UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Geochemical analyses and summaries of carbonate rocks from Kentucky

By

Jon J. Connor

Open-file Report 81-509
1981

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey stratigraphic nomenclature

GEOCHEMICAL ANALYSES AND SUMMARIES OF CARBONATE ROCKS FROM KENTUCKY

By

Jon J. Connor

INTRODUCTION

This report summarizes results of a study of geochemical variability in the Paleozoic carbonate rocks of Kentucky. The study was undertaken as a field experiment in geochemical sampling and was based on an attempt to collect samples of carbonate rock from outcrop in an objective fashion. Kentucky is typical of many areas in the cratonic part of the eastern United States in that a combination of low relief and pervasive weathering has resulted in a general paucity of bedrock exposures. This study indicates the impact of such constraints on objective sampling. These difficulties notwithstanding, the data resulting from this study were used to identify 13 geochemical subpopulations in the Paleozoic carbonate units of Kentucky.

Kentucky was chosen for these studies because of an ongoing U.S. Geological Survey-Kentucky Geological Survey cooperative mapping program at the time sampling was undertaken (1964-1965). Although only a third or so of the state was covered by mapping at that time, the 7-1/2'-scale maps that were available formed a reasonably solid geologic-stratigraphic base for relating the samples on a regional scale. Because a prime requirement for geochemical target definition is that it be unequivocally identifiable in the field, all sampling was restricted to those areas covered by 7-1/2' quadrangle mapping at the time of sample selection.

Numerous U.S. Geological Survey mappers contributed time and effort in helping to locate outcrops for sampling across the state. Paul Elmore, L. Artis, S. Botts, G. Chloe, J. Glenn, H. Smith, D. Taylor, R. G. Havens, Nancy Conklin, and Lorraine Lee analyzed more than 200 rock samples for some 50 elements for this work. Mel Johnson made thin sections of each sample.

STRATIGRAPHIC SETTING

Carbonate rocks of Ordovician, Silurian, Mississippian, and Pennsylvanian age crop out in Kentucky (fig. 1). The Silurian rocks were not sampled in this study because of limited outcrop. The Ordovician rocks consist of as much as 500 m of calcareous strata; the upper half of which, the Cincinnatian (Upper Ordovician) Series, consists of interbedded limestone, dolomite, and calcareous shale. The intercalated shale units represent in part the distal edges of clastic units deposited during the Taconic Orogeny of the northern Appalachian region (Swann and Willman, 1961, p. 478). Near the Tennessee line, the Cincinnatian is represented by dolomite and limestone of the Cumberland and Leipers Limestone. In central Kentucky, the base of the upper half contains shallow-water, locally coarse-grained deposits of the Middle and Upper Ordovician Lexington Limestone described by Cressman (1973).

Carbonate rocks of Osagean (Lower Mississippian) age in Kentucky are represented largely by the Borden and Fort Payne Formations (Sable, 1979). They constitute a heterogeneous assortment of interbedded limestone, dolomite, sandstone, shale, siltstone and chert. Deltaic clastics are prominent to the northeast (Borden Formation), and carbonates are prominent to the southwest (Fort Payne Formation). In northeastern Kentucky, the Borden attains a thickness of more than 200 m and consists of shale, siltstone, and fine-grained silty sandstone (Chaplin and Mason, 1978). In western Kentucky the Fort Payne ranges up to 200 m in thickness (Lambert and MacCary, 1964) and consists of dark, fine-grained, cherty limestone or dolomitic limestone. In west-central and south-central Kentucky, the Borden-Fort Payne interval contains numerous coarse-grained crinoidal bioherms, which are aligned northwesterly (Thaden and others, 1961, p. B88; Kepferle, 1966). A particularly prominent bioherm (the Cane Valley Limestone Member of the Fort Payne, Kepferle and Lewis, 1974) parallels the depositional strike of the Borden delta front (Kepferle, 1977, p. 5). Bedded chert is locally prominent in this same area in outcrop. The uppermost Borden strata of east-central Kentucky are apparently time equivalents of the lowermost strata in the Salem-Warsaw interval of west-central Kentucky (Sable, Kepferle, and Peterson, 1966).

Overlying the Borden-Fort Payne interval is a highly variable thickness of nearly pure limestone of Meramecian age, which in turn is overlain by an interbedded sequence of limestone, sandstone, and shale, mostly Chesterian in age. Together, these rocks, which comprise nearly all of the Upper Mississippian Series in the State (Sable, 1979), exceed 600 m in thickness in western Kentucky, where 18 formations are recognized. These strata thin to about 200 m in south-central Kentucky (over the Cincinnati arch) and are locally absent because of pre-Pennsylvanian erosion in northeastern Kentucky.

The Meramecian strata mark the peak of Mississippian transgression in Kentucky. They consist of light- to dark-gray, fine- to coarse-grained, cherty, fossiliferous limestone. The basal units (Salem and Warsaw Formations) in the Illinois basin are commonly crossbedded, crinoidal limestone. South of St. Louis, these rocks are about 200 m thick and are a bit more argillaceous and dolomitic than to the west. Near the Ohio River, they contain as much as 60 m of anhydrite-gypsum in the subsurface (McGrain and Helton, 1964, p. 11).

The overlying Chesterian rocks thin rapidly from 300 m in the middle of the Illinois basin to less than 150 m near the Cincinnati arch about 100 km to the east. This thinning reflects both slower deposition and pre-Pennsylvanian erosion. These strata reflect the closing phases of Mississippian deposition in western Kentucky. In the Illinois basin, this phase included at least 70 reversals of shoreline movement (Swann, 1964, p. 654) before final withdrawal of the sea to the southwest (Siever, 1951, p. 575).

The Pennsylvanian rocks comprise a heterogeneous assortment of poorly sorted, interbedded sandstone, shale, siltstone, claystone, coal, conglomerate, and carbonate. They are more than 900 m thick in the Illinois basin and more than 1500 m feet thick in the Appalachian basin of southeastern Kentucky (McKee and Crosby, 1975, Pl. 11). In many outcrops, the base of these rocks is marked by a conspicuous unconformity separating interlayered, well bedded, fine-grained carbonate and clastics below from interfingering conglomeratic sandstones and carbonaceous siltstone or shale above. In eastern Kentucky, the relation of the basal conglomerate in the Lee Formation to the underlying shale of the Mississippian Pennington Formation is in dispute. Wanless (1975a, p. 23) notes the presence of intertongues of Lee-type rocks in the Pennington in both northeastern and southeastern Kentucky, and Horne, Ferm, and Swinchatt (1974) suggest that this contact may not even be disconformable.

The great bulk of the Pennsylvanian interval, however, contains no conglomerate but rather represents rapid accumulation of poorly sorted sandstone and shale with interbeds of coal and carbonaceous shale. These deposits are particularly thick in extreme southeastern Kentucky, reflecting proximity to source (Wanless, 1975a). The deposits were laid down on a large piedmont alluvial fan built from the Appalachian geosyncline westward or northwestward (Siever, 1951, p. 578). Sources of the Pennsylvanian rocks of western Kentucky apparently lay to the northeast (Wanless, 1975b).

ANALYTICAL METHODS

Each sample was trimmed of obvious weathering rinds, where possible, and about 200 g were crushed, ground and split into two parts. Duplicates from each season's collection were placed in a randomized sequence prior to submission to the laboratory in order to circumvent analytical drift. All chemical analyses were performed in laboratories of the U.S. Geological Survey. The common rock-forming oxides were determined by rapid rock methods in Washington, D.C., using methods described in Shapiro and Brannock (1962). The trace elements were determined in Denver, Colo., by a semiquantitative emission spectrographic method adapted from procedures described in Myers, Havens and Dunton (1961).

The geochemical analyses are listed in tables 1A-1E. All samples (except PT121, table 1D, and PT122, table 1E) were analyzed in duplicate. Thus in table 1A, the first two rows (OS111) are replicate analyses of a single sample; the next two rows (OS112) are replicate analyses of another sample; and so forth. Trace elements commonly looked for but rarely detected are listed in table 2 along with their approximate lower limits of determination. Conventional thin-section modes, based on 50 points per section, were counted on all samples. Average modes are listed in table 3.

SAMPLING DESIGN

Four Paleozoic carbonate units were sampled in this work; in ascending stratigraphic order, they are:

1. Carbonate rocks of Cincinnatian age
2. Carbonate rocks of Lower Mississippian age (Borden and Fort Payne Formations)
3. Carbonate rocks of Upper Mississippian age
4. Carbonate rocks of Pennsylvanian age

The same sampling design was used for each of the four units. Following collection, however, a fifth unit was recognized consisting of a small suite of sideritic nodules and concretions taken from the top of unit 3 and the base of unit 4 in eastern Kentucky. Because of the distinctive geochemistry of these nodules, they were later placed in their own category. The regional design is a hierarchical one in which each level includes paired sampling units separated by a given distance or a range of distances. The State was arbitrarily divided into one-degree areas. For each unit sampled, two 7-1/2' quadrangles (mapped) were selected randomly within each one-degree area, if possible. (For some one-degree areas and some units, only two quadrangles were available). In each 7-1/2' quadrangle two sampling localities of a size 300 by 450 m were selected randomly from those parts of the quadrangle underlain by the unit. In each locality, two random samples of 4-8 kg were taken from outcrop. The quadrangles are listed in figure 2, and the sampling sites are described in tables 4A-4D. The quadrangle pairs in each one-degree area for each unit are identified in Part II of tables 6A-6D. In one area of Fort Payne rocks, three adjacent quadrangles were used instead of two because of lack of suitably spaced outcrops.

Histograms of the theoretical, planned and actual distributions of distance between samples in each locality and between localities in each 7-1/2' quadrangle are shown in figure 3. The theoretical frequency distribution of a distance between two points in a rectangle was based on work of Ghosh (1951). The planned frequency distrbution is based on distances between sample pairs (or locality pairs) as picked in the office using randomization procedures. The actual frequency distribution is based on the distances between sample (locality) pairs that actually occurred in the field. In general the planned and actual distances are distinctly less than the theoretical distances. This is so largely because of outcrop constraints. These discrepancies in distance indicate the severity with which operational problems can influence sampling design. Theoretical and actual average distances associated with three levels of the design are compared below:

Level of sampling design and rock unit	Theoretical distance (km)	Actual distance (km)
Between samples:		
Upper Ordovician	0.27	0.12
Borden-Fort Payne	.27	.047
Upper Mississippian	.27	.038
Pennsylvanian	.27	.045
Between localities:		
Upper Ordovician	6.4	5.8
Borden-Fort Payne	6.4	3.6
Upper Mississippian	6.4	4.7
Pennsylvanian	6.4	3.7
Between quadrangles:		
Upper Ordovician	53	52
Borden-Fort Payne	53	32
Upper Mississippian	53	37
Pennsylvanian	53	22

Commonly, a randomly picked locality lacked outcrop. In such a case, samples were collected as close as possible to the randomly picked locality. The average error in sample location in both the geographic and stratigraphic sense is diagrammed in figure 4.

The sampling design is a special case of the analysis of variance. The statistical model is

$$\text{Log } X(ijklm) = M + A(i) + B(ij) + C(ijk) + D(ijkl) + E(ijklm) \quad (1)$$

where X(ijklm) represents an analytical value reported by the analyst; M represents the grand average (in logs) for that element in the sampling target and the remaining terms are deviations, each reflecting a separate source of variation. The first term, A(i), represents the difference between M and the average (in logs) for *i*th sampled one-degree area; the second, B(ij), represents the difference between the average (in logs) of the *j*th 7-1/2' quadrangle and the *i*th one-degree area; the third, C(ijk), represents the difference between the average (in logs) of the *k*th sampling locality and the *j*th 7-1/2' quadrangle; the fourth, D(ijkl), represents the difference between the average (in logs) of the *l*th sample and the *k*th locality, and the fifth, E(ijklm), represents the difference (in logs) between the observed analytical result and the true (but unknown) concentration. Logarithms of concentration in trace-element work are commonly employed to help meet some of the assumptions underlying the statistical procedures used in data analysis (Miesch, 1976, p. 7-12). The estimate of total logarithmic variance in each sampled unit is equal to the sum of the estimates of the five components defined in equation (1):

$$V(\text{Log } X) = V(A) + V(B) + V(C) + V(D) + V(E) \quad (2)$$

where V(Log X) is the total logarithmic variance.

DATA EVALUATION

Summary statistics of most of the distributions in this study are based on logarithms of the data. Thus, average values are given either as geometric means (GM) or as medians (M). In general, medians were calculated for subsets of samples containing less than 10 samples (or 20 analyses where each sample was analyzed twice), and geometric means were calculated for sample sets of 10 or more. The scatter about these averages is measured by the geometric deviation (GD), a factor useful in computing expected ranges in concentration. For example, if a distribution is lognormal, about 68 percent of the determinations in a randomly selected suite should fall within the limits GM/GD to GMxGD, and about 95 percent should fall within the range GM/GDS to GMxGDS, where GDS is the square of GD.

Where an element was censored (that is, a suite contained one or more samples in which an element concentration was too low to be measured by the analytical method used), the mean and variance of the distribution (or their logarithmic counterparts), were adjusted in an unbiased manner (Miesch, 1976, 41-46). The analysis of variance, however, requires completely uncensored data, and the following arbitrary practice was used to circumvent problems of censoring. If a third or less of the frequency distribution was censored, a value equal to approximately seven-tenths of the lower limit of determination was used in place of the censored values. (If more than a third of the distribution was censored, the constituent was not subjected to the analysis of variance.) The justification for such a replacement is that substitution of any reasonable value below the analytical limit would not substantially alter geochemical conclusions drawn from the statistical analysis. The analysis of variance results are given in tables 5A-5D.

Where the analysis of variance indicated significant differences between areas (most areas in this work being represented by a pair of sampled 7-1/2' quadrangles), median values are listed for those areas (Part II, tables 6A-6D). A basic criterion for the sufficiency of differences among these medians is the conventional F-statistic, which is based on measures of variance between and within areas. If the F-statistic is found to be statistically significant, its probable that at least one of the areas is different from some other.

A more stringent criterion, described by Miesch (1976, p. 101), requires that the mean variance ratio, v(m), exceed a value of 1.0 if differences among area means are to be viewed as reproducible. This ratio for balanced designs based on equation (1) is defined as

$$v(m) = V(A)/D \qquad (3)$$

where D is defined as

$$D = V(B)/2 + V(C)/4 + V(D)/8 + V(E)/16 \qquad (4)$$

The denominators in equation (4) are products of the number of sampling units defined at each level of the hierarchical design, which in this work was set to 2.0. Non-response in sampling and definition of geochemical subpopulations following collection, however, resulted in some of the sampling units being slightly less than 2.0. Where this happened, the resulting bias in v(m) is footnoted (tables 5C, 5D).

MINERALOGY

The normative mineralogy of the samples used in this study is shown in figure 5. Because the argillic component of a carbonate rock is expected to contain minor amounts of MgO and CaO, concentrations of these oxides were slightly adjusted prior to computation of normative dolomite and calcite. Initially, all MgO was assigned to dolomite and excess CaO was assigned to calcite. If the sum of these two normative minerals turned out to be less than 60 percent, MgO was reduced by half of a percent and CaO by a quarter of a percent, and dolomite and calcite were recomputed. If dolomite and calcite summed to less than 40 percent, the original MgO and CaO concentrations were reduced by 1 percent and 1/2 percent, respectively, and the two carbonate minerals again recomputed. If, in addition, the ratio of normative illite to normative quartz exceeded 2.0 (a clay-rich rock), the original MgO and CaO concentrations were reduced by 2 percent and 1 percent, respectively and the two carbonate minerals computed once again. FeO in excess of 2 percent was put into siderite. All Al_2O_3 was put into illite of 26 percent Al_2O_3 composition, and excess SiO_2 put into quartz. Some samples plotted in figure 5 contain more than 50 percent normative quartz and illite, most of them being concretionary or sideritic. The siderites, of course, are high in ferrous carbonate, and the concretions in general contain at least as much carbonate as either quartz or illite.

