	1.73 1.78	7.49 5.09	14,050 14,460				SEAM C
PET-54	AR MF	1.9	38.1	55.9	6.0	3.1					14,260				SEAM C

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APPENDIX E

COAL SEAM DESCRIPTIONS LOCATIONS FOUND IN APPENDIX B

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
BLK-11	1540'	24-30" COAL	C
BLK-12	1540'	15' SHALE 16" COAL	C
BLK-13	1570'	23" COAL	C
BLK-14	1560'	28" COAL	C
BLK-15	1570'	20" COAL	C
BLK-16	1590'	10' SHALE 4" RASH 15" COAL 12" CLAY 6" COAL UNDERCLAY	C
BLK-17	1560'	24" COAL/3" PARTING	C
BLK-18	1560'	21" COAL/4" PARTING	C
BLK-21	1604'	28" SHALE, DARK 3" BONEY COAL 6'4" SHALE, SANDY 1'5" SHALE 9" COAL 4'9" SHALE	D C
BLK-31	1630'	29" COAL	C
BLK-32	1609'	SHALE 2" COAL 10" SHALE 9' SANDSTONE 10' SHALE 1" COAL SHALE	D C
BLK-41	1560'	22" COAL	C
BLK-42	1540'	42" COAL	C
BLK-43	1550'	15" COAL	C
BLK-44	1560'	10" COAL	C
BLK-45	1580'	20" COAL/2" PARTING	C
BLK-51	1535'	21" COAL	C
BLK-52	1517'	11" COAL 1" SHALE, GREY 9.5" SHALE, GREY, SANDY 4.5" SHALE, DARK 10" COAL	C
	1514'		
BLK-61	1600'	1" COAL 3" BONEY COAL	C
BLK-71	1580'	24" COAL	C
BLK-72	1490'	SHALE 18-29" COAL SHALE	C
BLK-73	1470'	6" COAL 12' SANDSTONE	B
BLK-74	1510'	15" COAL	C
BLK-81	1460'	14" COAL	B
BLK-82	1520'	24" COAL	C
BLK-83	1597'	11" COAL	C
BLK-84	1450'	24" COAL	C
BLK-85	1520'	14" COAL	C
BLK-91	1510'	12" COAL	C
BLK-92	1510'	12" COAL	C
BLK-93	1610'	42" COAL	C
BLK-94	1590'	27" COAL	C
BLK-95	1590'	18" COAL	C
	1487'	18" COAL	C
	1462'	23" COAL 1'6" SHALE 5'6" SILTSTONE, SIDERITE 7" SHALE 6" COAL	C ?

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
CAM-21	1980'	JELLICO HORIZON	C
CAM-22	1900'	JELLICO HORIZON	C
CAM-31	1782'	8" COAL IN 4 ZONES 17' SANDSTONE THIN COAL	C
CAM-32	1800'	JELLICO HORIZON	B
CAM-33	1790'	JELLICO HORIZON	C
CAM-51	2000'	JELLICO HORIZON	C
		70' SANDSTONE	C
CAM-61	1960'	24" COAL	C
CAM-62	1960'	24" COAL	C
CAM-63	1960'	24" COAL	C
CAM-64	1950'	32" COAL	C
CAM-65	1900'	25" COAL	C
CAM-66	1900'	24" COAL	C
CAM-67	1900'	COAL BENCH (MINED)	C
CAM-91	1960'	23" COAL	C
DUN-11	1560'	2" COAL	D
	1525'	19" COAL 4.5" SHALE 11" COAL	C3 C2,C1
DUN-12	1503'	25" COAL	C
DUN-13	1520'	JELLICO HORIZON	C
DUN-14	1520'	31" COAL	C
DUN-15	1520'	37" COAL	C
DUN-21		21" COAL 12" PARTING 10" COAL	C3 C2,C1
DUN-22	1520'	24" COAL	C
DUN-23	1520'	24" COAL	C
DUN-24	1520'	45" COAL	C
DUN-25	1500'	13" COAL	C
DUN-26	1510'	22" COAL	C
DUN-27	1530'	33" COAL	C
DUN-28	1500'	12" COAL	C
	1472'	1" COAL	B
DUN-29	1550'	36" COAL	C
DUN-210	1540'	30" COAL	C
DUN-211	1490'	30" COAL	C
DUN-212	1564'	1" COAL 3'6" SHALE, SANDY 2" COAL	D2 D1
	1540'	18" COAL 3" SHALE WITH COAL STREAKS	C
DUN-213		DARK SHALE 12" COAL 5" SHALE, RASHY 11" COAL 8" CLAY SANDSTONE	C3 C2,C1
DUN-214	1520'	27" COAL	C
DUN-215	1540'	20" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
DUN-31	1500'	13" COAL 38" SANDSTONE	C	DUN-49	1540'	19" COAL	C3
DUN-32	1550'	1" COAL 9" SHALE 1.5" COAL	D2 D1	DUN-410	1540'	31" COAL	C
				DUN-411	1540'	25" COAL 12" PARTING 10" COAL	C3 C2,C1
DUN-33	1527'	17.5" COAL	C	DUN-412	1560'	30" COAL 4" PARTING 8" COAL	C3 C2,C1
DUN-34	1506'	0" COAL (SANDSTONE IN PLACE)	C				
DUN-35	1520'	-- COAL	C	DUN-413		20" COAL, BRIGHT AND DULL BANDED 7" COAL, SLICKENSIDED WITH 11.5" SHALE PARTINGS 8.5" COAL, BRIGHT BANDED	C3 C2,C1
DUN-41	1560'	JELICO HORIZON 40' SANDSTONE	C				
DUN-42	1550'	37" COAL	C	DUN-414	1540'	30" COAL	C
DUN-43	--	30" COAL 5" PARTING 12" COAL	C3 C2,C1	DUN-415	1546'	23.75" COAL	C
DUN-44	--	35" COAL/0" PARTING	C	DUN-416	1518'	33" COAL 8.6" SHALE, SANDY 60' SANDSTONE WITH SHALE STREAKS	C
		16" COAL 6" RASH AND COAL 6" COAL 11" RASH AND BONE 5" CLAY 10" COAL	C3 C2,C1	DUN-417	1506'	11" COAL 5.5" SHALE 15" COAL	C3 C2,C1
DUN-45	1550'	2" COAL 1.75" BONE 14" COAL 1.5" PARTING 6.5" COAL 19" PARTING 18" COAL	C3 C2,C1	DUN-418	1523'	34" COAL 21.7" SHALE, SANDY 3.5" COAL	C B
DUN-46	1550'	2" COAL 2" BONE AND COAL 24" COAL 6" RASH AND SHALE 9" CLAY 8" COAL	C2,C1 C3 C2,C1	DUN-419	1520'	21.5" COAL 2" COAL AND SHALE 14.5" COAL	C3 C2,C1
	--			DUN-420		1.5" COAL 4" SHALE 30" COAL 14" SHALE 8" COAL	C3 C2,C1
DUN-47		4" COAL 2" CLAY 28" COAL 4.5" COAL AND RASH 10" CLAY 12" COAL	C3 C2,C1	DUN-421	1526'	16" COAL	C
				DUN-422	1509'	1" COAL	B
DUN-48	1540'	19" COAL 53" SHALE 8" COAL	C2,C1 C3 C2,C1	DUN-423	1540'	25" COAL	C
	1560'			DUN-424	1530'	36" COAL	C
				DUN-425	1540'	40" COAL/10" PARTING	C3,C2,C1
					--	37" COAL/8" PARTING	C3,C2,C1