In thin section, samples of Cincinnatian age were divided into biomicrite (or biomicrudite), micrite, and medium-crystalline dolomite. The biomicrites are composed of a jumble of variably sized fragments of shells and microfossils with or without pellets set in a very fine grained micritic limestone matrix.

Variable amounts of sparry calcite cement are present in blebs and stringers, some of which fill shell voids or represent recrystallized shell fragments. Rarely, crystals of sparry calcite exhibit cores of microfossils or rounded parts of microfossils. The micrite in these rocks commonly contains minor amounts of quartz silt and clay and scattered secondary dolomite rhombs, most of them with dusty (hematitic?) cores. Rarely, the rhombs cut shell fragments or ooids. Other acessory minerals in the micrite include plagioclase, muscovite(?), chlorite(?) and pyrite. Sample UOE212 (from the Bull Fork Formation) contained a cluster of pyrite microspheres, each about 0.02 mm in diameter.

The micritic limestones of Cincinnatian age are variably silty, argillaceous and dolomitic. The silt consists largely of quartz and minor microcline and plagioclase(?) in angular grains with an average maximum diameter of about 0.05 mm. The clay material is in general too fine grained to identify but includes glauconite, chlorite, and muscovite. Opaque minerals include hematite (from oxidation of pyrite?) and anatase. Dolomite occurs as secondary rhombs of about 0.1 mm diameter scattered through the rock.

The dolomites are recrystallized rocks with a finely saccharoidal texture and consist of an interlocking network of dolomite rhombs averaging about 0.1 mm in diameter but ranging up to 0.4 mm in diameter. Dusty cores are uncommon in these rhombs, although overgrowths are present. Most of the silt in these rocks consists of quartz and feldspar of a size approximately equal to that of the rhombs.

In thin section, samples from the Lower Mississippian interval consisted largely of fine- to medium-grained limestones in outcrops of westernmost Kentucky, medium- to coarse-grained limestones (rudites) and medium-grained crystalline dolomites in central and southern Kentucky, and calcareous siltstones or silty limestones in northwestern Kentucky. The fine-grained limestones in western Kentucky are micritic with variable amounts of pellets, clasts, or fossil fragments. Silicate detritus is rare and consists of silt-sized quartz, feldspar, and mica. Brown, aphanitic pellets of phosphate(?) are also rare. Secondary rhombic dolomite is persistently present in amounts generally less than 2 percent. Sample LMQ312 contained calcite nodules as much as a millimeter across which apparently formed as void fillings.

The limestone reefs (bioherms) and the carbonate deposits associated with them in central Kentucky tend to be very coarse grained and variably dolomitic. Allochems are largely unsorted and angular and consist of clasts of fine-grained limestone, a wide variety of fossil debris and, more rarely, oolites and pellets. Sparry calcite cement is locally present. Silicate detritus is similar in kind and amount to that seen in the micritic rocks of western Kentucky but appears to be present in slightly greater amounts. Both strained and composite quartz grains were observed. Accessory minerals included plagioclase, glauconite, muscovite, brown phosphatic(?) pellets and opaques. Samples LL121 and LL122 contained 4 percent modal pyrite.

Chertification is common in the Lower Mississippian carbonates of central Kentucky. Both allochems and matrix are variably silicified. Commonly, the chert is brown and contains abundant inclusions, most of which are residual calcite. Textures indicate that chertification took place prior to dolomitization. Many samples contained 20 percent or more modal chert.

The Borden Formation in the Tygarts Valley and Westerville quadrangles is practically all clastic; only the top few meters contain small amounts of calcareous material. Samples from these quadrangles contrast greatly with carbonates from this interval in other parts of Kentucky in that they tend to be calcareous siltstones rather than limestones. Three of the samples (LE111, LE112, LME212) are limestone concretions.

The clastic material in these rocks is largely quartz. The grains are angular but well sorted and have an average diameter of about 0.05 mm. Rarely, composite or strained quartz is present. Feldspar includes fresh microcline and plagioclase, and rock fragments consist of claystone, pellitic schist, chert, and brown, cryptocrystalline grains with abundant vacuoles which may be volcanic in origin. The carbonate clastic material consists of pellets and shell fragments. Accessory minerals include large (about 1 mm diameter), brown, phosphatic(?) pellets, muscovite, biotite, chlorite, and both opaque and non-opaque minerals. Sample LME222 (a silty limestone from the Wesleyville quadrangle) contained 10 percent glauconite.

In thin section, samples of Upper Mississippian age tend to be coarse grained, well washed biosparrudites. Dolomite is pervasive and occurs as rhombs, most commonly dispersed through the finer grained parts of the rocks. Finely crystalline dolomite and siderite were collected from the Pennington of eastern Kentucky. For the most part, carbonates from the Upper Mississippian are fairly pure. The clasts are most commonly fossil debris that have been invaded by small amounts of a tan (hydrous?) variety of chert. Small amounts of quartz (about 5 percent in the norm) are present throughout. In western Kentucky, this quartz occurs as small (.01-.02 mm) subhedral to euhedral clear crystals. In central and eastern Kentucky, the quartz coarsens (up to 0.1 mm) and locally contains detrital cores. Rarer accessories include widespread pyrite (or hematitic cubes and microspheres after pyrite), rare clay, leucoxene, fish scales or bone fragments, and amphibole(?). Dispersed siderite crystals were seen in samples UMF122 and UMF212 (from the top of the Newman Formation in the Grayson and Oldtown quadrangles).

Carbonate rocks of Pennsylvanian age contrast strongly with the carbonates of older age in three ways: (1) they are a quantitatively unimportant part of the geologic unit (Pennsylvanian), (2) most are not clastic limestones but, rather, intrastratally precipitated carbonates (concretions and nodules), and (3) many are sideritic. No dolomites were sampled, although many samples contained a small amount of dolomite in the norm. In thin section, the nodular-concretionary limestones were aphanitic to fairly coarse, the coarser rocks locally consisting of feathery calcite (as much as 0.2 mm in long direction) cementing a silty or argillaceous shale. Sample PN211, a concretion from the Matewan quadrangle, contained cone-in-cone structures in the calcite. All siderites were aphanitic. Samples from the Madisonville East, Tell City, and Maceo quadrangles were ordinary, relatively pure biomicrites and pelmicrites. The remaining samples, whether calcitic or sideritic tended to be highly silty or argillaceous.

Microspheres of pyrite were locally abundant in these rocks; samples PI121 and PI122 (Madisonville West quadrangle) contained more than 40 percent modal pyrite. In addition to pyrite, the noncarbonate material in these rocks included quartz, microcline, plagioclase, phyllitic fragments, muscovite, brown biotite, chlorite and, rarely, coaly(?) fragments. Also rare were small authigenic quartz euhedra and chert.

GEOCHEMICAL VARIABILITY

The analysis of variance and the geochemical summary of each rock unit are given in tables 5A-5D and 6A-6D. In table 6A (the Cincinnatian), a summary of the Lexington Limestone, based on data in Cressman (1973), is added for comparison with the overlying carbonates. In the Cincinnatian unit, only Na_2O and Zr show significant differences among the four areas of study (V(A), table 5A), with samples from southern Kentucky (Holland and Amandaville quadrangles, table 6A) being the highest. When the limestones alone are considered (second entries in table 5A), nine common oxides and Sr show significant differences between areas. These differences obviously reflect a variation in argillic content among the areas. Argillaceous material is most common in samples from southern Kentucky and decreases in samples to the northeast, as do Na_2O and Zr. This variation may be stratigraphically controlled, as the samples from southern Kentucky come from near the middle of the section of upper Ordovician rocks whereas the samples from the northern areas tend to come more from the top of the section.

Ten of eighteen elements evaluated in carbonate rocks of the Lower Mississippian interval exhibit regionally significant components of variation (V(A), table 5B). These reflect the marked facies changes noted in this interval from the northeast (shoreward) to the southwest (offshore) parts of the State. These differences are summarized in table 6B, part II. Variation in FeO is dominated by high concentrations in the samples from the Shopville-Eli area. All of these samples came from the top of the Borden Formation (the only part of the section that contains appreciable carbonate). These carbonates are ferroan dolomites.

CaO, K_2O, H_2O+, CO_2, and Ni also show unusual values in just one of the areas, the Adolphus and Meador quadrangles near the top of the Cincinnati arch. Samples from this area were the most cherty of the interval. As noted above, this chert is commonly brown and full of inclusions or vacuoles. If this chert is hydrous, it could account for the high H_2O+, and perhaps for the high K_2O as well, which is one of the most soluble of cations. Perhaps the unusually high Ni in these rocks was also introduced by the chertification process.

The analysis of variance of the carbonate rocks of Upper Mississippian age are shown in table 5C. Seven entries exhibit significant regional variation (V(A), table 5C). These differences are summarized in Part II, table 6C. Much of this variation results from the dolomitic and sideritic nature of the samples from the Barthell-Sawyer area; Fe_2O_3, FeO, MgO, and CaO reflect this. V is distinctly high in samples collected over the Cincinnati arch (and, thus, collected near the base of the unit), but the reason for the high V is unknown. Similarly, the variation in SiO_2 and Sr is unexplained.

The analysis of variance of the Pennsylvanian carbonates is given in table 5D. Eleven constituents in the combined limestone-concretion group exhibit significant regional variation (V(A), table 5D). Six constituents in the concretion group exhibit such variation. These differences are shown in table 6D, Part II. Much of the variation in the combined group reflects the more calcareous nature of the carbonate in western Kentucky, which was closer to the open ocean during deposition of these rocks; Al_2O_3, Na_2O, K_2O, Cr, Ti, V, and Zr (all argillic components), are low in these rocks. MgO and Ba are low in samples from the Maceo-Tell City area, probably reflecting a purer, less dolomitic rock there. Sideritic rocks of upper Mississippian-lower Pennsylvanian age are summarized in table 6D.

The highly variable nature of these rocks is demonstrated in figure 6. The individual frequency distributions given in this figure are visual representations based on the summary data in tables 6A-6D. The summary data in turn was organized, in part, according to the statistical tests given in tables 5A-5D. The distributions demonstrate that much of the geochemical variability in these rocks arises as a consequence of the presence of distinct geochemical subpopulations within each major geologic unit. In particular, limestone and dolomite tend to differ in many elements, and much of this difference reflects the tendency for dolomitic rocks to be more argillaceous than nondolomitic ones. The argillic material (mostly clay) constitutes a ready reservoir of a variety of trace elements, in contrast to the carbonate minerals calcite and dolomite, whose stoichiometric constraints preclude much elemental substitution in the crystal lattice.

Similarly, variation arising as a result of geographic location (differences among area means, Part II, tables 6A-6D) mostly reflects geographic differences in argillaceous or arenaceous content. Variation not specifically identified in the diagrams includes variation described by the intermediate-scaled components listed in tables 5A-5D. Such variation commonly accounts for more than half the total; it represents geochemical differences among samples within localities, V(D), among localities within quadrangles, V(C), and among quadrangles within one-degree areas, V(B). Much of the variation at these levels reflects variation in the major mineral constituents among samples. Finally, part of the variation in each distribution reflects laboratory errors, V(E).

The fitted distributions range from good to poor; some are distinctly bimodal, particularly in the Pennsylvanian carbonates, where the carbonate consists of both clastic and precipitated material. Highly censored histograms tend to display very broad or unusually shaped distributions (Mo in the Pennsylvanian and the Upper Mississippian carbonates, for example). Some histograms are, for all practical purposes, based on a a 3-step, rather than a 6-step, reporting interval (Cu, Ti, Mn), reflecting the inability of the analyst to "see" the intermediate line densities of the spectrum for these elements. Nevertheless, the diagrams are meant to provide a "first approximation" to the definition of the geochemical distributions in the Paleozoic platform carbonates of Kentucky.

REFERENCES CITED

Chaplin, James R., and Mason, Charles E., 1978, Geologic map of the Garrison quadrangle, Kentucky-Ohio, and part of the Pond Run quadrangle, Lewis County, Kentucky: U.S. Geological Survey Map GQ-1490.

Cressman, Earle R., 1973, Lithostratigraphy and depositional environments of the Lexington Limestone (Ordovician) of central Kentucky: U.S. Geological

Survey Professional Paper 768, 61 p.

Crider, A. F., 1913, Economic geology of the Tell City and Owensboro quadrangles: Kentucky Geological Survey, Ser. 4, v. 1, p. 263-316.

Ghosh, Birendranath, 1951, Random distances within a rectangle and between two rectangles: Calcutta Mathematical Society Bulletin, v. 43, p. 17-24.

Horne, John C., Ferm, John C., and Swinchatt, Jonathan P., 1974, Depositional model for the Mississippian-Pennsylvanian boundary in northeastern Kentucky: Geological Society of America Special Paper 148, p. 97, 114.

Kepferle, R. C., 1966, Geologic map of the Elizabethtown quadrangle, Hardin and Larue Counties, Kentucky: U.S. Geol. Survey Map GQ-559.

-------, 1977, Stratigraphy, petrology, and depositional environment of the Kenwood Siltstone Member, Borden Formation (Mississippian), Kentucky and Indiana: U.S. Geological Survey Professional Paper 1007, 49 p.

Kepferle, R. C., and Lewis, R. Q., Sr., 1974, Knifely Sandstone and Cane Valley Limestone--Two new members of the Fort Payne Formation (Lower Mississippian) in south-central Kentucky, _in_ Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1972: U.S. Geological Survey Bulletin 1394-A, p. A63-A70.

Lambert, T. W., and MacCary, L. M., 1964, Geology of the Briensburg quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-327.

McGrain, Preston, and Helton, W. L., 1964, Gypsum and anhydrite in the St. Louis Limestone in northwestern Kentucky: Kentucky Geological Survey, Ser. 10, Information Circular 13, 26 p.

McKee, E. D., and Crosby, E. J., coordinators, 1975, Paleotectonic investigations of the Pennsylvanian System in the United States: U.S. Geological Survey Professional Paper 853, 192 p.

Miesch, A. T., 1976, Sampling designs for geochemical surveys--Syllabus for a short course: U.S. Geological Survey Open-File Report 76-772, 128 p.

Myers, A. T., Havens, R. G., and Dunton, P. J., 1961, A spectrochemical method for the semiquantitative analysis of rocks, minerals and ores: U.S. Geological Survey Bulletin 1084-I, p. 1207-1229.

Sable, Edward G., 1979, Eastern interior basin region, _in_ Paleotectonic investigations of the Mississippian System in the United States, Part I, Introduction and regional analyses of the Mississippian System: U.S. Geological Survey Professional Paper 1010, p. 59-106.

Sable, E. G., Kepferle, R. C., and Peterson, W. L., 1966, Harrodsburg Limestone in Kentucky: U.S. Geological Survey Bulletin 1224-I, p. I1-I12.

Shapiro, Leonard, and Brannock, W. W., 1962, Rapid analysis of silicate, carbonate, and phosphate rocks: U.S. Geological Survey Bulletin 1144-A, 56 p.

Siever, Raymond, 1951, The Mississippian-Pennsylvanian unconformity in southern Illinois: American Association Petroleum Geologists Bulletin, v. 35, no. 3, p. 542-581.

Swann, D. H., 1964, Late Mississippian rythmic sediments of Mississippi Valley: American Association Petroleum Geologists Bulletin, v. 48, no. 5, p. 637-658.

Swann, David H., and Willman, H. B., 1961, Megagroups in Illinois: American Association Petroleum Geologists Bulletin, v. 45, no. 4, p. 471-483.