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
DUN-426	1540'	38" COAL	C	DUN-513		3" COAL 1'11" SHALE, DARK 4'0" SANDSTONE 30" COAL	C3
DUN-51	--	32" COAL	C			4" SHALE 1" COAL 1'8" SHALE 5'0" SHALE, SANDY 23" COAL	
DUN-52	1510'	36" COAL/0" PARTING	C		1518'	2" SHALE 13.5" COAL	C2,C1
DUN-53	1540'	3" COAL 1" BONE 25" COAL 36" CLAY 4" COAL	C3				
DUN-54	1530'	21" COAL	C3	DUN-514		2" COAL 0.75" SHALE 3" COAL 1" SHALE 11.5" COAL 1.5" SHALE 10" COAL 2.5" SHALE 0.5" COAL 2.5" SHALE 1.5" COAL	C3
DUN-55	--	12" PARTING 10" COAL	C2,C1				
DUN-56	1545'	28" COAL/0" PARTING	C				
DUN-57	1530'	42" COAL	C				
DUN-58	1530'	38" COAL	C		1516'		C2,C1
		2" COAL 3'2" SILTSTONE 36" COAL	C	DUN-515		7.5" COAL 16" SHALE 14" COAL	C3
DUN-59	1530'	10" SHALE 4" COAL 1" RASH 15" COAL 2" RASH 11" COAL	C	DUN-516	1521'		C2,C1
					1519'	29.5" COAL 0.5" SHALE 0.25" COAL	C
DUN-510	--	44" COAL	C	DUN-517	1613'	2" COAL 5" SHALE 3" COAL	E
DUN-511	1551'	2" COAL 2.5" SHALE 2" COAL	D2		1542'	6" COAL	C
			D1	DUN-518		7.5" COAL 28" SHALE 3.5" COAL 5" SHALE 6.5" COAL 9.75" SHALE 9" COAL 5" SHALE 4.5" COAL	D
DUN-512	1538'	31" COAL	C3				
		10" SHALE, DARK 4" SHALE 34" SHALE, SANDY 17" COAL	C2,C1		1524'		C2,C1
	1545'	2" COAL 4" SHALE 2" COAL	D2				
			D1	DUN-519		8" COAL 6'6.5" SHALE, SANDY 5'4" SANDSTONE WITH SHALE STREAKS 1'5" SHALE 24.5" COAL 3" SHALE 11.5" COAL	D
	1527'	41.5" COAL 16" SHALE, SANDY 3" SHALE 12" COAL	C3		1521'		C3
			C2,C1				C2,C1

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
DUN-520		11.75" COAL 3.5" SHALE 15" COAL 1" SHALE 1" COAL	C3
DUN-521	1528'	1" BONEY COAL 9" SHALE, GREY 2" BONEY COAL 38.5" COAL	C2, C1
DUN-522	1592'	1" COAL 1" SHALE, DARK 29" SHALE 33.5" COAL	C
DUN-523	1512'	37" COAL	C
DUN-524	1520'	35" COAL	C
DUN-525	--	28" COAL 6" SHALE 12" COAL	C3
DUN-526	--	32" COAL/0" PARTING	C2, C1
DUN-527	--	34" COAL/0" PARTING	C
DUN-528	--	34" COAL/3" PARTING	C3, C2, C1
DUN-529	--	36" COAL/8" PARTING	C3, C2, C1
DUN-530	--	38" COAL	C
DUN-61	1500'	JELICO HORIZON	C
DUN-62	1507'	2" COAL	D
DUN-63	1473'	4" SHALE, BLACK WITH COAL STREAKS 4" SHALE 4" SHALE, BLACK WITH COAL STREAKS	C
DUN-64	1456'	2" COAL, CANNEL	B
DUN-65	1510'	39" COAL	C
DUN-66	1510'	13.5" COAL 10.5" SHALE 10" COAL 3" COAL, BONEY 21.5" SHALE 8" COAL 2.5" SHALE 3" COAL	D C3 C C2, C1
DUN-67	1546'	8" COAL	D
DUN-68	1532'	7" COAL 4" SHALE 12" SANDSTONE 9.5" SHALE 2.5" COAL 4" SHALE 9" COAL 4.5" COAL AND SHALE 20" SHALE	D C3 C2, C1
DUN-69	1504'	6" COAL, BONEY 6.1" SHALE	B
DUN-70	1482'	6" RASH 31" COAL	C
DUN-71	1550'	8" COAL	E
DUN-72	1715'	8" SHALE WITH COAL	C
DUN-73	1630'	8" COAL AND SHALE MIXED	C
DUN-74	1586'	1" COAL	B
DUN-75	1538'	13" COAL/12" PARTING (SHALE)	C3, C2, C1
DUN-76	1520'	22" COAL	C
DUN-77	1617'	13" COAL	B
DUN-78	1591'	41" COAL	C
DUN-79	1515'	JELICO HORIZON	C
DUN-80	1500'	8" COAL	C
DUN-81	1570'	8" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
EAG-21	1940'	34" COAL	D3, D2, D1
EAG-22	1950'	49" COAL	D3, D2, D1
EAG-23	1984'	43" COAL/0" PARTING	D3, D2, D1
EAG-24	1895'	46" COAL/0" PARTING	D3, D2, D1
EAG-25	2000'	44" COAL/0" PARTING	D3, D2, D1
EAG-31	1800'	21" COAL/0" PARTING	E
EAG-32		-- COAL	F
		10' SHALE	E
		-- COAL	D3, D2, D1
	1640'	25' SHALE	B
		-- COAL	E
		10' SHALE	D3, D2, D1
		-- COAL	B
EAG-33	1730'	19" COAL	E
EAG-34	1770'	52" COAL	D3, D2, D1
EAG-35	1720'	57" COAL	D3, D2, D1
EAG-36		12" COAL	E
		31' SANDSTONE	D3
		4" SHALE	D2
		28" COAL	D1
		10" SHALE	D3, D2, D1
		24" COAL	E
		4" RASH	D3, D2, D1
	1780'	10" COAL	D3, D2, D1
EAG-37	1773'	40" COAL/0" PARTING	D3, D2, D1
EAG-38	1781'	40" COAL/0" PARTING	D3, D2, D1
EAG-39	1890'	55" COAL/0" PARTING	D3, D2, D1
EAG-310	1941'	49" COAL/0" PARTING	D3, D2, D1
EAG-311	1707'	37" COAL/0" PARTING	D3, D2, D1
EAG-312	1710'	23" COAL/0" PARTING	D3, D2, D1
EAG-313	1720'	17" COAL/0" PARTING	D3, D2, D1
EAG-314	1998'	7" COAL/0" PARTING	E
	1970'	31" COAL/0" PARTING	D3, D2, D1
EAG-315	1940'	58" COAL/0" PARTING	D3, D2, D1
		22" COAL	F
		22" COAL	E
		42" COAL	D2, D1
		38" COAL/0" PARTING	D3, D2, D1
		COAL BENCH	D2
		36" COAL	D2, D1
		30" COAL	D2
		36" COAL	D2
		5" PARTING	D2
		25" COAL	D1
		26" COAL	D2
		28" COAL	D2
		6" SHALE	D2
		12" COAL	D1
		10" SHALE	D1
		5" COAL	D1
		12" SHALE	D1
		20" COAL	D1
		20' SANDSTONE	D3, D2, D1
		7" SHALE	D3, D2, D1
		72" COAL ZONE WITH	D3, D2, D1
		14" PARTINGS	D3, D2, D1
		7" COAL	E
		3" SHALE	E
		16" COAL	E
		COAL BENCH	D2, D1
		24" COAL	E
		48" COAL	D2, D1
		22" COAL	E
		28" COAL	D2
		3" CLAY	D1
		8" COAL	B
		12" COAL	B

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PRM-21	1560'	25' COAL	C	PRM-35		SANDSTONE 4" SHALE 29" COAL SANDY CLAY	C
PRM-22	1530'	22' COAL	C		1500'		
PRM-23	1540'	26' COAL	C	PRM-36	1500'	32" COAL	C
PRM-24	1510'	26' COAL	C	PRM-37	1500'	29" COAL	C
PRM-25		6" COAL	D	PRM-38		SANDY SHALE 14" COAL 6" CLAY 14" COAL CLAY	C2,C1
	1500'	8' SANDSTONE 20" COAL/12" PARTING	C3,C2,C1		1520'		
PRM-26	1520'	22' COAL	C				
		40' SANDSTONE					
PRM-27	1560'	JELICO HORIZON	C	PRM-39	1500'	26" COAL	C
PRM-28	1540'	30" COAL	C	PRM-310		6.5" COAL 2" SHALE 9.5" COAL	C3 C2,C1
		15' SANDSTONE			1516'		
PRM-29	1530'	21" COAL	C	PRM-311		6.5" COAL 15" SHALE, LIGHT GREY 1.5" COAL 1" SHALE, BLACK 13" COAL 26.5" SHALE 11" COAL	C3 C2,C1
PRM-210	1520'	19" COAL	C		1506'		
PRM-211		13" COAL 1.5" PARTING 6.5" COAL	C3 C2,C1				
	1520'						
PRM-212	1520'	27" COAL	C	PRM-312	1525'	16.5" COAL	C3
PRM-213	1540'	30" COAL	C	PRM-313	--	12" COAL 4" PARTING 18" COAL 8" PARTING 13" COAL	D C3 C2,C1
PRM-214	--	34" COAL	C				
PRM-215	--	36" COAL	C				
PRM-216	1530'	30" COAL	C	PRM-314	1500'	27" COAL	C
PRM-31	1510'	31" COAL	C	PRM-315	1500'	24" COAL	C
PRM-32		SHALE 1" COAL 0.75" SHALE 13.5" COAL 1.25" SHALE 19.5" COAL SHALE	C3 C2,C1	PRM-316	--	36" COAL	C
				PRM-41	1740'	24" COAL	C
	1490'			PRM-42	1730'	12" COAL	C
				PRM-43	1620'	JELICO HORIZON	C
PRM-33	--	36" COAL	C	PRM-44	1720'	22" COAL	C
PRM-34		11" COAL	C3	PRM-51	--	COAL ANALYSIS ONLY	C
	1500'	1.5" SHALE 16.5" COAL	C2,C1	PRM-52	1550'	26" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
FRM-53	1548'	22" COAL	D	FRM-58	1514'	1.5" COAL	D
		17" SHALE				9 1/2" SHALE	
		3.5" COAL	C3			9" COAL	C3
		8" SHALE				5" COAL	C2
		7.5" COAL				9.5" SANDSTONE	
		60" SHALE				5" SHALE	
FRM-54	1548'	1.5" COAL	C2	FRM-59	1466'	9" COAL	C1
		11" COAL				32" COAL	C
		3" SHALE	C1			41" COAL	C
		15" COAL				12" COAL	D
		18" COAL	D			COAL ANALYSIS ONLY	C
		100.5" SHALE				18.5" COAL	C3
FRM-55	1545'	17" COAL	C3	FRM-60	1510'	13" SHALE	
		6" SHALE				16.5" COAL	C2
		4.5" COAL	C2			6" SHALE	
		2" COAL				15" COAL	C1
		1" SHALE	C1			17" COAL	C3
		24" COAL				1.25" SHALE	
FRM-56	1529'	18" COAL	D	FRM-61	1512'	12.5" COAL	C2,C1
		13" COAL	C3			40" COAL	C3,C2,C1
		7.5" SHALE				37" COAL	C3,C2,C1
		4.5" COAL, BONEY				18" COAL	C3
		5" COAL	C2			6" SHALE	
		3' 7.5" SHALE				10" COAL	C2
FRM-57	1517'	4.5" COAL, BONEY		FRM-62	1504'	4.5" SHALE	
		7" COAL	C1			3" SHALE WITH COAL STREAKS	
		17" COAL	D			7" SHALE	
		1.75" COAL				1" COAL	C1
		3.25" SHALE	C3			2" COAL	D
		16.5" COAL				3" SANDSTONE	
FRM-58	1557'	1.75" SHALE		FRM-63	1533'	2" COAL	C3,C2,C1
		1.25" SHALE				34.5" COAL	D
		2" SHALE	C2			2" COAL	D
		7.5" COAL				22.5" COAL	C3
		2.25" SHALE				10.5" SHALE	
		1" COAL	C1			2.5" COAL	C2
FRM-59	1515'	2.5" COAL		FRM-64	1531'	3" SHALE	C1
		20" COAL	D			12.5" COAL	
		23.5" SHALE				22.5" COAL	C3
		4.5" COAL	C3			10.5" SHALE	
		14" SHALE				2.5" COAL	C2
		7.5" COAL				3" SHALE	C1
FRM-60	1591'	46.5" SHALE		FRM-65	1509'	12.5" COAL	
		2.5" COAL	C2			22.5" COAL	C3

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PKM-610	1532'	20.5" COAL 8.5" SHALE 3" COAL 2.5" SHALE 5" COAL	C3 C2 C1	PKM-92	1560'	8' SANDSTONE 12' SHALE 34" COAL 3" SHALE 10" COAL	C3 C2,C1
PKM-611	1540'	19" COAL 3.5" SHALE 3" COAL 9" SHALE WITH COAL 8.5" COAL 8" SHALE 5" COAL	C3 C2 C1	PKM-93	1540'	36" COAL 2" SHALE 12" COAL	C3 C2,C1
PKM-612	1537'	21" COAL 32" SHALE 2.5" COAL 1" SHALE 16.5" COAL 12.5" SHALE 14" COAL	C3 C2 C1	PKM-94	1540'	3' SANDSTONE 10' SHALE 24" COAL	C
PKM-613	1556'	21" COAL 19" COAL 6" SHALE 15" COAL	C3 C2 C1	PKM-95	1580'	13" COAL	C
PKM-71	1543'	4" COAL 23.5" CLAY 6" COAL	C	PKM-96	1570'	22" COAL	C
PKM-72	1660'	JELICO HORIZON	C	PKM-97	1550'	18" COAL	C
PKM-81	1590'	42" COAL	C	PKM-98	1578'	12" COAL	D
PKM-82	1590'	4" COAL 2' SANDSTONE 4' SHALE 48" COAL	C	PKM-910	1528'	8" COAL 18.5" SHALE 1" COAL 19" SHALE 3" COAL	C3 C2 C1
PKM-83	--	SHALE 3" COAL, BONEY 19" COAL 2.5" BASHY COAL 13' COAL CLAY	C	PKM-911	1552'	11" COAL & SHALE MIXED STREAKS	D
PKM-84	--	28" COAL	C	PKM-912	1532'	21" COAL 58" SHALE 2" COAL	C C1
PKM-85	--	20-30" COAL	C	PKM-913	--	18" COAL	C
PKM-91	--	38" COAL 2" SHALE 8" COAL	C3 C2,C1	PKM-914	--	38" COAL	C
				PKM-915	--	27" COAL	C
				PKM-916	--	37" COAL	C
				PKM-917	1600'	34" COAL	C
				PKM-918	1600'	38" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PKR-11	1845'	31" COAL	D3	PKR-21	1640'	THIN COAL	D3
		3" BLACK SHALE				8" SHALE	
		24" COAL	D2			THIN COAL	D2
		10" BONE				12" SHALE	B
PKR-12	1845'	18" SHALEY CLAY	D1	PKR-22	1640'	THIN COAL	D3
		30" COAL				16" COAL	
		10" COAL	D3			14" PARTING	
		1" CLAY				22" COAL	D2
PKR-13	1860'	24" COAL	D2	PKR-23	1610'	19" COAL	D3
		11" CLAY				40" PARTING	
		12" COAL	D1			26" COAL	D2
		20" CLAY				30" COAL	D3
PKR-14	1740'	25" COAL	D3, D2, D1	PKR-24	--	29" PARTING	D2
		55" COAL				26" COAL	D2
		15" COAL	D3			24" COAL	D3
		1.5" SHALE				10" PARTING	
PKR-15	1740'	34" COAL	D2, D1	PKR-25	--	16" COAL	D2
		4" SHALEY COAL				5" PARTING	
		35" COAL	D3			8" COAL	
		5" CLAY AND COAL				24" COAL	D3
PKR-16	1780'	25" COAL	D2	PKR-26	--	12" PARTING	
		2.5" CLAY				18" COAL	D2
		1" COAL	D1			6" PARTING	
		1.5" CLAY				5" COAL	
PKR-17	1820'	6.5" COAL	D3	PKR-27	1595'	31" COAL	D3
		23" COAL	D2			15" PARTING	D2
		1.5" CLAY				18" COAL	
		20" COAL	D3			15" COAL	D2
PKR-18	1760'	31" COAL	D2	PKR-28	--	25" COAL	D3
		1.5" CLAY AND COAL				28" COAL	D3
		20" COAL	D1			29" COAL	D3
		3" CLAY & COAL, SLICKENSIDES				29" COAL	D3
PKR-19	--	5.5" CLAY	D2	PKR-34	--	29" COAL	D3
		5" COAL				29" COAL	
		18" COAL/0" PARTING					
		21" COAL, BRIGHT, LAMINATED					
PKR-20	--	5" SHALE WITH BANDS OF BONE, INTERBEDDED		PKR-35	--		
		3" BONE AND LENSES OF IMPURE COAL, INTERBEDDED					
		26" COAL, BRIGHT WITH DULL BANDS					
		.5" RASH					
PKR-21	--	2" COAL, BRIGHT		PKR-36	--		
		10" SHALE					
		35" COAL, MASSIVE, HARD					