Thaden, Robert E., Lewis, Richard Q., Sr., Cattermole, J. Mark, and Taylor, Alfred R., 1961, Reefs in the Fort Payne Formation of Mississippian age, south-central Kentucky, in Geological Survey Research 1961: U.S. Geological Survey Professional Paper 424-B, p. B88-B90.

Wanless, Harold R., 1975a, Appalachian region in Paleotectonic investigations of the Pennsylvanian System in the United States, Part I, Introduction and regional analyses of the Pennsylvanian System: U.S. Geological Survey Professional Paper 853, p. 17-62.

-------, 1975b, Illinois basin region in Paleotectonic investigations of the Pennsylvanian System in the United States, Part I, Introduction and regional analyses of the Pennsylvanian System: U.S. Geological Survey Professional Paper 853, p. 71-96.

Table 1A.--Chemical analyses of selected carbonate rocks of Cincinnatian age in Kentucky. [%, percent; ppm, parts per million; N, not detected; leaders (--) indicate no data; labels ending in "-S" are spectrographic determinations]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
OS111	36 38 0	86 0 0	118,228	11.8	1.50	.20	1.50	16.20	27.6	<.01	.33
OS111	36 38 0	86 0 0	118,488	11.7	1.20	.35	1.50	15.70	28.4	.19	.41
OS112	36 38 0	86 0 0	118,356	10.8	1.80	.49	1.10	17.20	26.1	N	.47
OS112	36 38 0	86 0 0	118,438	10.7	1.80	.38	1.20	15.60	28.7	.16	.49
OS121	36 38 0	86 0 0	118,253	17.7	3.20	.15	.70	13.30	27.1	.22	.83
OS121	36 38 0	86 0 0	118,500	18.0	3.00	.77	.66	14.00	25.8	.14	.87
OS122	36 38 0	86 0 0	118,262	25.0	3.70	.65	.86	13.20	22.8	.46	.79
OS122	36 38 0	86 0 0	118,289	24.6	3.20	.72	.62	13.30	22.4	.48	.79
OS211	36 53 0	85 15 0	118,151	22.7	2.90	.31	.52	4.10	35.6	.51	.63
OS211	36 53 0	85 15 0	118,345	22.3	2.40	.47	.48	3.60	36.4	.42	.78
OS212	36 53 0	85 15 0	118,334	18.7	3.00	.93	.34	3.50	38.3	.17	.79
OS212	36 53 0	85 15 0	118,351	19.1	2.80	.88	.38	3.10	38.0	.36	.74
OS221	36 53 0	85 15 0	118,318	32.2	3.80	.50	.64	3.40	29.8	.36	.99
OS221	36 53 0	85 15 0	118,436	32.4	3.30	.72	.62	3.20	30.0	.69	1.00
OS222	36 53 0	85 15 0	118,121	17.5	2.20	.31	.28	2.30	39.8	.43	.52
OS222	36 53 0	85 15 0	118,450	16.7	2.30	.37	.54	2.00	41.6	.59	.63
UOK311	37 38 0	85 30 0	121,038	6.2	1.50	.42	.32	3.50	46.5	.22	.59
UOK311	37 38 0	85 30 0	120,988	6.4	1.20	.32	.32	3.00	46.4	.26	.46
UOK312	37 38 0	83 30 0	121,046	12.1	1.60	.32	.28	1.70	45.3	.29	.35
UOK312	37 38 0	85 30 0	121,064	12.8	1.60	.28	.32	1.70	44.6	.39	.58
UOK321	37 38 0	85 30 0	121,051	10.6	3.00	.79	1.10	15.40	28.2	.14	.80
UOK321	37 38 0	85 30 0	121,013	9.7	2.50	.79	.92	15.70	28.4	.28	.94
UOK322	37 38 0	85 30 0	121,023	4.1	.83	2.00	2.70	16.40	28.5	.15	.25
UOK322	37 38 0	85 30 0	120,981	3.9	.85	1.50	3.10	15.50	30.2	.18	.31
OK211	37 8 0	85 0 0	118,122	17.5	3.50	.90	.36	2.70	39.2	.24	1.10
OK211	37 8 0	85 0 0	118,377	17.3	3.70	.76	.58	2.60	39.3	.26	1.10
OK212	37 8 0	85 0 0	118,147	7.5	2.00	.67	.28	1.00	48.5	.33	.42
OK212	37 8 0	85 0 0	118,427	8.8	1.40	.56	.26	.95	48.1	<.01	.59
OK221	37 8 0	85 0 0	118,314	22.5	2.70	1.00	.42	2.60	36.9	.17	.70
OK221	37 8 0	85 0 0	118,325	22.9	3.10	1.40	N	2.60	36.7	N	.82
OK222	37 8 0	85 0 0	118,189	22.0	2.60	.89	.46	2.40	37.4	.35	1.10
OK222	37 8 0	85 0 0	118,213	21.4	2.50	.41	.46	2.50	37.8	N	.83
OK111	37 8 0	84 53 0	118,110	25.7	6.80	1.70	.86	12.70	18.8	.16	1.90
OK111	37 8 0	84 53 0	118,343	25.5	7.10	2.00	.94	12.40	18.8	.27	2.00
OK112	37 8 0	84 53 0	118,443	24.0	6.80	1.60	.90	12.50	20.9	.19	1.80
OK112	37 8 0	84 53 0	118,285	23.6	5.90	1.60	.84	13.40	20.3	.32	1.50
OK121	37 8 0	84 53 0	118,160	14.0	3.80	1.50	.98	15.10	25.8	.16	1.00
OK121	37 8 0	84 53 0	118,184	12.8	3.40	1.60	1.10	14.40	26.0	N	1.10
OK122	37 8 0	84 53 0	118,136	17.8	5.10	1.40	1.60	13.80	23.9	N	1.40
OK122	37 8 0	84 53 0	118,142	18.2	5.10	1.30	1.00	13.40	24.0	.24	1.40
UOL211	37 45 0	84 22 0	121,035	3.7	1.00	.39	.12	.78	51.8	.14	.33
UOL211	37 45 0	84 22 0	120,979	3.9	.85	.41	.12	.76	51.6	.30	.40
UOL212	37 45 0	84 22 0	121,039	6.2	1.20	.41	.20	2.10	48.7	.12	.54
UOL212	37 45 0	84 22 0	121,020	5.7	.95	.53	.24	2.00	48.8	.15	.49
UOL221	37 45 0	84 22 0	121,053	16.2	3.30	1.00	.42	.95	42.3	.18	1.10
UOL221	37 45 0	84 22 0	121,060	17.3	3.90	1.20	.36	.89	40.8	.18	1.40
UOL222	37 45 0	84 22 0	120,987	3.1	.65	.36	.16	1.20	52.1	.26	.37
UOL222	37 45 0	84 22 0	121,024	3.6	.93	.34	.16	1.40	51.3	.14	.27
OD111	38 23 0	83 30 0	118,363	3.9	1.20	.93	2.70	17.80	28.4	N	.20
OD111	38 23 0	83 30 0	118,517	3.2	1.10	1.00	2.60	15.00	32.5	N	.11

Table 1A.--Cont.

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
OS111	.55	.08	.14	.27	.08	39.6	1.5	10.0	>10	.050	200
OS111	.43	.03	.12	.26	.05	39.7	1.5	7.0	>10	.020	200
OS112	.55	.11	.11	.15	.06	40.2	1.0	10.0	>10	.050	200
OS112	.50	.12	.13	.11	<.01	40.0	1.5	10.0	10	.050	500
OS121	.58	.37	.28	.28	.07	35.1	1.0	5.0	>10	.100	500
OS121	.63	.14	.24	.27	.05	35.3	1.0	10.0	>10	.100	200
OS122	.59	.15	.31	.19	.04	31.3	1.0	5.0	>10	.100	300
OS122	.75	.16	.29	.16	.07	31.9	.2	1.0	>10	.010	50
OS211	.43	.13	.19	.56	.14	31.3	.5	1.5	>10	.100	700
OS211	.56	.09	.18	.58	.12	31.5	.5	1.0	>10	.100	500
OS212	.57	.12	.19	.34	.08	32.8	1.0	1.0	>10	.100	500
OS212	.83	.02	.18	.34	.08	32.4	.7	1.0	>10	.100	300
OS221	.61	.14	.40	.62	.09	26.3	.7	1.0	>10	.150	500
OS221	.73	.15	.29	.58	.07	26.2	.5	1.5	10	.150	300
OS222	.21	.11	.19	.67	.11	34.9	.5	1.0	>10	.100	500
OS222	.45	.09	.21	.64	.06	33.7	.5	.5	>10	.050	500
UOK311	.66	.03	.03	.29	.18	39.5	.7	2.0	>10	.050	500
UOK311	.74	.09	.09	.29	.13	39.8	.7	2.0	>10	.070	500
UOK312	.62	.02	.06	.40	.18	36.0	.5	1.0	>10	.050	700
UOK312	.44	<.01	.08	.37	.12	36.4	.7	1.0	>10	.070	700
UOK321	1.20	.08	.11	.03	.04	38.4	>10.0	10.0	>10	.050	500
UOK321	1.40	.09	.17	<.01	.09	39.1	1.5	7.0	>10	.050	200
UOK322	1.80	.04	<.01	.03	.21	42.9	5.0	7.0	>10	.015	1,000
UOK322	.55	.08	.06	<.01	.13	43.6	5.0	10.0	>10	.020	1,000
OK211	.79	.31	.22	.30	.13	32.3	1.0	2.0	>10	.150	700
OK211	.75	.35	.23	.27	.10	32.5	1.0	.7	>10	.050	500
OK212	.54	.13	.10	.11	.13	38.2	.5	.5	>10	.050	500
OK212	2.20	.13	.11	<.01	.08	36.4	.5	.2	>10	.030	500
OK221	.73	.18	.21	.44	.11	31.2	1.0	.5	>10	.100	500
OK221	.71	.17	.21	.42	.12	30.7	1.0	.5	>10	.050	500
OK222	.79	.17	.18	.39	.12	31.0	1.0	1.0	>10	.070	500
OK222	.79	.17	.20	.43	.13	31.7	1.0	1.0	>10	.050	500
OK111	1.60	.27	.39	.18	.16	28.0	2.0	7.0	>10	.200	700
OK111	1.50	.27	.38	.18	.14	27.7	1.0	5.0	10	.150	500
OK112	1.40	.28	.38	.09	.08	28.9	1.5	2.0	7	.150	500
OK112	1.30	.29	.34	.13	.10	29.6	1.5	7.0	10	.100	500
OK121	.93	.17	.11	.19	.16	35.7	1.5	10.0	>10	.100	1,000
OK121	1.80	.14	.18	.19	.18	36.9	2.0	1.0	>10	.050	1,000
OK122	1.20	.26	.27	.16	.15	32.6	2.0	7.0	>10	.150	500
OK122	1.40	.23	.27	.13	.15	33.1	2.0	10.0	>10	.150	1,000
UOL211	.35	<.01	<.01	.09	.37	40.8	.5	.5	>10	.020	700
UOL211	.46	.07	.06	.18	.13	40.6	.5	.5	>10	.030	700
UOL212	.47	<.01	.04	.26	.21	39.5	.7	1.0	>10	.050	700
UOL212	.47	.04	.10	.26	.13	40.2	.5	1.5	>10	.050	1,000
UOL221	1.30	.16	.20	.42	.07	32.3	1.5	.7	>10	.150	1,000
UOL221	.48	.16	.21	.45	.03	32.6	1.0	.5	>10	.150	1,000
UOL222	.32	.09	.07	.19	.13	41.0	.5	1.0	>10	.030	700
UOL222	.55	.02	<.01	.25	.13	40.5	.5	.7	>10	.020	500
OD111	.41	.08	.06	.22	.16	43.1	2.0	7.0	>10	.010	500
OD111	.63	.13	.04	.21	.14	42.5	3.0	10.0	>10	.020	1,000

Table 1A.--Cont.

SAMPLE	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
OS111	<50	50	N	N	5	5	N	N	N	N
OS111	<50	30	N	N	5	5	N	N	N	N
OS112	<50	100	N	N	5	<2	N	N	N	N
OS112	<50	70	N	N	10	2	N	N	N	N
OS121	50	100	N	N	15	15	N	10	N	N
OS121	50	100	N	N	20	10	N	<10	20	N
OS122	50	100	N	N	15	10	N	<10	20	N
OS122	<50	20	N	N	20	2	N	N	N	N
OS211	50	100	N	N	15	7	N	20	N	N
OS211	<50	70	N	<7	15	5	N	N	N	N
OS212	50	70	N	N	15	5	N	<10	30	N
OS212	<50	100	N	N	10	5	N	<10	20	N
OS221	50	100	N	N	20	5	N	N	20	N
OS221	N	100	N	N	20	5	N	N	N	N
OS222	<50	70	<2	N	10	5	N	N	N	N
OS222	<50	50	N	N	10	2	N	N	N	N
UOK311	<50	50	N	N	15	5	N	<10	20	N
UOK311	50	50	N	N	15	5	N	<10	N	N
UOK312	<50	50	N	N	10	5	N	20	N	N
UOK312	<50	70	N	N	10	5	N	15	20	N
UOK321	50	70	N	7	20	7	N	20	20	N
UOK321	50	50	N	7	20	7	N	<10	<20	N
UOK322	<50	20	N	N	10	7	N	10	N	N
UOK322	50	30	N	7	10	10	N	10	20	N
OK211	50	100	<2	N	20	5	N	N	N	N
OK211	<50	100	N	N	15	5	N	<10	20	N
OK212	<50	50	N	N	10	5	N	10	20	N
OK212	<50	50	N	N	10	5	N	N	<20	N
OK221	50	70	N	N	15	5	N	<10	20	N
OK221	50	70	N	N	15	5	N	10	20	N
OK222	N	70	N	N	15	7	10	10	N	N
OK222	50	50	N	N	15	5	N	N	N	N
OK111	100	200	5	10	30	15	N	15	20	10
OK111	50	150	N	<7	20	10	N	10	20	10
OK112	70	150	N	7	30	10	N	10	20	N
OK112	70	150	N	10	30	10	N	10	20	N
OK121	50	100	N	7	20	7	N	20	20	<10
OK121	50	100	N	N	30	10	N	15	20	N
OK122	50	150	N	N	30	10	N	20	20	N
OK122	50	150	N	7	20	10	N	10	20	N
UOL211	<50	30	N	N	5	2	N	10	20	N
UOL211	50	30	N	N	15	5	N	<10	20	N
UOL212	<50	50	N	N	10	7	N	<10	20	N
UOL212	<50	50	N	N	10	5	N	<10	20	N
UOL221	50	150	N	<7	30	5	N	20	N	N
UOL221	50	150	N	7	30	7	N	15	20	10
UOL222	<50	30	N	N	5	2	N	<10	N	N
UOL222	<50	20	N	N	5	2	N	10	20	N
OD111	N	20	N	7	5	10	N	10	20	N
OD111	N	20	N	N	5	10	N	10	20	N

Table 1a.--Cont.