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PKR-35	1827'	3.5" COAL AND SHALE 2.5" COAL	E
	1758'	33" COAL 1" SHALE	D3
		2" COAL	
	1726'	5" COAL 4" SHALE	D2
		22" COAL	
	1713'	5" COAL	B
	1700'	11" COAL	A
PKR-36	1820'	25" COAL	D2
PKR-37		19" COAL	D3
	1725'	9' PARTING 14" COAL	D2
PKR-38	--	8" COAL/0" PARTING 27' PARTING	D3
	1761'	30" COAL/0" PARTING	D2
PKR-39	1619'	24" COAL/0" PARTING	D2
PKR-310	1640'	28" COAL/1.5" PARTING	D2
PKR-311	1760'	30" COAL	D2
PKR-312	1750'	32" COAL	D2
PKR-313	--	COAL ANALYSIS ONLY	D3,D2
PKR-314		36" COAL	D3
		22" CLAY	
		4" COAL	
		3" CLAY	
		1" COAL	
		24" CLAY	
	1730'	24" COAL	D2
		6" CLAY	
PKR-41	1840'	30" COAL	D2?
PKR-42		18" COAL	E
		22' PARTING	
		THIN COAL	D3
		3' PARTING	
		24" COAL	D2
		7' PARTING	
	1790'	THIN COAL	D1
		30' PARTING	B
		18" COAL	
QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PKR-43	1800'	40" COAL	D3,D2
PKR-44		28" COAL	D3
		2" SHALE, LAMINATED, BLACK 2" COAL	
		5" SHALE, GREY 20" COAL	D2
		3" SHALE, LAMINATED, BLACK 7" SHALE, LAMINATED WITH COAL STRINGERS	
	1855'	5" COAL	D1
PKR-45		16" COAL	E
		40' SILTSTONE, LIGHT GREY, LAMINATED	
	1830'	-- COAL BENCH	D3,D2,D1
PKR-46	1857'	-- COAL	E
	1778'	48" COAL	D3,D2,D1
		10' SHALE 24" COAL	B
		3' SHALE 8" COAL	A
PKR-47	1858'	8" COAL	F
	1834'	3" COAL	E
	1786'	60" COAL	D3,D2
		24" SHALE 12" COAL	B
		46" SHALE 11" COAL	A
PKR-48	1779'	THIN COAL	F
	1820'	THIN COAL	E
	1792'	48" COAL	D3,D2,D1
	1732'	6' SHALE THIN COAL	B
		10' SHALE 18' SANDSTONE THIN COAL	
PKR-49		10' SHALE 1' COAL	D3
		2' SHALE, BLACK 1' COAL	D2
		2' SHALE, BLACK 8' SILTSTONE 10' COVERED TO BENCH	B
PKR-410	--	25.5" COAL	D3
		1" CLAY	D2
		24" COAL	

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PKR-411	--	26" COAL, LAMINATED 3" SHALE AND RASH, INTERBEDDED 25" COAL, BLOCKY	D3 D2	PKR-419		25" COAL 1" CLAY 1" COAL 1" CLAY 5" COAL 1" CLAY 21.75" COAL 4" CLAY & COAL, SLICKENSIDES 5.5" COAL	D3 D2 D1
PKR-412	1840'	32" COAL 3" SHALE 10' COVERED TO BENCH	D3 D2	PKR-420	1800'	27" COAL 3.5" CLAY 2" COAL 6" SHALE 24" COAL 4.5" CLAY 1" COAL 2.5" CLAY 4.5" COAL	D3 D2 D1
PKR-413		29" COAL 2" CLAY 1.5" COAL 2" CLAY 1" COAL 18" COAL 3.5" CLAY 4.5" COAL	D3 D2	PKR-421	1800'	32" COAL 52" PARTING 32" COAL 4" PARTING 3" COAL	D3 D2 D1
PKR-414	1805'	25" COAL 5" CLAY 1" COAL 2.5" CLAY 1.5" COAL 5" CLAY 23" COAL	D3 D2	PKR-422	--	32" COAL 34" PARTING 24" COAL 4" PARTING 3" COAL	D3 D2 D1
PKR-415	1805'	12.5" COAL 1" CLAY 15" COAL 4" CLAY 20.5" COAL	D3 D2	PKR-423	--	24" COAL 18" PARTING 12" COAL	D3 D2 D3,D2
PKR-416	1820'	29" COAL 2" CLAY 1.5" COAL 2" CLAY 2.5" COAL 1" CLAY 21" COAL	D3 D2	PKR-424	1810'	COAL BENCH	D3,D2
PKR-417	1830'	29.5" COAL 1.75" CLAY 1.5" COAL 5" CLAY 21.5" COAL 3" CLAY AND COAL 5" COAL	D3 D2	PKR-425	1820'	COAL BENCH	D3,D2
PKR-418	1820'	33" COAL 1.25" SHALE 22.75" COAL	D3 D2	PKR-51	1760'	28" COAL 20" GREY SHALE 32" COAL	D3 D2
	1840'			PKR-52	1740'	30' GREY SHALE 32" COAL	D3
				PKR-53	1730'	40' SHALE 9" COAL 40' SHALE BENCH	D3
				PKR-54	1770'	30" COAL	D3,D2
					1776'		D3