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zn ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
OS111	150	<15	N	N	100	.7	N	N	<2
OS111	150	15	<20	N	100	.5	N	N	<2
OS112	150	15	N	N	50	.7	N	<10	N
OS112	150	15	N	N	50	.7	N	N	N
OS121	200	20	N	N	70	1.0	1.5	<10	<2
OS121	200	20	<20	N	100	.2	1.5	N	<2
OS122	150	20	N	N	70	1.0	1.5	<10	2
OS122	1,000	20	N	N	N	.5	N	N	N
OS211	300	20	20	N	70	1.5	N	<10	2
OS211	300	<15	<20	N	70	1.0	N	N	<2
OS212	500	20	N	N	50	1.0	1.5	N	<2
OS212	300	15	N	N	50	1.0	1.5	<10	N
OS221	300	20	<20	N	100	1.5	2.0	10	<2
OS221	300	20	<20	N	N	1.5	2.0	<10	<2
OS222	500	20	20	N	70	1.0	N	N	2
OS222	300	15	<20	N	50	1.0	N	N	N
UOK311	700	20	N	N	50	1.0	N	N	<2
UOK311	700	15	N	N	50	1.0	N	N	N
UOK312	300	<15	N	N	50	.7	N	N	N
UOK312	700	15	<20	N	50	1.0	N	<10	<2
UOK321	200	20	N	N	50	1.0	1.5	<10	<2
UOK321	150	20	N	N	50	1.5	1.5	<10	N
UOK322	150	<15	N	1,500	N	.5	N	N	N
UOK322	200	20	20	3,000	50	.7	N	N	N
OK211	300	20	20	N	50	2.0	1.5	N	2
OK211	500	20	<20	N	50	1.0	1.5	<10	<2
OK212	700	15	N	N	50	1.0	N	N	N
OK212	700	15	N	N	N	1.0	N	<10	N
OK221	500	20	<20	N	70	1.5	1.5	<10	<2
OK221	500	15	N	N	50	1.0	2.0	<10	<2
OK222	500	20	20	N	70	1.0	1.5	10	2
OK222	500	20	<20	N	70	1.0	1.5	<10	2
OK111	150	50	20	N	50	3.0	3.0	10	2
OK111	150	50	<20	N	50	2.0	5.0	10	<2
OK112	150	50	<20	N	50	2.0	5.0	15	<2
OK112	150	50	<20	N	50	2.0	N	10	<2
OK121	200	50	<20	N	50	2.0	2.0	10	2
OK121	200	30	<20	N	50	1.5	1.5	10	<2
OK122	200	50	N	N	50	2.0	2.0	10	<2
OK122	200	50	N	N	50	2.0	2.0	10	<2
UOL211	1,000	<15	N	N	20	.5	N	N	N
UOL211	2,000	15	N	N	20	1.0	N	N	N
UOL212	1,500	20	N	N	50	.7	N	N	2
UOL212	1,000	15	N	N	50	.7	N	N	N
UOL221	700	50	20	N	70	2.0	3.0	10	2
UOL221	700	30	20	N	100	2.0	2.0	10	1
UOL222	1,000	15	N	N	50	.7	N	N	N
UOL222	1,000	<15	N	N	20	.7	--	N	N
OD111	150	15	<20	N	N	.5	N	N	<2
OD111	150	15	20	N	N	.5	N	N	2

Table 1A.--Cont.

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
OD112	38 23 0	83 30 0	118,215	4.7	.71	.73	2.70	16.10	30.9	<.01	.12
OD112	38 23 0	84 20 0	118,240	4.2	.81	.63	2.70	15.30	32.4	<.01	.23
OD121	38 23 0	83 30 0	118,312	1.3	.87	.59	.30	.84	52.5	<.01	.38
OD121	38 23 0	83 30 0	118,405	1.2	.39	.49	.42	.95	52.9	.13	.39
OD122	38 23 0	83 30 0	118,279	2.1	.56	.36	.58	1.90	52.0	<.01	.28
OD122	38 23 0	83 30 0	118,309	2.1	.55	.40	.48	1.80	51.7	<.01	.12
UOE211	38 38 0	83 30 0	121,057	4.4	1.50	.75	.68	1.00	49.7	.12	.50
UOE211	38 38 0	83 30 0	121,016	4.1	1.60	.74	.60	1.00	50.2	N	.55
UOE212	38 38 0	83 30 0	120,994	3.2	1.20	.40	.64	1.90	50.5	.22	.39
UOE212	38 38 0	83 30 0	121,040	3.1	1.30	.50	.64	1.80	49.5	N	.37
UOE221	38 38 0	83 30 0	120,982	2.0	.46	.39	.36	2.00	51.0	N	.19
UOE221	38 38 0	83 30 0	121,056	2.5	.93	.37	.36	1.70	50.4	.12	.21
UOE222	38 38 0	83 30 0	121,005	7.0	1.70	.26	.76	1.80	47.4	.15	.70
UOE222	38 38 0	83 30 0	121,030	7.2	2.10	.45	.68	1.90	47.5	.30	.38

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
OD112	.55	.11	.06	.26	.17	42.2	2.0	10.0	>10	.015	700
OD112	.64	.10	.06	.24	.15	42.1	2.0	10.0	>10	.010	200
OD121	.32	.08	.04	.14	.07	41.7	.5	.2	>10	.005	300
OD121	.29	.09	.03	<.01	.07	42.1	.5	.1	>10	.007	500
OD122	.35	.07	.03	.06	.09	41.7	.7	.5	>10	.010	500
OD122	.29	.13	.04	.07	.08	41.5	.5	.5	>10	.010	500
UOE211	.56	.03	.03	.06	.18	40.1	.7	1.0	>10	.020	1,000
UOE211	.54	.03	.10	.10	.07	40.2	1.0	.7	>10	.020	1,000
UOE212	.56	.06	.07	.05	.18	40.4	1.0	1.0	>10	.020	1,000
UOE212	.33	<.01	--	.05	.18	41.4	1.0	1.0	>10	.050	1,000
UOE221	.28	.09	.06	.08	.04	42.4	.5	1.0	>10	.020	700
UOE221	.39	.03	<.01	.09	.14	42.0	.7	1.0	>10	.020	700
UOE222	.60	.04	.12	.21	.02	38.2	1.0	1.0	>10	.050	1,500
UOE222	.62	<.01	<.01	.18	.22	38.2	1.0	1.0	>10	.070	1,500

Table 1A.--Cont.

SAMPLE	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
OD112	N	20	N	7	5	20	N	N	20	N
OD112	<50	20	N	7	5	15	N	N	20	N
OD121	<50	10	N	N	5	5	N	<10	20	N
OD121	<50	50	N	N	2	5	15	N	<20	N
OD122	<50	20	N	N	5	5	N	N	N	N
OD122	<50	30	N	N	5	5	N	N	N	N
UOE211	<50	1,500	N	N	10	5	N	10	20	N
UOE211	<50	30	N	N	10	7	N	<10	20	N
UOE212	70	300	N	N	5	5	N	<10	N	N
UOE212	<50	200	N	N	10	5	N	10	20	N
UOE221	<50	1,500	N	N	10	7	N	<10	N	N
UOE221	<50	2,000	N	N	5	5	N	10	20	N
UOE222	<50	2,000	N	N	15	7	N	10	N	N
UOE222	<50	3,000	N	<7	15	7	N	10	N	N

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zn ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
OD112	150	<15	<20	N	N	.5	N	N	<2
OD112	100	15	20	N	N	.5	N	N	2
OD121	700	N	N	N	N	.2	N	N	N
OD121	700	<15	N	N	N	.5	N	N	N
OD122	500	<15	N	N	N	.5	N	N	N
OD122	500	15	N	N	N	.5	N	N	N
UOE211	700	<15	N	N	N	.3	N	N	<2
UOE211	500	15	N	N	N	.7	N	N	<2
UOE212	500	15	N	N	N	.7	N	N	N
UOE212	700	20	N	N	20	.7	N	N	2
UOE221	500	N	N	N	50	.7	N	N	N
UOE221	500	N	N	N	50	.3	N	N	N
UOE222	700	20	<20	N	30	1.5	N	<10	N
UOE222	1,000	20	<20	N	50	1.5	N	<10	<2

Table 1B.--Chemical analyses of carbonate rocks of Lower Mississippian age in Kentucky. [%, percent; ppm, parts per million; N, not detected; labels ending in "-S" are spectrographic determinations]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
LH111	37 0 0	88 8 0	118,137	10.6	1.00	.40	.26	1.70	46.6	<.01	.26
LH111	37 0 0	88 8 0	118,157	9.7	.48	.94	.60	1.90	46.4	.13	.33
LH112	37 0 0	88 8 0	118,367	12.5	.69	.25	.14	1.90	45.6	N	.11
LH112	37 0 0	88 8 0	118,486	11.9	.76	.26	.14	1.90	45.6	N	N
LH121	37 0 0	88 8 0	118,293	30.2	.24	N	N	.84	38.1	N	.27
LH121	37 0 0	88 8 0	118,372	28.5	.51	<.01	N	.88	38.5	<.01	.12
LH122	37 0 0	88 8 0	118,218	8.6	.23	<.01	<.01	2.30	47.7	<.01	.10
LH122	37 0 0	88 8 0	118,361	8.4	.67	.10	N	2.30	47.6	<.01	.17
LH211	37 0 0	88 0 0	118,145	19.7	2.40	.66	.20	.74	41.6	N	<.01
LH211	37 0 0	88 0 0	118,196	20.5	2.10	.88	.20	.66	41.2	<.01	.57
LH212	37 0 0	88 0 0	118,317	13.8	1.50	.72	.18	.98	44.9	<.01	.10
LH212	37 0 0	88 0 0	118,326	13.3	1.80	.59	.16	.97	45.4	<.01	.26
LH221	37 0 0	88 0 0	118,212	8.8	1.10	<.01	.14	1.90	47.5	<.01	.15
LH221	37 0 0	88 0 0	118,471	8.8	.57	.29	N	1.70	48.2	N	.79
LH222	37 0 0	88 0 0	118,225	10.1	.46	<.01	<.01	1.80	47.3	<.01	.12
LH222	37 0 0	88 0 0	118,410	9.7	.54	.17	N	1.70	47.7	.16	.45
LMQ311	36 45 0	88 8 0	121,029	16.0	1.20	.34	.16	2.00	43.6	.22	.35
LMQ311	36 45 0	88 8 0	121,009	15.6	1.20	.31	.12	1.80	43.3	.12	.41
LMQ312	36 45 0	88 8 0	121,031	19.8	1.60	.43	N	1.00	42.1	.18	.31
LMQ312	36 45 0	88 8 0	121,027	18.6	1.40	.34	.16	1.00	42.5	.22	.41
LMQ321	36 45 0	88 7 59	121,059	24.4	1.90	.55	.20	.98	39.2	.13	.38
LMQ321	36 45 0	88 8 0	121,000	24.3	2.50	.36	.24	1.00	39.0	.22	.47
LMQ322	36 45 0	88 8 0	121,002	25.7	.75	.28	.24	1.20	38.5	.12	.26
LMQ322	36 45 0	88 8 0	121,011	24.6	.75	1.10	.28	1.10	38.8	.10	.31
LP121	36 45 0	87 52 59	118,242	4.2	.42	N	N	2.10	50.7	N	.13
LP121	36 45 0	87 53 0	118,498	4.3	.25	N	.10	2.10	50.5	<.01	N
LP122	36 45 0	87 53 0	118,288	3.2	.70	.14	N	2.20	50.8	.13	.23
LP122	36 45 0	87 53 0	118,324	3.4	N	N	N	2.20	50.8	<.01	<.01
LP212	36 45 0	88 0 0	118,487	19.8	.46	.19	.14	1.10	42.6	N	.39
LP212	36 45 0	88 0 0	118,507	20.4	.74	.22	N	1.00	42.6	<.01	.12
LP222	36 45 0	88 0 0	118,128	47.4	.94	.20	.14	.89	26.9	N	.22
LP222	36 45 0	88 0 0	118,473	48.6	.76	.28	.10	.99	26.1	N	.87
LR111	36 38 0	86 15 0	118,158	57.4	3.90	1.10	.38	1.30	17.5	.28	1.20
LR111	36 38 0	86 15 0	118,294	57.1	4.40	1.20	.22	.82	18.5	.14	1.00
LR112	36 38 0	86 15 0	118,255	43.1	2.20	<.01	<.01	.94	28.6	N	.56
LR112	36 38 0	86 15 0	118,286	44.1	1.70	.58	.32	.97	28.8	.10	.64
LR121	36 38 0	86 15 0	118,159	57.7	1.80	.93	.34	3.00	17.2	.19	.57
LR121	36 38 0	86 15 0	118,194	63.2	1.60	.54	.30	2.60	16.0	<.01	.49
LR122	36 38 0	86 15 0	118,257	36.6	1.50	<.01	<.01	1.80	32.1	N	.51
LR122	36 38 0	86 15 0	118,292	36.7	1.60	.34	.22	1.80	31.8	.11	.39
LR211	36 53 0	86 8 0	118,391	48.2	5.70	1.10	.66	9.00	13.6	.14	1.30
LR211	36 53 0	86 8 0	118,442	49.2	5.60	1.10	.66	8.40	12.6	.24	1.30
LR212	36 53 0	86 8 0	118,174	51.2	4.70	1.00	.72	8.10	12.2	.17	1.70
LR212	36 53 0	86 8 0	118,407	51.6	5.20	.93	.70	7.70	12.5	.36	1.30
LR221	36 53 0	86 8 0	118,178	38.1	4.90	1.10	.72	10.70	16.0	.16	1.60
LR221	36 53 0	86 8 0	118,298	38.3	5.20	1.00	.70	10.80	15.9	.29	1.20
LR222	36 53 0	86 8 0	118,256	32.2	.20	N	N	4.40	32.3	N	.25
LR222	36 53 0	86 8 0	118,418	31.8	.54	.80	.14	4.50	32.0	<.01	.27
LK111	37 0 0	85 53 0	118,119	30.2	2.20	.76	.40	13.00	21.4	<.01	.44
LK111	37 0 0	85 53 0	118,431	30.7	1.30	.88	N	11.80	23.1	.19	.41

Table 1B.--Cont.

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
LH111	.64	.11	.05	.07	.05	37.8	.20	1.0	>10	.020	70
LH111	.51	.11	.05	.06	.08	38.1	.50	.5	>10	.030	70
LH112	.56	.09	.07	.06	.02	37.6	.20	.5	>10	.020	50
LH112	.24	.22	.06	.08	<.01	37.8	.30	1.0	>10	.020	50
LH121	.35	.09	<.01	.02	<.01	29.3	.10	.3	>10	.010	20
LH121	.40	.11	.02	.02	<.01	30.6	.05	.2	>10	.005	20
LH122	.42	.11	.05	.04	.02	39.8	.20	1.0	>10	.010	30
LH122	.24	.19	.04	.04	.02	39.9	.10	.5	>10	.010	30
LH211	.64	.28	.13	.09	.05	33.5	.50	.5	>10	.050	150
LH211	1.00	.18	.15	.09	.03	31.7	.50	.2	>10	.050	100
LH212	.78	.22	.14	.12	.03	35.8	1.00	.2	>10	.030	100
LH212	.53	.19	.11	.12	.03	36.1	.50	.2	>10	.030	50
LH221	.52	.11	.09	.07	.03	38.8	.20	1.0	>10	.020	50
LH221	.51	.10	.06	.03	<.01	38.7	.20	.1	>10	.020	50
LH222	.51	.07	.05	.03	.03	39.5	.20	.5	>10	.020	50
LH222	.41	.13	.05	<.01	<.01	38.6	.20	1.0	>10	.020	50
LMQ311	.72	.03	<.01	.04	.04	35.1	.50	1.5	>10	.050	100
LMQ311	.57	.07	.10	.07	.09	36.0	.50	1.5	>10	.050	100
LMQ312	.76	.05	<.01	.08	.07	33.5	.50	.7	>10	.050	100
LMQ312	1.20	.04	.03	.09	<.01	33.9	.50	.7	>10	.050	70
LMQ321	.81	.08	.03	.09	.10	31.0	1.00	.3	>10	.020	1,000
LMQ321	.83	.09	.26	.08	<.01	30.7	.70	.5	>10	.050	100
LMQ322	.57	.06	.07	.08	<.01	31.3	.50	1.0	>10	.020	100
LMQ322	.36	.08	.07	.05	.07	31.5	.20	.7	>10	.020	70
LP121	.32	.08	.03	.03	.02	41.1	.10	.7	>10	.005	10
LP121	1.30	.07	.02	.05	<.01	40.7	.10	1.0	>10	.010	20
LP122	.21	.10	.02	.05	<.01	42.1	.20	1.0	>10	.010	50
LP122	.25	.06	.04	.06	.03	42.1	.10	.5	>10	.010	20
LP212	.45	.07	.05	.04	<.01	34.2	.20	1.0	>10	.015	50
LP212	.36	.09	.04	.04	.02	34.4	.20	.3	>10	.020	70
LP222	1.00	.12	.05	.07	.05	21.3	.20	.5	>10	.020	50
LP222	.48	.12	.05	<.01	<.01	21.2	.20	.5	>10	.020	50
LR111	1.20	.47	.18	.06	.13	14.5	1.00	.2	>10	.100	700
LR111	1.10	.38	.18	.05	.09	14.9	1.00	.2	>10	.070	500
LR112	.67	.21	.11	<.01	.09	22.8	.50	.5	>10	.050	50
LR112	.67	.19	.08	.03	.08	22.5	.50	.3	>10	.050	500
LR121	1.00	.24	.19	<.01	.03	16.5	.50	.1	10	.050	100
LR121	.76	.20	.09	<.01	.03	14.2	.50	1.0	10	.030	100
LR122	.59	.16	.10	<.01	.04	26.4	.50	.7	>10	.030	150
LR122	.69	.16	.08	.03	.03	26.0	.50	.5	>10	.030	100
LR211	1.50	.55	.29	<.01	.02	17.8	1.00	2.0	5	.100	100
LR211	1.50	.46	.30	<.01	<.01	18.0	1.00	2.0	7	.150	150
LR212	1.40	.39	.28	.03	.03	17.8	1.00	5.0	10	.150	200
LR212	2.00	.47	.28	<.01	.02	16.9	1.00	5.0	7	.100	150
LR221	1.90	.34	.27	<.01	.03	24.2	1.00	5.0	>10	.100	100
LR221	1.40	.36	.30	.07	.03	24.3	1.00	5.0	10	.100	150
LR222	.45	.11	.04	<.01	.03	28.9	.50	2.0	>10	.010	100
LR222	.37	.14	.03	<.01	<.01	29.2	.70	2.0	>10	.010	100
LK111	.72	.20	.07	.06	.07	30.5	.50	7.0	>10	.020	150
LK111	2.80	.24	.07	<.01	.02	28.4	1.00	5.0	10	.020	200

Table 1B.--Cont.

SAMPLE	Ag ppm-S	B ppm-S	Ba ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
LH111	N	<50	30	N	30	2	N	N	10	N	N
LH111	N	<50	50	N	50	2	N	N	10	N	N
LH112	N	<50	30	N	30	2	N	N	10	N	N
LH112	N	<50	30	N	30	5	N	N	10	N	N
LH121	N	<50	10	N	10	2	N	N	10	N	N
LH121	N	<50	10	N	7	5	N	N	<10	N	N
LH122	N	N	10	N	15	2	N	N	N	N	N
LH122	N	N	10	N	15	<2	N	N	<10	N	N
LH211	N	<50	70	N	50	7	N	N	20	50	N
LH211	N	<50	50	N	50	10	N	N	20	50	N
LH212	N	<50	50	N	50	5	N	N	10	20	N
LH212	N	<50	70	N	50	5	N	N	15	30	N
LH221	N	N	30	N	20	2	N	N	10	N	N
LH221	N	<50	70	N	30	5	N	N	10	N	N
LH222	N	N	20	N	20	2	N	N	10	N	N
LH222	N	<50	30	N	20	2	N	7	<10	N	N
LMQ311	N	<50	70	N	30	5	N	30	15	20	N
LMQ311	N	<50	50	N	30	5	N	N	10	20	N
LMQ312	N	<50	100	N	30	5	N	N	15	N	N
LMQ312	N	<50	70	N	30	5	N	N	10	N	N
LMQ321	N	<50	50	7	15	7	N	N	15	20	N
LMQ321	N	<50	70	N	30	5	N	N	10	20	N
LMQ322	N	<50	50	N	20	5	N	N	<10	N	N
LMQ322	N	<50	50	N	15	2	N	N	<10	N	N
LP121	N	<50	10	N	15	2	N	N	N	N	N
LP121	N	<50	10	N	20	2	N	N	10	N	N
LP122	N	<50	20	N	20	5	N	N	10	N	N
LP122	N	<50	20	N	10	2	N	N	N	20	N
LP212	N	<50	20	N	20	5	N	N	<10	N	N
LP212	N	<50	30	N	20	2	N	N	<10	N	N
LP222	N	50	50	N	20	2	N	N	N	N	N
LP222	N	<50	50	N	15	5	N	N	<10	N	N
LR111	N	100	150	7	30	2	N	N	50	N	10
LR111	N	50	150	10	20	2	N	N	50	N	10
LR112	N	50	50	N	10	10	N	N	30	N	N
LR112	N	50	50	N	10	7	N	N	20	N	N
LR121	N	70	70	N	20	5	N	N	20	N	N
LR121	N	<50	50	N	15	5	N	N	15	N	N
LR122	N	<50	50	N	15	5	N	N	70	N	N
LR122	N	50	50	N	20	5	N	N	15	N	N
LR211	N	50	150	N	50	10	N	N	30	20	<10
LR211	N	70	150	7	50	10	N	N	30	20	10
LR212	N	50	150	7	50	5	N	N	20	20	10
LR212	N	50	150	N	50	10	N	N	20	20	<10
LR221	N	50	150	7	50	10	N	N	50	20	10
LR221	10	70	150	N	50	10	N	N	50	20	N
LR222	N	<50	20	N	10	2	N	N	N	N	N
LR222	N	<50	10	N	10	5	N	N	10	N	N
LK111	N	<50	50	N	20	10	N	N	20	N	N
LK111	N	<50	50	N	15	10	N	N	20	N	N

Table 1B.--Cont.

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P%-S	Ga ppm-S	Yb ppm-S
LH111	700	20	N	N	.5	N	N	N	N
LH111	1,000	20	N	N	.7	N	N	N	N
LH112	1,000	20	N	N	.7	N	N	N	N
LH112	1,000	20	N	20	.7	N	N	N	N
LH121	500	N	N	N	.2	N	N	N	N
LH121	500	<15	N	N	.1	N	N	N	N
LH122	500	<15	N	N	.5	N	N	N	N
LH122	700	15	N	N	.2	N	N	N	N
LH211	500	30	N	50	1.0	N	N	N	<2
LH211	500	50	<20	50	1.0	N	N	<10	<2
LH212	500	30	N	20	1.0	N	N	N	<2
LH212	700	30	N	20	1.0	N	N	<10	<2
LH221	500	20	N	N	.5	N	N	N	N
LH221	700	20	N	20	.7	N	N	N	N
LH222	500	20	N	N	.5	N	N	N	N
LH222	1,000	15	N	N	.2	N	N	N	N
LMQ311	1,000	20	N	20	1.0	N	N	N	N
LMQ311	1,000	20	<20	50	1.0	N	N	N	N
LMQ312	1,500	20	N	20	1.0	N	N	N	<2
LMQ312	1,000	20	N	N	1.0	N	N	N	<2
LMQ321	300	20	50	30	.7	N	N	<10	3
LMQ321	700	20	<20	20	.5	N	N	N	2
LMQ322	1,000	15	N	N	.3	N	N	N	N
LMQ322	700	15	N	20	.7	N	N	N	N
LP121	1,000	15	N	N	.2	N	N	N	N
LP121	1,500	15	N	N	.2	N	N	N	N
LP122	1,000	15	N	N	.5	N	N	N	N
LP122	1,000	15	N	N	.2	N	N	N	N
LP212	700	20	N	N	.5	N	N	N	N
LP212	1,000	15	N	N	.5	N	N	N	N
LP222	500	<15	N	N	.5	N	N	<10	<2
LP222	700	15	N	N	.5	N	N	N	N
LR111	150	50	20	50	2.0	2.0	N	10	2
LR111	100	50	20	50	1.0	N	N	10	<2
LR112	150	20	<20	N	1.0	N	N	N	<2
LR112	150	20	<20	20	.7	3.0	N	N	<2
LR121	200	50	N	N	1.0	N	N	<10	<2
LR121	200	20	N	N	.7	N	N	<10	N
LR122	500	20	N	N	.7	N	N	N	N
LR122	500	20	N	N	.7	N	N	N	N
LR211	70	100	<20	50	1.5	3.0	N	15	<2
LR211	100	70	<20	50	2.0	2.0	N	15	<2
LR212	100	100	<20	70	2.0	2.0	N	10	2
LR212	100	100	<20	70	2.0	2.0	N	10	<2
LR221	150	50	<20	50	2.0	2.0	N	10	2
LR221	100	100	<20	50	1.5	N	N	10	<2
LR222	300	15	N	N	.5	N	N	N	N
LR222	300	15	N	N	.2	N	N	N	N
LK111	150	30	N	N	.7	N	N	N	<2
LK111	150	50	<20	N	1.0	N	N	<10	N

Table 1B.--Cont.

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
LK112	37 0 0	85 53 0	118,120	28.3	1.50	.52	.42	14.20	20.9	<.01	.31
LK112	37 0 0	85 53 0	118,460	27.8	1.10	.29	.58	13.80	22.5	N	.69
LK121	37 0 0	85 53 0	118,456	9.0	.58	.19	.18	3.00	45.5	N	.94
LK121	37 0 0	85 53 0	118,490	9.7	N	.15	.24	3.00	46.2	<.01	.22
LK122	37 0 0	85 53 0	118,322	9.5	N	.16	.30	2.00	47.4	<.01	<.01
LK122	37 0 0	85 53 0	118,457	9.7	.47	.19	.18	1.90	47.4	N	.60
LK211	37 8 0	85 8 0	118,171	8.2	.19	.21	.37	2.30	47.4	<.01	.16
LK211	37 8 0	85 8 0	118,390	7.6	.69	.44	.14	2.20	48.5	<.01	.10
LK212	37 8 0	85 8 0	118,227	6.2	.38	.10	.18	1.70	49.1	<.01	.12
LK212	37 8 0	85 8 0	118,230	5.9	.52	N	.14	1.80	49.8	.18	.12
LK221	37 8 0	85 8 0	118,216	3.5	.37	<.01	<.01	.83	52.2	<.01	N
LK221	37 8 0	85 8 0	118,229	3.9	.52	<.01	.10	.85	52.2	.14	.12
LK222	37 8 0	85 8 0	118,239	4.6	.23	<.01	<.01	.69	51.5	<.01	.11
LK222	37 8 0	85 8 0	118,389	4.4	.19	.22	.10	.72	52.0	N	.15
LS111	36 45 0	85 23 0	118,161	29.8	2.00	1.20	.48	1.90	34.4	N	.48
LS111	36 45 0	85 23 0	118,360	31.7	1.80	1.20	.42	1.60	33.6	.10	.49
LS112	36 45 0	85 53 0	118,185	34.2	4.00	1.00	.92	11.50	18.5	.29	1.10
LS112	36 45 0	85 53 0	118,273	33.2	4.10	.81	.90	11.50	19.1	.59	1.00
LS121	36 45 0	85 53 0	118,251	2.5	.71	<.01	<.01	7.60	38.8	<.01	.23
LS121	36 45 0	85 53 0	118,365	3.0	.58	.30	.26	8.00	43.1	<.01	N
LS122	36 45 0	85 53 0	118,248	9.6	1.80	<.01	<.01	7.00	41.2	N	.37
LS122	36 45 0	85 53 0	118,313	9.7	1.50	.41	.22	7.40	39.9	<.01	.44
LS211	36 45 0	85 0 0	118,374	15.9	1.50	.94	.60	.75	43.9	N	.35
LS211	36 45 0	85 0 0	118,491	16.7	1.10	.87	.30	.78	43.4	N	.34
LS212	36 45 0	85 0 0	118,452	20.4	1.80	.93	.34	.71	40.5	.20	.52
LS212	36 45 0	85 0 0	118,439	20.1	1.80	1.00	.26	.71	41.2	.12	.51
LS221	36 45 0	85 0 0	118,226	4.0	.33	<.01	.22	.80	52.0	<.01	N
LS221	36 45 0	85 0 0	118,501	4.5	.25	.17	.18	.77	51.6	<.01	.18
LS222	36 45 0	85 0 0	118,214	5.2	.33	<.01	.15	1.00	50.9	<.01	N
LS222	36 45 0	85 0 0	118,433	5.2	<.01	N	.34	.98	51.1	.11	.17
LL111	37 0 0	84 53 0	118,329	18.2	.72	.39	.74	2.80	41.0	<.01	.29
LL111	37 0 0	84 53 0	118,475	18.1	.46	.22	.80	2.90	40.6	<.01	.71
LL112	37 0 0	84 53 0	118,168	16.0	2.50	.66	1.40	9.40	31.9	N	.67
LL112	37 0 0	84 53 0	118,297	15.1	2.30	.67	1.30	9.00	33.0	.25	.59
LL121	37 0 0	84 53 0	118,115	19.3	1.20	1.70	4.10	8.30	30.2	N	.23
LL121	37 0 0	84 53 0	118,383	21.7	1.80	.72	3.80	7.60	29.7	N	.53
LL122	37 0 0	84 53 0	118,277	14.2	1.00	.66	4.40	8.40	32.6	N	.44
LL122	37 0 0	84 53 0	118,404	14.7	1.20	.64	4.60	8.90	31.5	N	.43
LL211	37 8 0	84 23 0	118,364	20.1	2.90	.65	.86	14.60	24.0	.44	.51
LL211	37 8 0	84 23 0	118,406	20.8	2.80	.55	.86	15.20	22.7	.23	.68
LL212	37 8 0	84 23 0	118,164	22.4	2.20	.46	.58	14.80	25.0	.31	.29
LL212	37 8 0	84 23 0	118,278	21.8	1.80	.43	.70	14.60	24.1	.31	.41
LL221	37 8 0	84 23 0	118,138	5.1	1.20	<.01	.15	16.80	31.2	N	.34
LL221	37 8 0	84 23 0	118,304	5.4	.94	.38	.58	17.00	31.4	.12	.41
LL222	37 8 0	84 23 0	118,413	4.4	.93	.30	.26	16.70	32.3	N	.69
LL222	37 8 0	84 23 0	118,503	4.7	.94	.36	.22	16.20	32.6	<.01	.40
LME211	38 22 0	83 8 0	121,021	45.3	4.50	1.80	.24	.66	24.4	.30	1.30
LME211	38 22 0	83 8 0	121,041	45.8	4.50	1.50	.60	.78	24.0	.23	1.30
LME212	38 22 0	83 8 0	121,015	52.7	4.90	.36	1.40	.73	20.2	.16	1.50
LME212	38 22 0	83 8 0	121,063	52.6	5.00	.36	1.40	.70	20.2	.10	1.40