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PRR-55	1770'	25" COAL 2-10" SHALE 29" COAL WITH PYRITE STREAKS	D3	PRR-516		12" COAL 6" SHALE WITH COAL STREAKS 27" CLAY, SHALE 2" BONE 42" COAL	D3
PRR-56	--	26.5" COAL 38.5" PARTING 19" COAL 8" PARTING 3" COAL	D3	PRR-517	1810'	26" COAL 3" RASH 1" SHALE AND SULFUR LENSES INTERBEDDED 24" COAL 5" SULFUR BANDS 1.5" COAL 1" RASH	D2
PRR-57	--	30" COAL 15.5" PARTING 25" COAL	D3	PRR-518	--	26" COAL 2" RASH AND COAL LENSES 9" SHALE AND RASH, INTERBEDDED 16" COAL 4" SHALE AND CLAY, INTERBEDDED .. 4" COAL	D3
PRR-58	--	32" COAL 22" PARTING 25" COAL	D2	PRR-519	--	23" COAL 9" PARTING 16" COAL 9" PARTING 5" COAL	D2
PRR-59	1820'	30" COAL 6" SHALE 12" COAL 18" SHALE 10" COAL	D3	PRR-520	--	28" COAL 25" PARTING 31" COAL 4" PARTING 6" COAL	D3
PRR-510	1870'	10" COAL	D2	PRR-521	--	31" COAL 17" PARTING 24" COAL 5" PARTING 7" COAL	D3
PRR-511	1857'	3" COAL	F	PRR-522	--	29" COAL 20" PARTING 19" COAL	D2
PRR-512	1810'	50" COAL 16" SHALE 13" COAL	E	PRR-61	1802'	32" COAL 20" SHALE 22" COAL 5" SILTSTONE 25" SANDSTONE THIN COAL	D3
PRR-513	--	34" COAL 1" CLAY 3" COAL 15" CLAY 20" COAL	D3		1780'		D2
PRR-514	--	30" COAL 7" CLAY 30" COAL	D2				B
PRR-515	--	32" COAL 8" CLAY 18" COAL 1" CLAY 6" COAL	D3				
	--	COAL ANALYSIS ONLY	D3,D2				
	--	COAL ANALYSIS ONLY	D3,D2				

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PER-62	--	36" COAL	D3	GOR-21	1831'	4" COAL	B
PER-63	--	25" COAL	D3	GOR-51	1907'	JELLICO HORIZON	C
PER-64	--	36" COAL	D3	GOR-61	1750'	JELLICO HORIZON	C
PER-65	--	26" COAL	D3	GOR-62	1690'	23.5" COAL WITH 5" RASH AND COAL STREAKS AT BASE	C
PER-66	--	20" COAL	D3				
PER-67	1800'	40" COAL	D3	GOR-63	1690'	21" COAL WITH 5" RASH AND COAL STREAKS AT BASE	C
	1775'	25" PARTING 26" COAL	D2				
PER-68	1800'	39" COAL	D3	GOR-64	1680'	21" COAL	C
	1780'	20" PARTING 24" COAL	D2	GOR-65	1670'	23" COAL	C
PER-69	1760'	32" COAL	D2	GOR-66	1690'	18" COAL 1 1/2" RASH 3.5" COAL	C
PER-610		13" COAL 1" CLAY 7.5" COAL 12.5" CLAY 1.5" COAL 3" CLAY 2.5" COAL 3" CLAY 4" COAL 16" CLAY 20" COAL	D2				
	1760'	50" COAL	D3	GOR-81	1900'	24" COAL	C
PER-611	1790'	18" COAL		GOR-82	1900'	22" COAL	C
PER-612	1750'	2" RASH 11" COAL .5" SHALE 10" COAL	D3	GOR-91	1765'	JELLICO HORIZON	C
PER-71	1820'	85" COAL, DEFORMED	D3				
PER-72	1940'	8" COAL	F				
		1" BONE 28" COAL	E				
	1902'	COAL BENCH	D3				
PER-73	1876'	18" COAL	F				
	1981'	COAL BENCH	E				
	1941'	23" COAL	D3				
	1915'	23" COAL	E				
PER-74	1897'	23" COAL	E				
	1873'	COAL BENCH	D3				
PER-75	1800'	COAL BENCH	D3, D2, D1				

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
HUN-21	1630'	JELLICO HORIZON	C
HUN-22	1560'	32" COAL	C
HUN-23	1570'	17" COAL	C
	1530'	-- COAL	B
HUN-24	1560'	24" COAL	C
HUN-31	1640'	18" COAL 20' COVERED 30' SANDSTONE 10' COVERED -- COAL (MINED)	C
	1590'	JELLICO HORIZON	B
HUN-32	1530'	JELLICO HORIZON	C
HUN-33	1598'	16" COAL 30' COVERED 20' SANDSTONE 10' SHALE 6" COAL	C
	1528'	JELLICO HORIZON	B
HUN-51	1570'	JELLICO HORIZON	C
HUN-52	1600'	JELLICO HORIZON	C
HUN-61	1580'	28" COAL 20' SANDSTONE 20' SHALE 16" COAL	C
	1540'	6" COAL	B
HUN-62	1600'	JELLICO HORIZON	C
HUN-81	1560'	-- COAL (MINED)	C
HUN-82	1540'	1" COAL	C
HUN-91	1558'		

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
IVY-11	1400'	0-7" COAL	C
IVY-21	1841'	4" COAL 15' SHALE AND SILTSTONE 7" COAL	F
	1826'	1" COAL	E
	1780'	0" COAL (SANDSTONE IN PLACE)	C
IVY-22	--	DRILL HOLE Cased AT JELLICO HORIZON	C
IVY-23	1870'	6" COAL	F
IVY-51	1899'	6" COAL	E
	1870'	0" COAL (SHALE IN PLACE)	C
	1837'	1" COAL	C
IVY-52	1773'	DRILL HOLE BELOW JELLICO HORIZON	C
IVY-53	--	6" COAL	E
IVY-61	1781'	24" SHALE, BLACK, CARBONACEOUS	C
	1728'	2" COAL	F
IVY-71	2131'	6'11" SHALE, BLACK	E
	2097'	2" COAL 10' SHALE, BLACK	C
	2057'	-- COAL	E
IVY-72	2111'	-- COAL	C
	2056'	-- COAL	E
IVY-73	2130'	-- COAL	C
	2080'	1.5" COAL	F
IVY-81	2048'	1" COAL	E
	2013'	1" COAL	D
	1944'	7" COAL 6" CLAY 24" SILTSTONE 2" COAL	C2
	1966'		C1