Table 1B.--Co

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
LK112	.54	.13	.05	.05	.07	32.9	.50	7.0	>10	.020	150
LK112	.55	.13	.05	<.01	<.01	32.3	.50	5.0	10	.020	150
LK121	.51	.07	.02	<.01	.02	39.0	.30	1.0	>10	.010	200
LK121	.17	.04	.02	.02	.03	39.6	.30	1.5	>10	.007	200
LK122	.44	.06	.02	.13	.04	39.1	.20	.5	>10	.005	200
LK122	.59	.06	.02	.10	<.01	38.7	.20	.5	>10	.005	200
LK211	.28	.08	.02	<.01	.02	40.4	.50	1.0	>10	.010	200
LK211	.32	.14	.03	<.01	.04	39.7	.50	.5	>10	.005	200
LK212	.57	.07	.04	<.01	.06	40.8	.20	.5	>10	.010	200
LK212	.50	.08	.04	.02	.05	40.8	.50	.5	>10	.010	200
LK221	.33	.10	.02	<.01	.03	42.0	.10	.2	>10	.005	100
LK221	.40	.05	.02	<.01	.02	41.5	.20	.2	>10	.005	100
LK222	.44	.07	.03	<.01	.04	42.3	.20	.5	>10	.005	50
LK222	.24	.13	.02	<.01	<.01	41.2	.10	.1	>10	.005	100
LS111	.69	.18	.11	<.01	.03	28.0	1.00	1.0	>10	.050	500
LS111	.77	.16	.07	.05	.02	27.4	1.00	.5	>10	.020	100
LS112	1.20	.26	.22	.02	.04	26.8	1.00	.5	>10	.050	150
LS112	1.10	.26	.21	.07	.04	27.0	1.50	7.0	10	.070	150
LS121	.37	.09	.04	.05	.06	42.9	.50	5.0	>10	.010	200
LS121	.53	.09	.04	.08	.04	43.5	.30	2.0	>10	.100	150
LS122	.74	.14	.08	<.01	.09	39.5	.50	5.0	>10	.030	500
LS122	.66	.13	.08	.05	.09	38.9	.30	2.0	>10	.020	300
LS211	.62	.22	.08	.04	.04	34.9	1.00	.2	>10	.020	200
LS211	.52	.10	.08	.04	.03	34.9	1.00	.5	>10	.020	200
LS212	.93	.17	.11	<.01	<.01	32.7	1.00	.1	>10	.050	200
LS212	.81	.19	.12	<.01	<.01	33.0	1.00	.5	>10	.050	200
LS221	.40	.07	.02	<.01	.05	41.3	.30	.2	>10	.005	200
LS221	.37	.05	.02	.03	.03	41.4	.30	.5	>10	.005	200
LS222	.24	.30	.03	.02	.06	41.3	.50	.2	>10	.005	200
LS222	.36	.10	.04	<.01	.02	41.1	.50	.5	>10	.005	200
LL111	.46	.08	.04	.02	.18	35.0	1.00	1.0	>10	.010	700
LL111	.38	.09	.02	<.01	.15	35.5	1.00	2.0	>10	.010	500
LL112	.81	.16	.13	<.01	.17	36.1	1.50	5.0	>10	.030	700
LL112	.79	.13	.14	.03	.17	36.4	1.50	5.0	>10	.050	1,000
LL121	.53	.12	.08	.11	.25	33.8	3.00	5.0	>10	.020	1,500
LL121	.50	.16	.08	.06	.21	33.2	2.00	5.0	>10	.020	700
LL122	.57	.08	.08	.07	.22	36.5	2.00	5.0	>10	.020	1,000
LL122	.64	.13	.09	.04	.20	36.6	2.00	5.0	>10	.020	700
LL211	.81	.19	.19	<.01	.04	34.6	1.00	7.0	10	.050	150
LL211	.50	.26	.21	<.01	.02	34.8	1.00	10.0	10	.050	150
LL212	.65	.13	.15	<.01	.02	34.4	.70	10.0	>10	.050	100
LL212	.58	.13	.15	.02	.03	34.8	.70	7.0	10	.070	100
LL221	1.40	.14	.05	.03	.05	42.3	.50	10.0	>10	.020	100
LL221	.69	.14	.05	.02	.02	42.8	.50	10.0	>10	.020	100
LL222	.54	.17	.07	<.01	<.01	43.3	.30	10.0	>10	.010	100
LL222	.49	.11	.05	.02	.02	43.6	.30	10.0	>10	.020	100
LME211	1.00	.18	.27	.07	.14	19.7	2.00	.5	>10	.200	700
LME211	1.40	.16	.36	.06	.14	19.2	1.00	.2	>10	.150	500
LME212	1.10	.08	.47	.03	.05	15.7	1.50	.5	>10	.200	200
LME212	1.50	.05	.42	.03	.07	16.0	2.00	.5	>10	.200	200

Table 1B.--cont.

SAMPLE	Ag ppm-S	B ppm-S	Ba ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
LK112	N	<50	30	N	15	5	N	N	10	N	N
LK112	N	<50	30	N	10	7	N	N	20	N	N
LK121	N	<50	10	N	10	2	N	N	15	N	N
LK121	N	<50	10	N	10	5	N	N	10	N	N
LK122	N	<50	20	N	5	2	N	N	<10	N	N
LK122	N	<50	10	N	5	2	N	N	10	N	N
LK211	N	<50	50	N	10	2	N	N	N	N	N
LK211	N	<50	30	N	5	2	N	N	N	N	N
LK212	N	N	30	N	5	2	N	N	N	N	N
LK212	N	<50	30	N	15	5	300	N	20	20	N
LK221	N	N	15	N	5	2	N	N	N	N	N
LK221	N	<50	20	N	5	2	N	N	N	N	N
LK222	N	<50	10	N	5	<2	N	N	N	N	N
LK222	N	<50	20	N	5	2	N	N	<10	N	N
LS111	N	50	100	N	30	10	N	N	20	20	N
LS111	N	50	100	N	5	5	N	N	10	20	N
LS112	N	50	200	N	30	7	N	N	20	N	N
LS112	N	50	200	N	30	10	N	N	15	20	10
LS121	N	<50	20	N	5	2	N	N	N	N	N
LS121	N	N	20	N	10	2	N	N	10	N	N
LS122	N	<50	50	N	15	2	N	N	10	N	N
LS122	N	<50	50	N	15	5	N	N	<10	20	N
LS211	N	<50	50	N	15	5	N	N	<10	N	N
LS211	N	<50	50	N	15	2	N	N	10	N	N
LS212	N	<50	70	N	20	2	N	N	10	N	N
LS212	N	<50	100	N	30	5	N	N	10	N	N
LS221	N	N	100	N	5	2	N	N	N	N	N
LS221	N	50	150	N	5	<2	N	N	N	N	N
LS222	N	<50	20	N	5	2	N	N	N	N	N
LS222	N	N	20	N	5	2	N	N	N	N	N
LL111	N	<50	30	N	5	2	N	N	N	N	N
LL111	N	<50	30	N	5	2	N	N	<10	N	N
LL112	N	<50	70	N	15	2	N	N	10	N	N
LL112	N	<50	70	N	20	2	N	N	15	N	N
LL121	N	<50	300	N	10	5	N	N	10	N	N
LL121	N	<50	300	N	7	5	N	N	50	N	N
LL122	N	<50	150	N	10	5	N	N	10	20	N
LL122	N	<50	200	N	10	5	N	N	10	20	N
LL211	N	<50	70	N	20	5	N	N	<10	20	N
LL211	N	<50	100	N	20	5	N	N	<10	N	N
LL212	N	<50	100	N	20	<2	N	N	<10	N	N
LL212	N	50	50	N	15	2	N	N	N	N	N
LL221	N	<50	30	N	10	2	N	N	10	N	N
LL221	N	<50	30	N	10	5	N	N	10	N	N
LL222	N	<50	20	N	10	5	N	N	<10	N	N
LL222	N	<50	30	N	7	5	N	N	<10	N	N
LME211	N	50	200	7	100	7	N	N	20	20	10
LME211	N	50	200	N	70	5	N	N	20	20	10
LME212	N	50	200	7	50	5	N	N	20	20	10
LME212	N	50	300	7	70	7	N	N	20	20	10

Table 1B.--Con'.

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P%-S	Ga ppm-S	Yb ppm-S
LK112	100	20	N	N	.7	N	N	N	<2
LK112	150	20	N	N	.5	N	N	N	N
LK121	500	20	N	N	.2	N	N	N	N
LK121	500	15	<20	N	.2	N	N	N	N
LK122	300	15	<20	N	.2	N	N	N	N
LK122	500	15	N	N	.2	N	N	N	N
LK211	500	15	N	N	.2	N	N	N	N
LK211	500	15	N	N	.2	N	N	N	N
LK212	300	<15	N	N	.5	N	N	N	N
LK212	500	20	<20	N	.5	N	N	N	N
LK221	500	<15	N	N	.2	N	N	N	N
LK221	700	20	20	N	.2	N	N	N	N
LK222	700	15	N	N	.2	N	N	N	<2
LK222	700	15	<20	N	.2	N	N	N	N
LS111	300	50	20	N	1.0	N	N	<10	2
LS111	500	20	<20	20	1.0	N	N	<10	<2
LS112	300	70	<20	30	2.0	1.5	N	10	<2
LS112	200	50	<20	50	1.0	1.5	N	10	<2
LS121	500	15	<20	N	.2	N	N	N	<2
LS121	700	15	N	N	.5	N	N	N	N
LS122	300	20	<20	N	.7	N	N	N	N
LS122	300	50	<20	N	1.0	N	N	<10	<2
LS211	700	20	N	N	.7	N	N	N	N
LS211	700	20	<20	N	.7	N	N	N	N
LS212	700	20	<20	20	1.0	N	N	N	<2
LS212	700	50	<20	20	1.0	N	N	N	N
LS221	500	<15	N	N	.2	N	N	N	N
LS221	700	<15	N	N	.1	N	N	N	N
LS222	500	<15	<20	N	2.0	N	N	N	N
LS222	500	<15	N	N	.2	N	N	N	N
LL111	500	15	N	N	.5	N	N	N	N
LL111	500	15	<20	N	.5	N	N	N	N
LL112	200	30	<20	30	1.0	N	N	<10	<2
LL112	300	50	<20	N	1.0	N	N	<10	<2
LL121	200	20	N	N	.7	N	N	N	<2
LL121	200	20	N	N	.7	N	N	N	N
LL122	150	20	N	N	.5	N	N	N	N
LL122	200	15	<20	N	1.0	N	N	<10	N
LL211	200	20	N	50	1.0	N	N	<10	N
LL211	150	30	N	70	1.0	1.5	N	<10	<2
LL212	200	20	N	70	1.0	N	N	<10	<2
LL212	150	20	N	50	.5	N	N	N	N
LL221	200	20	N	N	.5	N	N	N	N
LL221	300	15	N	N	.5	N	N	N	N
LL222	200	15	N	N	.5	N	N	N	N
LL222	200	<15	N	N	.5	N	N	N	N
LME211	300	150	20	200	2.0	N	N	10	2
LME211	200	150	30	300	1.5	1.5	N	10	5
LME212	100	100	20	200	2.0	1.5	N	10	2
LME212	150	100	20	300	2.0	3.0	N	10	3

Table 18.--Cont.

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
LME221	38 22 0	83 8 0	120,990	59.0	4.70	1.40	.52	.38	17.4	.42	1.40
LME221	38 22 0	83 8 0	121,010	58.0	4.60	1.50	.52	.45	17.3	.27	1.30
LME222	38 22 0	83 8 0	121,012	37.0	3.30	1.60	.48	.72	30.3	N	1.60
LME222	38 22 0	83 8 0	121,048	37.4	3.40	1.70	.44	.62	29.9	N	1.60
LE111	38 23 0	83 0 0	118,258	20.7	4.90	<.01	<.01	1.80	31.6	.12	.25
LE111	38 23 0	83 0 0	118,301	20.4	3.70	1.20	.64	.71	39.2	.16	.97
LE112	38 23 0	83 0 0	118,211	22.6	4.20	2.30	.60	.65	37.1	<.01	1.20
LE112	38 23 0	83 0 0	118,362	22.0	5.00	2.50	.62	1.50	35.8	.17	1.20
LE121	38 23 0	83 0 0	118,206	47.9	4.50	1.90	.70	.50	23.2	.28	1.50
LE121	38 23 0	83 0 0	118,482	48.1	3.80	1.90	.66	.53	23.0	.24	1.60
LE122	38 23 0	83 0 0	118,496	40.9	3.40	1.30	.90	.43	27.6	N	1.10
LE122	38 23 0	83 0 0	118,300	40.6	3.70	1.40	.62	.42	28.7	.21	.94

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
LME221	1.00	.21	.57	.02	.11	12.6	2.00	.2	>10	.300	700
LME221	1.60	.21	.59	.02	.09	13.4	1.50	.2	10	.200	700
LME222	1.10	.22	.12	.02	.12	23.2	1.50	.3	>10	.100	700
LME222	1.40	.18	.20	.03	.09	23.0	1.50	.3	>10	.150	700
LE111	.96	.44	.11	<.01	.04	38.4	1.00	.2	>10	.150	500
LE111	1.10	.34	.28	1.80	.07	28.6	1.00	.2	>10	.100	500
LE112	1.20	.34	.31	.48	.09	28.9	2.00	.2	>10	.100	300
LE112	1.30	.32	.32	.46	.08	28.7	2.00	.2	>10	.100	500
LE121	1.00	.10	.44	<.01	.09	17.9	1.50	.1	>10	.200	500
LE121	1.10	.31	.43	<.01	.11	18.2	1.50	.5	>10	.150	500
LE122	.55	.35	.38	.05	.11	22.3	1.50	.2	>10	.150	500
LE122	.85	.25	.38	.05	.10	21.8	1.00	2.0	>10	.150	700

Table 1B.--C[illegible]

SAMPLE	Ag ppm-S	B ppm-S	Ba ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
LME221	N	100	300	10	70	15	N	N	30	N	15
LME221	N	50	300	7	70	10	70	N	20	20	15
LME222	N	50	150	<7	100	2	N	N	15	<20	10
LME222	N	70	150	7	100	5	N	N	20	20	10
LE111	N	<50	150	N	20	50	N	N	15	N	10
LE111	N	50	150	7	30	20	100	N	15	N	10
LE112	N	50	150	7	20	10	70	N	20	20	10
LE112	N	50	150	7	30	70	N	N	10	20	10
LE121	N	50	150	7	100	5	N	N	20	20	10
LE121	N	<50	150	10	150	5	N	N	50	20	10
LE122	N	50	150	7	70	5	70	N	20	N	10
LE122	N	50	150	7	70	2	N	N	15	20	10

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P%-S	Ga ppm-S	Yb ppm-S
LME221	200	100	70	1,000	2.0	2.0	N	N	7
LME221	150	100	50	1,000	2.0	1.5	N	<10	7
LME222	300	150	20	300	1.5	2.0	N	N	N
LME222	300	150	20	300	1.5	3.0	N	10	5
LE111	300	50	70	70	1.5	2.0	N	<10	2
LE111	500	70	70	70	2.0	2.0	1	10	2
LE112	200	100	50	100	2.0	1.5	N	10	2
LE112	300	70	30	50	2.0	2.0	N	10	2
LE121	300	100	20	200	1.5	1.5	N	<10	2
LE121	300	150	30	300	2.0	5.0	N	<10	2
LE122	300	100	20	150	1.5	1.5	N	<10	2
LE122	300	100	20	200	1.0	N	N	10	2