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
IVY-82			
		4" COAL	E2
	1921'	3" CLAY	E1
	1869'	6" COAL	C
		3" COAL	C
IVY-83	1930'	JELLICO HORIZON	C
JAK-41	1580'	JELLICO HORIZON	C
JAK-42		SHALE	
		22" COAL	
	1475'	10" COAL, CLAY & RASH MIXED	C
		5" COAL	
		UNDERCLAY	
JAK-43	1595'	10" COAL	C
JAK-71	1520'	10" COAL	C
JAK-72	1522'	15" COAL	C
JAK-73	1429'	18" COAL	C
JAK-74	1338'	9" COAL	C
JAK-75	1474'	10" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
JEE-11	1310'	32" COAL/0" PARTING	C	JEM-11	1370'	26" COAL	C
JEE-21	1310'	48-72" COAL	C	JEM-12		10" COAL .5" SHALE 24" COAL	C
JEE-22	1290'	17" COAL/0" PARTING	C	JEM-13	1350'		C
JEE-23	1310'	94" COAL, DEFORMED	C	JEM-14	1400'	42-49" COAL	C
JEE-31	1300'	38" COAL/0" PARTING	C	JEM-15	1400'	49-56" COAL	C
JEE-81	1780'	16" COAL	B	JEM-16	1380'	21-28" COAL	C
JEE-82	1760'	38" COAL	B	JEM-17	1370'	28-35" COAL	C
JEE-83	1700'	24" COAL	B	JEM-21	1360'	15" COAL	C
JEE-84	1700'	12" COAL, BRIGHT BANDED	D	JEM-22	1300'	34" COAL	C
JEE-85	1749'	12" COAL, DULL BANDED	D	JEM-23	1290'	36" COAL	C
	1726'	14.5" COAL, BRIGHT BANDED	C	JEM-24	--	COAL ANALYSIS ONLY	C
	1710'	2" COAL, BONEY	B			1" COAL 6" CLAY 5" COAL	D
JEE-91	1720'	COAL BENCH	B		1380'		
JEE-92	1828'	40" COAL	B			5" COAL 1" BONE 20" COAL	C
		28" COAL, WITH SHALE LAMINATIONS IN BOTTOM HALF	D		1366'		
JEE-93	1790'	COAL BENCH	B		1342'		
		2" COAL, BRIGHT BANDED		JEM-25	1330'	11" COAL	B
JEE-94	1730'	6" CLAYSTONE, ROOTED, MINOR COAL LAMINATIONS	B	JEM-26	1280'	JELICO HORIZON	C
		37" COAL, BRIGHT BANDED		JEM-27	1370'	38" COAL/0" PARTING	C
		1.5" COAL		JEM-31		21-28" COAL	C
		8.75" COAL				15" COAL 2" SHALE 22" COAL	C
		6" SHALE			1350'		
		.25" COAL		JEM-32		19" COAL 1" SHALE 20" COAL	C
		2.25" SHALE			1300'		
		1.25" COAL, RASHY			1290'	40" COAL	C
	1700'	23.5" COAL	B	JEM-33	1300'	39" COAL	C
JEE-95	1700'	6.5" COAL 15" SHALE 28.75" COAL	B	JEM-34	1300'	39" COAL	C
JEE-96	--	45.5" COAL WITH BONEY BANDS AND SULFUR BALLS	B	JEM-35	1300'	39" COAL	C
				JEM-36	1300'	37" COAL/0" PARTING	C
				JEM-37	1280'	36" COAL/0" PARTING	C
				JEM-38	1387'	6" COAL/0" PARTING	JOYNER

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SPAM DESIGNATION
JEW-39	1300'	39" COAL/0" PARTING	C
JEW-310	1390'	43" COAL/0" PARTING	C
JEW-311	1310'	JELICO HORIZON	C
JEW-312	--	COAL ANALYSIS ONLY	C
JEW-313	1290'	28-35" COAL	C
JEW-314	1310'	35" COAL	C
JEW-41	1350'	30" COAL	C
JEW-42	1380'	30" COAL	C
JEW-43	--	32" COAL	C
JEW-44	1380'	29" COAL/0" PARTING	C
JEW-45	1350'	18" COAL	C
JEW-46	--	35" COAL	C
JEW-47	1339'	34" COAL	C
JEW-51	1390'	21-28" COAL	C
JEW-52		4" COAL 2" SHALE 22" COAL 1" SHALE 5" COAL 1" SHALE 4" COAL	C
JEW-53	1400'	26" COAL	C
JEW-54	1410'	3.5" COAL 5" SHALE 16" COAL 1" SHALE 28" COAL	C
JEW-55	1360'	3.5" COAL 25" SHALE 24" COAL 1.5" CLAY 3.5" COAL 1.5" CLAY 25" COAL	C
JEW-56	--	1.5" BONE 3" RASH 5" COAL 1.5" BONE 5" COAL 2" CLAY, BLACK 20.5" COAL	C
JEW-57	1430'	THIN COAL	D
JEW-58	1400'	26-31" COAL	C
JEW-59	--	2" COAL, LAMINATED 1" BONE 21" COAL 4" CLAY 6" COAL, IMPURE	C
JEW-510	--	16" COAL 4" BONE 4" COAL, BRIGHT 1.5" COAL, DULL 4.5" COAL, BRIGHT 4" COAL, RASH, BONE 4" CLAY 18" COAL	C
JEW-61	1360'	42-49" COAL	C
JEW-62	1370'	21-28" COAL	C
JEW-63	1330'	35-42" COAL	C
JEW-64	1340'	23" COAL 4" SHALE 29" COAL	C
JEW-65	1320'	12" COAL 9" CLAY 20" COAL	C
JEW-66	1370'	14" COAL 4" CLAY 24" COAL	C
JEW-71	1390'	18" COAL 2" SHALE 5" COAL	C
JEW-72		THIN COAL 18" SHALE 4" SHALE, BLACK 24" COAL 4" UNDERCLAY 2" COAL 3" IMPURE COAL	D
	1380'		C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
JEW-73	1360'	32-36" COAL	C
JEW-74	1360'	24" COAL 3.5" CLAY 6" COAL	C
JEW-75	1520'	6" COAL	D
	1492'	20" COAL 12" SHALE 4" COAL	C
JEW-76	1477'	3" COAL	B
JEW-77	1410'	JELICO HORIZON	C
JEW-78	1490'	JELICO HORIZON	C
JEW-81	1420'	7-14" COAL	C
JEW-82	1450'	17" COAL	C
JEW-83	1400'	JELICO HORIZON	C
	1400'	21" COAL	C
KET-11	1495'	26" COAL	C
KET-12	1530'	0-7" COAL	C
KET-13	1470'	0-7" COAL	C
KET-21	1465'	16" COAL	C
KET-22	1513'	17.3" COAL	C
KET-23	1460'	21"-28" COAL	C
KET-31	1440'	21"-28" COAL	C
KET-32	1410'	20" COAL 2" SHALE 7" COAL	C
KET-41	1550'	26" COAL	C
KET-42	1560'	29.5" COAL	C
KET-43	1551'	0" COAL (SILTSTONE IN PLACE)	C
KET-51	1480'	21.5" COAL/0" PARTING	C
KET-52	1481'	3.5" COAL 5" SHALE 6.3" COAL	C
KET-61	1480'	20" COAL	C
		5' COVERED 5' SANDSTONE 17' SHALE -- COAL	B
KET-62	1433'	25" COAL	C
KET-63	1455'	30" COAL	C
KET-64	1390'	24" COAL	C
KET-65	1440'	20" COAL/0" PARTING	C
KET-66	1433'	5.8" COAL AND BONY COAL	D
		55.8" SHALE 19" COAL 2" CLAY 3" COAL	C
KET-67	1391'	21" COAL	C
KET-68	1430'	21"-28" COAL	C
KET-71	1540'	16" COAL	C
KET-72	1500'	22" COAL/2.5" PARTING	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
KET-73	1481'	9" COAL	C	LAF-11	1800'	36" COAL	C
KET-81	1495'	9" COAL	C	LAF-12	1760'	50" COAL	C
KET-82	1491	0" COAL (INTERBEDDED SILTSTONE AND SHALE IN PLACE)	C	LAF-13	1800'	2" COAL	D
KET-91	1420'	21" COAL 3" SHALE 6" COAL	C			3" COAL 8" SHALE 2" SHALE, CARBONACEOUS 20" COAL	C
KET-92	1410'	7-14" COAL	C		1735'	.5" COAL	B
KET-93	1400'	0-7" COAL 23' SHALE	C	LAF-14	1835'	8" COAL 2" SHALE, CARBONACEOUS 5" COAL	E2 E1
KET-94	1377'	-- COAL	B		1800'	COAL BENCH	D
	1378'	12" OP THIN COALS	C	LAF-15	1790'	24" COAL	E
		26' SHALE 4' SILTSTONE 11' SHALE			1765'	COAL BENCH	D
	1337'	THIN COAL	B		1753'	COAL BENCH	C
				LAF-16	1770'	2" BONE 18.5" COAL, BRIGHT BANDED	D
					1753'	COAL BENCH	C
				LAF-17	1805'	6" COAL	E
					1770'	COAL BENCH	D
				LAF-18	1840'	12" COAL 6" SHALE 6" COAL	E2 E1
					1800'	COAL BENCH	D
				LAF-19	1842'	7.5" COAL, BRIGHT BANDED 3" SHALE, CARBONACEOUS 4.5" COAL, BRIGHT BANDED	E2 E1
					1820'	COAL BENCH	D
				LAF-110	1855'	9" COAL	E
					1800'	31" COAL/10" PARTING COAL SPLIT INTO 3 BENCHES BY PARTINGS ADDING UP TO 10"	C
				LAF-111	1800'	13" COAL	C
				LAF-21	1763'	10' SHALE 30" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
LAP-22		SHALE TOP 12" COAL 1" RASH 10" COAL 7" COAL AND BONE UNDERCLAY	
	1770'		C
LAP-23		6.5" COAL, BRIGHT BANDED 3.0" COAL, SHALEY TO RASHY 12.0" COAL, BRIGHT BANDED 6.5" CLAYSTONE, VERY DARK 2.5" SHALE, CARBONACEOUS, BLACK 3.0" COAL, BRIGHT BANDED 2.5" SHALE, BLACK, CARBONACEOUS 5" CLAYSTONE, VERY DARK, GREY, SOFT 3" COAL, BRIGHT BANDED, HARD 6" CLAY, LIGHT GREY, ROOTED, SOFT	
	1760'		C
LAP-24		-- COAL 7" SHALE, GREY -- COAL -- COAL, SHALEY -- COAL 11" 2" SHANDSTONE, SHALEY, GREY -- COAL 43" COAL 41" COAL 18.5" COAL, BRIGHT & DULL BANDED .5" SHALE, CARBONACEOUS 20.0" COAL, BRIGHT, BANDED, HARD 1.5" COAL, DULL	E2 E1 D C B B B
	1827'		
	1800'		
LAP-31	1760'		C
LAP-32	1810'		B
LAP-33	1754'		B
	1770'		B
LAP-34	1750'		B
LAP-35	1760'		B
LAP-36	1790'		B
LAP-37	1750'		B
LAP-38	1740'		B
LAP-39	1710'		B
LAP-310	1780'		B
LAP-311	1700'	30" COAL	B
LAP-312	1710'	38" COAL	B
LAP-313	1780'	32" COAL	B
LAP-314	1710'	34" COAL	B
LAP-315	1740'	26" COAL	B
LAP-316	1780'	29" COAL	B
LAP-317	--	2.5" COAL 9" SHALE .75" COAL .25" SHALE 28" COAL	B
LAP-318	1790'	26" COAL	B
LAP-41	1800'	36" COAL	C
LAP-42	1800'	32" COAL	C
LAP-43	1800'	37" COAL	C
LAP-44	1830'	20" COAL	C
LAP-45	1810'	29" COAL	C
LAP-46	1859'	11" COAL, BRIGHT BANDED 9" SHALE, CARBONACEOUS 14" COAL, BRIGHT BANDED	E2 E1
	1840'	2" COAL, BONY, WITH BRIGHT BANDS 16" COAL, BRIGHT BANDED, STREAKS, PYRITE	D
LAP-47	1810'	33" COAL	C
LAP-71	--	DRILL HOLE BELOW JELICO HORIZON	