Table 1C.--Chemical analyses of carbonate rocks of Upper Mississippian age in Kentucky. [%, percent; ppm, parts per million; N, not detected; labels ending in "-S" are spectrographic determinations]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
UH111	37 0 0	88 8 0	118,149	8.40	1.50	.22	.18	.95	48.7	N	.28
UH111	37 0 0	88 8 0	118,179	8.80	1.40	.50	.10	1.00	48.4	.10	.27
UH112	37 0 0	88 8 0	118,445	12.90	.77	.31	N	.86	46.6	<.01	.15
UH112	37 0 0	88 8 0	118,497	12.90	.92	.23	.16	.88	49.2	N	.31
UH121	37 0 0	88 8 0	118,199	3.70	1.30	.22	.42	.73	51.6	<.01	.13
UH121	37 0 0	88 8 0	118,476	3.40	N	N	N	.71	51.6	N	.73
UH122	37 0 0	88 0 0	118,299	4.00	<.01	.17	N	.83	51.8	N	.17
UH122	37 0 0	88 8 0	118,393	2.30	.28	.22	.10	.71	53.4	<.01	.33
UH211	37 0 0	88 0 0	118,209	5.10	.52	.15	.22	.61	51.7	<.01	.11
UH211	37 0 0	88 0 0	118,451	4.40	.38	.13	.10	.49	52.4	N	.33
UH212	37 0 0	88 0 0	118,155	1.80	N	<.01	N	.76	53.6	.27	.37
UH212	37 0 0	88 0 0	118,163	1.30	<.01	N	.10	.47	54.2	<.01	<.01
UH221	37 0 0	88 0 0	118,388	10.20	.69	.30	.10	6.00	42.0	N	.24
UH221	37 0 0	88 0 0	118,485	9.40	.67	.36	.22	5.60	42.8	<.01	.36
UH222	37 0 0	88 0 0	118,148	3.40	.60	<.01	N	.82	52.4	.32	<.01
UH222	37 0 0	88 0 0	118,299	4.00	<.10	.17	.06	.83	51.8	.08	.17
UP111	36 53 0	88 15 0	118,347	11.40	.38	.22	.10	1.10	47.5	<.01	.51
UP111	36 53 0	88 15 0	118,358	11.90	.38	.22	.10	1.20	47.3	<.01	.11
UP112	36 53 0	88 15 0	118,342	7.50	.46	.31	.16	1.20	49.4	<.01	.32
UP112	36 53 0	88 15 0	118,516	7.60	.37	.21	.12	.93	49.9	.19	N
UP121	36 53 0	88 15 0	118,260	11.70	.40	.33	N	4.40	43.8	N	.26
UP121	36 53 0	88 15 0	118,462	11.70	.28	.22	N	4.30	43.5	N	.48
UP122	36 53 0	88 15 0	118,170	1.30	<.01	.10	N	.69	53.0	N	.15
UP122	36 53 0	88 15 0	118,395	1.30	<.01	N	N	.70	54.2	N	.29
UP211	36 53 0	88 0 0	118,150	9.50	1.20	<.01	N	2.70	46.4	.11	.12
UP211	36 53 0	88 0 0	118,421	10.90	.54	N	.10	2.70	46.1	N	.30
UP212	36 53 0	88 0 0	118,284	4.30	.44	<.01	.18	1.40	51.0	N	.21
UP212	36 53 0	88 0 0	118,355	4.10	.34	.18	.14	1.30	52.0	<.01	.10
UP221	36 53 0	88 0 0	118,302	10.40	.79	.25	.36	5.00	43.2	N	.29
UP221	36 53 0	88 0 0	118,397	10.40	1.20	.43	N	5.00	42.8	<.01	.28
UP222	36 53 0	88 0 0	118,366	16.50	1.10	.39	N	1.80	43.7	<.01	.29
UP222	36 53 0	88 0 0	118,416	16.80	1.10	.35	.10	1.60	43.1	N	.16
UQ111	36 45 0	87 45 0	118,357	2.50	.19	N	.10	1.10	52.7	N	<.01
UQ111	36 45 0	87 45 0	118,489	2.70	<.01	N	N	1.10	52.4	<.01	.26
UQ112	36 45 0	87 45 0	118,165	1.50	<.01	<.01	N	1.10	52.6	N	<.01
UQ112	36 45 0	87 45 0	118,354	1.70	.27	.67	.30	1.00	52.7	<.01	.32
UQ121	36 45 0	87 45 0	118,167	9.00	.19	.36	.14	6.30	42.6	<.01	.17
UQ121	36 45 0	87 45 0	118,474	9.70	.19	.11	N	6.40	42.5	N	.67
UQ122	36 45 0	87 45 0	118,243	6.20	.42	<.01	<.01	2.50	48.7	<.01	.17
UQ122	36 45 0	87 45 0	118,264	6.30	.40	.34	.22	2.60	48.6	<.01	.26
UQ211	36 53 0	87 15 0	118,132	7.70	1.20	.31	.44	.96	48.7	N	.33
UQ211	36 53 0	87 15 0	118,310	5.20	1.00	.25	.30	.89	51.1	N	.31
UQ212	36 53 0	87 15 0	118,261	12.70	.91	N	.22	1.10	46.4	<.01	.39
UQ212	36 53 0	87 15 0	118,463	12.50	.68	N	.18	1.00	46.6	N	.75
UQ221	36 53 0	87 15 0	118,335	6.40	.49	.29	.26	.80	50.3	N	.24
UQ221	36 53 0	87 15 0	118,414	6.60	.48	.21	.26	1.00	50.2	N	.14
UQ222	36 53 0	87 15 0	118,193	9.60	.88	.28	.36	.75	47.8	.22	.23
UQ222	36 53 0	87 15 0	118,420	10.20	.93	.25	.38	.96	47.5	<.01	.41
UJ111	37 45 0	86 30 0	118,140	1.20	.35	<.01	.15	N	54.0	.14	.19
UJ111	37 45 0	86 30 0	118,323	1.30	N	N	.14	.46	54.0	<.01	<.01

Table 1C.--Cont.

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S
UH111	.57	.16	.06	<.01	.05	38.4	.50	.50	>10	.050
UH111	.67	.12	.07	<.01	.02	37.8	.50	.50	>10	.030
UH112	.48	.13	.05	<.01	<.01	37.0	.20	.50	>10	.020
UH112	.47	.11	.05	.02	.02	37.0	.30	.50	>10	.020
UH121	.40	.10	.03	<.01	.03	41.4	.20	.20	>10	.007
UH121	.52	.10	.02	<.01	<.01	41.7	.10	.50	>10	.010
UH122	.23	.10	.02	.02	<.01	42.1	.20	2.00	>10	.005
UH122	.21	.15	.02	<.01	<.01	42.2	.05	.20	>10	.015
UH211	.38	.10	.03	.04	.04	40.8	.20	.05	>10	.005
UH211	.40	.07	.02	<.01	<.01	41.1	.30	.10	>10	.010
UH212	.38	.08	.02	.03	.05	42.5	.20	.10	>10	.005
UH212	.20	.09	.02	<.01	.02	43.0	.10	.50	>10	.005
UH221	.51	.17	.06	<.01	<.01	39.1	.10	2.00	>10	.010
UH221	.43	.17	.05	.05	<.01	39.7	.50	.30	>10	.015
UH222	.39	.08	<.01	.02	.05	41.7	.10	.50	>10	.005
UH222	.23	.10	.02	.02	<.01	42.1	.20	2.00	>10	.005
UP111	.60	.09	<.01	.03	.02	37.1	.20	.20	>10	.005
UP111	.32	.09	<.01	.02	<.01	37.6	.15	.20	>10	.005
UP112	.38	.07	<.01	.02	.03	39.8	.20	.20	>10	.005
UP112	.33	.10	.02	.03	.02	39.9	.30	.50	>10	.010
UP121	.50	.10	.03	.08	<.01	38.2	.20	2.00	>10	.020
UP121	.44	.10	.05	.02	<.01	38.3	.20	2.00	>10	.020
UP122	.25	.04	<.01	<.01	<.01	43.6	.10	.20	>10	.002
UP122	.19	.14	.02	<.01	<.01	42.9	.05	.10	>10	.001
UP211	.51	.11	.04	.02	.05	39.0	.20	1.00	>10	.020
UP211	.50	.11	.07	.02	<.01	38.6	.20	1.00	>10	.020
UP212	.25	.10	<.01	<.01	<.01	41.5	.20	.50	>10	.005
UP212	.40	.07	<.01	.02	<.01	41.2	.10	.20	>10	.005
UP221	.62	.15	.07	.16	.02	38.4	.20	2.00	>10	.030
UP221	.59	.15	.08	<.01	<.01	38.7	.20	1.00	>10	.020
UP222	.65	.13	.08	.03	.03	35.2	.20	.50	>10	.020
UP222	.64	.18	.08	<.01	<.01	35.0	.30	.50	>10	.020
UQ111	.37	.10	<.01	.04	<.01	42.2	.05	.20	>10	.005
UQ111	.48	.05	.02	.05	<.01	42.0	.10	.50	>10	.005
UQ112	.27	.11	.02	<.01	<.01	43.5	.10	.50	>10	.020
UQ112	.42	.10	<.01	.04	<.01	42.4	.10	.20	>10	.005
UQ121	.25	.10	.04	<.01	.02	40.7	.15	5.00	>10	.015
UQ121	.48	.08	.03	<.01	<.01	39.7	.15	5.00	>10	.010
UQ122	.49	.10	.04	<.01	.02	41.2	.20	1.00	>10	.010
UQ122	.35	.11	.03	.05	.02	40.2	.20	1.00	>10	.010
UQ211	.57	.17	.08	.03	.07	39.3	.50	.50	>10	.020
UQ211	.48	.18	.05	.02	.02	39.9	.50	.20	>10	.020
UQ212	.46	.16	.05	.05	.02	37.2	.20	.50	>10	.030
UQ212	.47	.15	.04	<.01	<.01	37.3	.20	.50	>10	.020
UQ221	.35	.15	.02	.04	.17	40.2	.50	.20	>10	.010
UQ221	.38	.21	.05	<.01	.14	40.1	.50	.20	>10	.010
UQ222	.60	.15	.05	<.01	.11	38.2	.50	.20	>10	.020
UQ222	.63	.22	.06	<.01	.08	38.2	.50	.20	>10	.020
UJ111	.36	.06	<.01	.02	.07	42.7	.20	.30	>10	.002
UJ111	.27	.04	.02	.02	.04	42.9	.10	.10	>10	.002

Table 1C.--Cont.

SAMPLE	Mn ppm-S	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S
UH111	70	50	70	N	N	50	5	10	15	20
UH111	100	<50	50	N	N	50	2	7	10	N
UH112	100	<50	30	N	N	20	5	N	10	N
UH112	100	<50	30	N	N	20	2	N	10	N
UH121	70	N	10	N	N	20	5	N	10	N
UH121	50	N	20	N	N	20	5	N	10	30
UH122	100	N	20	N	N	10	2	N	10	N
UH122	50	<50	10	N	N	15	2	20	<10	N
UH211	100	N	10	N	N	10	2	N	N	N
UH211	100	N	10	N	N	10	2	N	N	N
UH212	50	<50	20	N	N	10	<2	N	30	N
UH212	100	<50	20	N	N	5	<2	N	N	N
UH221	20	<50	20	N	N	20	2	7	10	N
UH221	50	<50	30	N	N	20	5	N	10	N
UH222	100	N	30	N	N	15	2	N	10	N
UH222	100	N	20	N	N	10	2	N	10	N
UP111	50	<50	70	N	N	5	<2	N	N	N
UP111	70	N	100	N	N	5	<2	N	N	N
UP112	100	<50	100	N	N	10	<2	N	N	N
UP112	100	<50	150	N	N	15	2	N	N	N
UP121	50	<50	30	N	N	15	2	N	<10	N
UP121	50	N	20	N	N	10	<2	N	<10	N
UP122	50	N	10	N	N	15	<2	N	N	N
UP122	20	<50	5	N	N	5	<2	7	N	N
UP211	50	50	30	N	N	50	5	N	10	N
UP211	50	<50	20	N	N	30	5	N	10	N
UP212	50	<50	20	N	N	10	2	N	N	N
UP212	50	N	20	N	N	10	2	N	N	N
UP221	70	<50	30	N	N	30	2	N	10	N
UP221	50	<50	30	N	N	20	2	N	<10	N
UP222	50	<50	30	N	N	15	2	N	N	N
UP222	50	<50	50	N	N	20	2	N	<10	N
UQ111	50	N	10	N	N	10	<2	N	<10	N
UQ111	50	<50	10	N	N	15	2	N	<10	N
UQ112	50	<50	20	N	N	15	<2	N	<10	N
UQ112	50	N	10	N	N	10	<2	N	<10	N
UQ121	50	<50	20	N	N	10	<2	N	N	N
UQ121	50	<50	10	N	N	15	2	N	<10	N
UQ122	15	<50	15	N	N	15	2	N	N	N
UQ122	50	<50	20	N	N	20	2	N	10	N
UQ211	200	<50	30	N	N	20	5	N	10	N
UQ211	100	<50	30	N	N	10	2	N	N	N
UQ212	200	<50	30	N	N	20	2	N	10	N
UQ212	100	N	30	N	N	15	5	N	<10	N
UQ221	1,000	<50	30	N	N	10	2	N	N	N
UQ221	1,000	<50	30	N	N	10	2	N	N	N
UQ222	500	N	20	N	N	10	2	10	<10	N
UQ222	500	<50	20	N	N	10	5	N	<10	N
UJ111	200	<50	10	N	N	10	<2	N	N	N
UJ111	200	<50	10	N	N	5	2	N	N	20

Table 1(.--Con..

SAMPLE	Sc ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
UH111	N	700	70	20	N	1.00	N	<10	N
UH111	N	500	50	N	N	1.00	N	<10	<2
UH112	N	700	30	N	N	.70	N	N	N
UH112	N	700	30	N	N	.70	N	N	N
UH121	N	500	15	<20	N	.20	N	N	N
UH121	N	700	20	<20	N	.20	N	N	N
UH122	N	1,000	20	N	N	.20	2.0	N	N
UH122	N	300	15	<20	N	.10	N	N	N
UH211	N	500	<15	N	N	.20	N	N	N
UH211	N	500	<15	N	N	.20	N	N	N
UH212	N	700	15	N	N	.20	N	N	N
UH212	N	300	20	N	N	.20	N	N	N
UH221	N	500	15	N	N	.50	N	N	N
UH221	N	300	20	N	N	.50	N	N	N
UH222	N	2,000	15	N	N	.10	N	N	N
UH222	N	1,000	20	N	N	.20	2.0	N	N
UP111	N	700	<15	N	N	.20	N	N	N
UP111	N	500	15	N	N	.20	N	N	N
UP112	N	700	<15	N	N	.20	N	N	N
UP112	N	700	20	N	N	.50	N	N	N
UP121	N	700	15	N	N	.50	N	N	N
UP121	N	700	15	N	N	.50	N	N	N
UP122	N	500	15	N	N	.10	N	N	N
UP122	N	300	<15	N	N	.05	N	N	N
UP211	N	700	20	N	50	.70	N	<10	N
UP211	N	700	20	N	N	.50	N	N	N
UP212	N	1,000	15	N	N	.10	N	N	N
UP212	N	1,500	<15	N	N	.50	N	N	N
UP221	N	500	20	N	20	.70	2.0	N	N
UP221	N	300	20	N	20	.50	N	N	N
UP222	N	700	15	N	N	.70	N	N	N
UP222	N	700	20	N	N	.70	N	N	N
UQ111	N	500	15	N	N	.10	N	N	N
UQ111	N	500	15	N	N	.10	N	N	N
UQ112	N	500	20	N	N	.20	N	N	<2
UQ112	N	500	<15	N	N	.20	N	N	N
UQ121	N	300	20	N	50	.20	N	N	N
UQ121	N	500	15	N	N	.20	N	N	N
UQ122	N	700	15	N	N	.20	N	N	N
UQ122	N	1,000	20	N	N	.50	N	<10	<2
UQ211	N	500	20	N	N	1.00	N	N	N
UQ211	N	700	15	N	N	.70	N	N	N
UQ212	N	2,000	20	N	N	.70	N	N	N
UQ212	N	1,500	20	N	N	.50	N	N	N
UQ221	N	1,000	15	N	20	.50	N	N	N
UQ221	N	1,000	<15	N	N	.50	N	N	N
UQ222	N	500	15	N	N	.50	N	<10	N
UQ222	N	1,000	15	N	N	.70	N	N	N
UJ111	N	500	15	N	N	.20	N	N	<2
UJ111	N	1,000	N	N	N	.20	N	N	N