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
LAK-11	1515'	0" COAL (4" SHALE, CARBONACEOUS IN PLACE).....	C
LAK-12	1500'	1" COAL	C
LAK-13	1430'	< 24" COAL	C
LAK-14	1418'	2" COAL	C
LAK-15	1445'	0" COAL (SHALE IN PLACE)	C
LAK-21	1550'	-- COAL	F
	1470'	-- COAL	C
LAK-22	1420'	6" COAL	C
LAK-41	1550'	16" COAL	E
LAK-42	1498'	4" COAL	E
	1433'	0" COAL (SANDSTONE IN PLACE)	C
LAK-43	1511'	3" BONE	E
	1461'	7" COAL	C
LAK-44		3.6" COAL 3.6" SHALE 2.4" COAL 7'4.8" SHALE 2.4" COAL	C
	1499'		
LAK-51	1510'	3" COAL	E
LAK-71	1655'	4" COAL	E
	1615'	18" COAL	C
LAK-72	1640'	22" COAL	E?

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
NOR-11	1600'	28" COAL	C
NOR-12	1600'	32" COAL	C
NOR-13	1600'	32" COAL	C
NOR-14	1726'	8" COAL	C
NOR-31	1690'	17" COAL	C
NOR-32	1690'	17" COAL	C
NOR-33	1690'	15" COAL	C
NOR-34	1620'	26" COAL	C
NOR-35	1650'	24" COAL	C
NOR-36	1680'	12" COAL	C
NOR-41	1700'	25" COAL	C
NOR-42	1710'	26" COAL	C
NOR-43	1710'	29" COAL	C
NOR-44	1700'	26" COAL	C
NOR-45	1700'	23" COAL	C
NOR-46	1690'	20" COAL	C
NOR-47		6" COAL 8" PARTING 3" COAL	C
	1700'		
NOR-48	1685'	0" COAL (SHALE IN PLACE)	C
	1660'	8" COAL	B
NOR-49		20" COAL 3.5" PARTING 6" COAL	C
	1700'		
NOR-410	1680'	40' SANDSTONE 18" COAL	C
NOR-411		10" COAL 2" PARTING 5" COAL	C
	1690'		
NOR-412	1700'	5" COAL 1" PARTING 9" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
ONS-91	1715'	0" COAL (SHALE IN PLACE)	C
PET-11	1640'	40" COAL	C
PET-12	1720'	24" COAL	C
PET-13	1790'	4.5" COAL 6" CLAY 6" COAL	C
PET-21	1630'	16' SHALE, SILTY 29" COAL	C
PET-22		25' SHALE 44" COAL	C
PET-23	1680'	30-46" COAL	C
PET-24	1670'	32-46" COAL	C
PET-25	1650'	32" COAL	C
PET-26	1620'	38" COAL	C
PET-27	--	24" COAL	C
PET-28	1620'	36" COAL	C
PET-29	1620'	40" COAL	C
PET-210	1640'	30" COAL	C
PET-211	--	26" COAL	C
PET-212	1640'	30" COAL	C
PET-213	1626'	10" COAL	C
PET-214	1630'	22.5" COAL, BONE & SHALE 1.25" RASH, FUSAIN & SHALE 16.75" COAL, FUSAIN & PYRITE	C
PET-215	--	6" COAL 1" COAL, RASHY 6.75" COAL, MASSIVE 25" SULFUR 17" COAL, MASSIVE	C
PET-216	--	12" COAL, LAMINATED 16" COAL, MASSIVE 1" COAL, RASHY 13" COAL, MASSIVE AND HARD	C
PET-217	--	28" COAL WITH THIN SULFUR LENSES	C
PET-218	--	COAL ANALYSIS ONLY	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PET-219	--	9" COAL, LAMINATED WITH 1" SULFUR LENSES 22" COAL, MASSIVE WITH LOCAL CHARCOAL	 C	PET-43	1740'	24" COAL 1" PARTING 7" COAL	 C
PET-220	--	1.75" COAL 1" CHARCOAL 6.25" COAL, LAMINATED 2" CHARCOAL 17" COAL, MASSIVE 5" COAL WITH CHARCOAL LENSES 17" COAL, MASSIVE, WITH CHARCOAL LENSES	... C	PET-44	--	COAL ANALYSIS ONLY	 C
PET-211	--	4" COAL WITH SHALE LENSES 22" COAL, LAMINATED 5" COAL, WITH BANDS OF CHARCOAL	 C	PET-45	1800'	30" COAL	 C
PET-222	--	8" COAL, MASSIVE 2" COAL, SOFT 8" COAL, MASSIVE 5" CHARCOAL 6" COAL, LAMINATED 20" COAL, MASSIVE	 C	PET-46	1800'	32" COAL	 C
PET-223	--	COAL ANALYSIS ONLY	 C	PET-47	1800'	33" COAL	 C
PET-224	--	26" COAL	 C	PET-48	1800'	32" COAL	 C
PET-31	1610'	28" COAL	 C	PET-51	1800'	10'+ SANDSTONE 32" COAL WITH SULFUR BANDS	 C
PET-32	1672'	1" COAL	 C	PET-52	1696	10'+ SANDSTONE 32" COAL	 C
PET-33	1662'	9" COAL	 C	PET-53	1715'	8' SANDSTONE 30" COAL	 C
PET-34	1575'	1" COAL	 C	PET-54	1800'	.75" FUSAIN AND SULFUR 2.75" COAL 2" COAL AND FUSAIN 10" COAL WITH BONE STREAKS 1" BONE 20.75" COAL, BONE, SULFUR STREAKS	 C
PET-35	1556'	1" COAL 36" SHALE 28" COAL 21" SHALE 13" SANDSTONE 2" COAL	 D	PET-55	1800'	10'+ SANDSTONE 32" COAL	 C
PET-36	1720'	18" COAL	 C	PET-56	--	COAL ANALYSIS ONLY	 C
PET-41	1800'	10'+ SANDSTONE 36" COAL	 C	PET-57	--	32" COAL	 C
PET-42	1740'	36" COAL	 C	PET-58	1801'	4.5" COAL	 E
					1790'	23" COAL 5.3" SHALE 3.5" COAL	 C
					1800'	-- COAL 30' SANDSTONE	 C
					1800'	26" COAL	 C
					1710'	35" COAL	 C
					1800'	42" COAL	 C
					1715'	16" COAL	 C
					1723'	28" COAL	 C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
PET-62		2.5" COAL 0.5" BONE 10" COAL 1.5" BONEY COAL WITH PYRITE BLOOM 2.5" COAL, SOFT 2" COAL, BROKEN		P10-11	1560'	14-21" COAL	C
	1737'			P10-12	1550'	30" COAL	C
PET-63	1754'	3" COAL, BONEY	B	P10-13	1630'	7" COAL	C
	1733'	22" COAL	C	P10-14	1490'	0-7" COAL	C
PET-64	1778'	1" COAL, BONEY	B	P10-15	1500'	0-7" COAL	C
	1770'	3" COAL	D	P10-16	1420'	7-14" COAL	C
		0.5" COAL, BONEY 11.5" COAL, HARD 3" COAL, BROKEN 7.5" COAL, HARD		P10-21	1500'	7-14" COAL	C
PET-65	1758'	SHALE 12" COAL 4" CLAY 6" COAL UNDERCLAY	C	P10-22	1540'	7" COAL	C
	1770'			P10-23	1530'	14" COAL	C
PET-66	1780'	25" COAL	C	P10-31	1490'	0-7" COAL	C
PET-67	1748'	4" COAL	C	P10-32	1500'	0-7" COAL	C
PET-71	1930'	23-24" COAL	C	P10-33	1440'	7-14" COAL	C
PET-72	1930'	23" COAL	C	P10-34	1455'	0-7" COAL 15' COVER 0-7" COAL 7' SHALE 85' SANDSTONE	B
				P10-41	1550'	25" COAL	C
				P10-42	1520'	23" COAL 4" COAL IMPURE	C
				P10-43	1530'	20" COAL	C
				P10-44	1530'	24" COAL	C
				P10-45	1570'	20" COAL	C
				P10-46	1530'	33" COAL	C
				P10-47	1570'	11" COAL	C
				P10-48	1570'	5" COAL	C
				P10-49	1565'	6" COAL	B
					1530'	21-28" COAL	C
				P10-410	1535'	7-14" COAL	C
				P10-411	1525'	6" COAL	C

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
P10-51	1550'	25' COAL 6" COAL, IMPURE	C
P10-52	1543'	3" COAL	B
P10-53	1540'	21-28" COAL	C
P10-54	1520'	10" COAL	C
P10-55	--	21-28" COAL	C
P10-56	1550'	21-28" COAL	C
P10-71	1520'	THIN COAL	B
P10-72	1500'	7-14" COAL	C
P10-73	1530'	26" COAL	C
P10-74	1560'	JELICO HORIZON	C
P10-75	1540'	7-14" COAL	C
P10-81	1500'	0-7" COAL	C
P10-82	1520'	3" COAL	C
P10-83	1510'	2" CLAY	C
P10-84	1530'	9" COAL	C
P10-85	1500'	25" COAL	C
P10-86	1525'	27" COAL	C
	1530'	5" COAL	C
	1530'	22" COAL	C
	1500'	21-28" COAL	C
		10" BONE	
		6" CLAYSTONE, DARK GRAY	
		1" COAL	
		5" CLAYSTONE, BLACK	E
	1535'	3" COAL	
		1.5" COAL, BRIGHT	
		.75" COAL AND RASH	
	1500'	1.5" COAL, BRIGHT BANDED	C
ROB-31	1725'	0" COAL (SHALE IN PLACE)	C
ROB-32	1721'	8" COAL	C
ROB-61	1729'	19.5" COAL	C
	1684'	8" COAL	B
		30' SANDSTONE	
ROB-71	1880'	16" COAL	B
ROB-72	1880'	14" COAL	B
ROB-81	1915'	JELICO HORIZON	C
ROB-91	1780'	12-14" COAL	B
		20' SANDSTONE	

QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION	QUADRANGLE NUMBER	ELEVATION (AT COAL BASE)	COAL MEASUREMENT	SEAM DESIGNATION
WFD-51		3" COAL	D7	WRK-11	1710'	JELICO HORIZON 35' SANDSTONE	C
	1590'	46" SHALE	C	WRK-21	1600'	28" COAL	C
WFD-61		17" COAL	C	WRK-22	1600'	-- COAL	E
	1600'	4" COAL	C		1550'	0" COAL (SILTY SHALE IN PLACE) ..	C
WFD-62	1600'	.25" PARTING	C	WRK-23	1610'	3" COAL	C
WFD-63	1600'	20" COAL	C	WRK-41	1612'	6" COAL	E
WFD-64	1600'	23" COAL	C			8' SHALE, SANDY	
WFD-65	1610'	24" COAL	C			6' SANDSTONE	
WFD-66	1610'	25" COAL	C			10' SHALE, SANDY	
WFD-67	1620'	25" COAL	C		1588'	6" COAL	C
WFD-68	1620'	26" COAL	C				
WFD-69	1600'	22" COAL	C				
WFD-610		18" COAL	C				
	1584'	0" COAL	C				
		THIN COAL	D7				
		36" SHALE	C				
		12" COAL	C				
WFD-611	1620'	6" COAL	D7				
		24" SHALE	C				
		23" COAL	C				
WFD-612	1521'	20" COAL	C				
WFD-613	1613'	20" COAL	C				
WFD-81	1620'	24" COAL	C				
WFD-82	1560'	24" COAL	C				
WFD-83	1580'	20" COAL	C				
WFD-91	1540'	24-30" COAL	C				
WFD-92	1461'	14.4" COAL	C				
WFD-93	1600'	18-20" COAL	C				

VITA

Barry W. Miller was born on January 30, 1957 in Harrisonburg, Virginia. He grew up and was educated in Elkton, Virginia. Barry received a B.S. in Geology from James Madison University in Virginia in 1980. He worked as a remote sensing analyst and a coal geologist for three years with the Virginia Division of Mineral Resources. After entering the Graduate School of the University of Tennessee, he worked several months as a geologist technician with the Bureau of Land Management in Wyoming. The author is a junior member of the American Association of Petroleum Geologists and a student member of the American Society of Photogrammetry and the Society of Mining Engineers. In addition to his academic interests he enjoys sports, music, and professional wrestling.