Table 1C.--Co[illegible]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
UJ112	37 45 0	86 30 0	118,210	2.10	N	<.01	.15	.39	54.0	.12	N
UJ112	37 45 0	86 30 0	118,408	1.80	<.01	N	.14	.46	54.0	.10	N
UJ121	37 45 0	86 30 0	118,368	1.60	.47	.64	.42	.58	52.9	<.01	.15
UJ121	37 45 0	86 30 0	118,382	1.30	.39	.75	.41	.54	52.8	<.01	.17
UJ122	37 45 0	86 30 0	118,246	3.00	.81	<.01	<.01	.75	52.7	<.01	.10
UJ122	37 45 0	86 30 0	118,504	3.10	.67	.27	.30	.94	51.5	<.01	N
UJ211	37 0 0	86 15 0	118,440	1.20	<.01	<.01	.18	.68	54.3	.14	N
UJ211	37 0 0	86 15 0	118,492	1.30	<.01	N	N	.81	53.8	<.01	.40
UJ212	37 0 0	86 15 0	118,144	.97	.28	<.01	<.01	.82	53.7	<.01	<.01
UJ212	37 0 0	86 15 0	118,203	1.20	.19	N	.14	.89	52.7	N	.10
UJ221	37 0 0	86 15 0	118,283	2.10	.24	.27	.12	.60	53.4	N	.24
UJ221	37 0 0	86 15 0	118,412	3.40	.63	.18	.14	.68	52.8	N	.21
UJ222	37 0 0	86 15 0	118,396	3.30	.76	.18	.14	.86	51.6	N	.52
UJ222	37 0 0	86 15 0	118,417	3.70	.89	.13	.18	.92	51.6	<.01	.32
UR111	36 38 0	86 15 0	118,447	40.50	4.60	1.50	.62	10.00	16.7	.20	1.20
UR111	36 38 0	86 15 0	118,480	40.90	4.50	1.50	.58	9.90	16.2	.16	1.70
UR112	36 38 0	86 15 0	118,217	54.80	9.60	1.90	1.10	4.00	10.8	.34	2.50
UR112	36 38 0	86 15 0	118,432	55.40	8.80	2.30	1.20	4.40	11.0	.45	2.10
UR121	36 38 0	86 15 0	118,250	2.40	.96	<.01	<.01	.84	47.7	.45	.14
UR121	36 38 0	86 15 0	118,435	2.60	<.01	.45	.18	.65	53.3	N	.13
UR122	36 38 0	86 15 0	118,352	3.60	.46	.59	.14	.98	51.6	<.01	N
UR122	36 38 0	86 15 0	118,381	3.60	.47	.59	.15	1.10	51.4	<.01	.35
UR211	36 38 0	86 8 0	118,188	33.10	2.00	1.10	.18	12.10	20.2	N	.72
UR211	36 38 0	86 8 0	118,280	33.00	1.60	1.00	.18	12.90	19.9	N	.49
UR212	36 38 0	86 8 0	118,154	38.00	3.40	1.10	.34	12.10	16.6	.13	.89
UR212	36 38 0	86 8 0	118,271	38.30	3.50	1.40	.38	11.10	17.3	N	.75
UR221	36 38 0	86 8 0	118,499	10.50	.46	.71	.14	.67	48.0	<.01	.23
UR221	36 38 0	86 8 0	118,508	10.50	.60	.61	.14	.66	47.7	<.01	N
UR222	36 38 0	86 8 0	118,191	5.00	.39	.58	.18	.69	50.8	.30	.23
UR222	36 38 0	86 8 0	118,247	5.30	.56	<.01	.18	.59	51.9	<.01	.17
US111	36 45 0	85 38 0	118,265	6.90	.40	.16	.22	1.50	49.9	N	.22
US111	36 45 0	85 38 0	118,510	6.90	.37	.19	.14	1.40	49.7	N	.13
US112	36 45 0	85 38 0	118,398	4.80	.39	.26	.14	2.40	49.7	.17	.15
US112	36 45 0	85 38 0	118,430	4.80	.15	.17	.22	2.60	49.5	N	.22
US121	36 45 0	85 38 0	118,177	20.00	2.60	1.00	.42	8.20	31.0	.27	.69
US121	36 45 0	85 38 0	118,419	21.20	2.80	.95	.50	7.80	31.7	.20	.78
US122	36 45 0	85 38 0	118,252	21.90	3.40	.64	.42	9.20	29.2	.21	.95
US122	36 45 0	85 38 0	118,520	22.00	3.80	1.20	.48	9.30	28.1	.25	.76
US211	36 53 0	85 23 0	118,126	2.60	.19	.19	.30	.73	52.0	N	N
US211	36 53 0	85 23 0	118,295	1.50	<.01	.23	.32	.74	53.5	N	.22
US212	36 53 0	85 23 0	118,134	1.60	.54	.39	.38	.91	52.9	<.01	.15
US212	36 53 0	85 23 0	118,220	2.10	.33	<.01	<.01	.80	52.5	N	N
US221	36 52 59	85 22 59	118,369	5.60	.99	.39	.42	2.00	49.0	.15	N
US221	36 53 0	85 23 0	118,479	5.20	.38	.43	.36	2.10	49.2	N	.94
US222	36 53 0	85 23 0	118,291	11.50	.44	.34	.22	.77	46.8	N	.19
US222	36 53 0	85 23 0	118,453	11.90	.98	.45	.18	.76	47.3	.03	.22
UK111	37 0 0	85 15 0	118,380	36.90	4.20	1.40	.68	5.70	23.4	.36	.99
UK111	37 0 0	85 15 0	118,400	37.00	4.00	1.30	.70	6.40	23.2	.47	.89
UK112	37 0 0	85 15 0	118,130	46.10	4.00	.94	.60	2.90	22.2	.62	.87
UK112	37 0 0	85 15 0	118,231	45.20	4.10	.85	.50	3.00	22.3	.80	.93

Table 1C.--C

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S
UJ112	.26	.10	.02	.08	.04	42.3	.20	.05	>10	.001
UJ112	.79	.07	.02	<.01	.02	42.1	.20	.07	>10	.001
UJ121	.50	.07	.03	.02	.13	42.2	1.00	.10	>10	.010
UJ121	.59	.14	.02	.02	.13	42.1	.70	.20	>10	.005
UJ122	.35	.09	.06	<.01	.09	41.2	.50	.50	>10	.020
UJ122	.57	.09	.04	<.01	.07	41.4	.50	.50	>10	.020
UJ211	.40	.08	.02	<.01	<.01	42.9	.05	.50	>10	.005
UJ211	.44	.05	<.01	<.01	<.01	42.6	.10	.50	>10	.005
UJ212	.35	.08	<.01	.02	.05	42.8	.10	.50	>10	.005
UJ212	.40	.10	.02	<.01	.02	43.5	.10	.20	>10	.005
UJ221	.37	.12	.02	.02	.03	42.3	.20	.20	>10	.010
UJ221	.34	.16	.04	<.01	.02	41.4	.20	.20	>10	.010
UJ222	.47	.18	.05	<.01	.02	41.1	.15	.20	>10	.010
UJ222	.50	.20	.06	<.01	.02	41.0	.20	.50	>10	.020
UR111	1.30	.34	.26	.02	<.01	22.0	1.50	5.00	10	.100
UR111	1.50	.34	.25	.02	<.01	21.7	1.50	5.00	10	.100
UR112	.05	.44	.48	.20	.04	12.9	1.50	1.00	7	.200
UR112	2.50	.54	.69	<.01	.02	10.0	2.00	2.00	7	.200
UR121	.39	.13	.04	<.01	.03	41.4	.50	.20	>10	.010
UR121	.44	.14	.04	<.01	<.01	41.8	.50	.50	>10	.005
UR122	.51	.14	.02	.02	.03	41.0	.70	1.00	>10	.070
UR122	.29	.19	.03	<.01	.02	41.2	.50	.20	>10	.010
UR211	1.10	.24	.14	<.01	.03	28.8	.70	5.00	10	.050
UR211	.87	.23	.13	.05	.02	29.5	.70	10.00	>10	.050
UR212	2.30	.31	.19	.07	.09	24.4	1.00	5.00	10	.100
UR212	1.40	.05	.20	.07	.03	25.2	1.00	5.00	10	.050
UR221	1.50	.21	.03	.02	<.01	37.0	.50	.50	>10	.010
UR221	.68	.21	.02	.02	.02	37.9	.50	.30	>10	.010
UR222	.42	.16	.03	<.01	.02	41.0	.50	.20	>10	.002
UR222	.43	.12	.04	<.01	.03	40.0	.50	.20	>10	.010
US111	.26	.08	.03	.02	.02	39.5	.30	.50	>10	.010
US111	.39	.08	.03	.02	.02	40.1	.50	1.00	>10	.020
US112	.44	.09	.03	<.01	<.01	40.9	.20	.50	>10	.007
US112	.88	.09	.04	<.01	.02	40.3	.50	2.00	>10	.010
US121	1.10	.21	.19	<.01	.03	34.0	1.00	5.00	>10	.100
US121	.51	.26	.19	<.01	<.01	33.0	1.00	5.00	>10	.100
US122	1.00	.26	.25	.02	.04	32.1	1.00	5.00	>10	.100
US122	1.00	.25	.23	.05	.03	31.7	1.50	10.00	>10	.100
US211	.53	.06	.03	.04	.07	42.8	.50	.50	>10	.010
US211	.26	.11	.02	.05	.03	42.8	.50	.20	>10	.010
US212	.34	.08	.02	.05	.07	42.0	.70	.50	>10	.010
US212	.28	.13	.04	.03	.04	42.9	.50	.10	>10	.010
US221	.49	.09	.05	.02	.04	40.2	.50	.50	>10	.015
US221	.45	.08	.03	<.01	<.01	40.4	.70	1.00	>10	.010
US222	.32	.11	.02	.03	.03	38.4	.50	.20	>10	.010
US222	.45	.08	.02	<.01	<.01	37.2	.50	.20	>10	.010
UK111	.23	.35	.27	.05	.04	24.5	1.00	2.00	10	.100
UK111	1.10	.30	.26	.03	.02	24.1	1.50	2.00	10	.100
UK112	1.00	.33	.30	.05	.07	19.9	1.50	2.00	>10	.200
UK112	1.10	.33	.31	.02	.04	19.6	1.00	1.00	>10	.100

Table 1C.--Cont.

SAMPLE	Mn ppm-S	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S
UJ112	150	<50	10	N	N	5	2	N	10	N
UJ112	200	N	5	N	N	2	<2	N	N	N
UJ121	1,000	N	20	N	N	70	5	N	<10	20
UJ121	500	<50	20	N	N	70	5	N	<10	20
UJ122	500	<50	20	N	N	20	5	N	N	20
UJ122	500	<50	30	N	N	15	5	N	<10	20
UJ211	100	N	5	N	N	20	2	N	N	N
UJ211	100	<50	10	N	N	20	2	N	<10	N
UJ212	100	<50	10	N	N	20	2	N	N	N
UJ212	50	N	10	N	N	15	2	N	N	N
UJ221	100	<50	20	N	N	15	2	N	N	N
UJ221	150	N	20	N	N	15	2	10	<10	<20
UJ222	100	<50	50	N	N	15	<2	N	N	N
UJ222	150	<50	70	N	N	20	5	N	<10	N
UR111	150	50	150	N	7	50	10	N	20	20
UR111	100	50	150	N	7	50	10	N	50	N
UR112	150	70	200	N	7	50	15	N	30	20
UR112	200	100	300	N	10	70	10	<7	30	20
UR121	100	<50	150	N	N	30	<2	N	N	N
UR121	100	N	70	N	N	30	2	N	N	N
UR122	300	<50	100	N	N	10	5	20	10	20
UR122	100	<50	20	N	N	15	<2	N	N	N
UR211	100	<50	50	N	N	20	5	N	10	N
UR211	100	50	70	N	N	20	5	N	15	20
UR212	150	50	100	N	N	30	5	N	20	20
UR212	100	50	70	N	N	20	5	N	20	N
UR221	100	<50	20	N	N	20	<2	N	N	N
UR221	100	<50	20	N	N	15	<2	N	10	N
UR222	100	N	20	N	N	20	2	10	N	N
UR222	100	<50	20	N	N	20	2	N	N	N
US111	100	<50	20	N	N	15	<2	N	N	N
US111	100	<50	20	N	N	50	2	N	N	N
US112	100	<50	10	N	N	15	<2	N	N	N
US112	100	N	20	N	N	15	<2	N	N	N
US121	100	<50	100	N	N	50	7	N	<10	N
US121	150	<50	100	N	N	20	5	N	<10	N
US122	150	50	100	N	N	20	15	N	10	N
US122	200	50	100	N	N	30	7	N	15	20
US211	200	<50	20	N	N	20	<2	N	N	N
US211	200	<50	10	N	N	20	5	N	15	N
US212	200	<50	20	N	N	30	5	N	<10	N
US212	100	N	10	N	N	20	2	N	N	N
US221	150	<50	20	N	N	15	<2	N	N	20
US221	150	<50	20	N	N	20	2	N	<10	N
US222	200	<50	20	N	N	20	2	N	N	N
US222	200	N	10	N	N	15	<2	N	N	N
UK111	150	<50	150	N	N	20	5	7	10	N
UK111	150	50	100	N	<7	30	5	N	20	N
UK112	200	50	150	N	7	30	7	N	15	N
UK112	150	50	150	N	N	20	5	N	15	N

Table 1C.--Cont.

SAMPLE	Sc ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
UJ112	N	700	<15	N	N	.20	N	N	N
UJ112	10	1,000	N	N	N	.07	N	N	N
UJ121	N	1,000	50	N	N	.20	N	N	N
UJ121	N	2,000	50	N	N	.20	N	N	N
UJ122	N	1,000	20	N	N	.70	N	N	N
UJ122	N	1,000	20	N	N	.50	N	N	N
UJ211	N	700	15	<20	N	.20	N	N	N
UJ211	N	1,500	15	<20	N	.10	N	N	N
UJ212	N	1,000	15	<0	N	.10	N	N	N
UJ212	N	700	15	<20	N	.10	N	N	N
UJ221	N	1,000	20	N	N	.20	N	N	N
UJ221	N	1,500	15	N	N	.50	N	N	N
UJ222	N	500	<15	N	N	.20	N	N	N
UJ222	N	1,000	15	N	N	.70	N	<10	N
UR111	<10	150	70	<20	50	2.00	2.0	10	<2
UR111	10	150	100	<20	50	2.00	2.0	10	<2
UR112	10	150	100	<20	70	5.00	3.0	10	2
UR112	15	150	100	20	N	5.00	5.0	20	2
UR121	N	5,000	30	<20	N	.20	N	N	<2
UR121	N	200	20	<20	N	.20	N	N	N
UR122	N	300	15	N	50	1.00	1.5	<10	N
UR122	N	700	30	N	N	.50	N	N	N
UR211	N	150	50	N	N	1.00	N	<10	<2
UR211	N	150	50	<20	20	.70	N	N	N
UR212	N	150	50	<20	50	1.50	N	10	2
UR212	N	100	50	20	70	1.00	N	10	<2
UR221	N	500	50	<20	N	.20	N	N	N
UR221	N	500	50	N	N	.20	N	N	N
UR222	N	300	50	N	N	.20	N	N	N
UR222	N	500	50	N	N	.50	N	N	N
US111	N	500	15	N	N	.20	N	N	N
US111	N	700	20	N	50	.50	N	N	N
US112	N	500	<15	N	N	.20	N	N	N
US112	N	700	15	N	N	.20	N	N	N
US121	N	500	100	N	50	1.00	1.5	10	<2
US121	N	300	50	N	20	1.50	1.5	<10	<2
US122	N	150	30	N	50	1.00	1.5	<10	<2
US122	N	200	50	N	50	1.00	1.5	10	2
US211	N	500	50	N	N	.20	N	N	<2
US211	N	500	70	N	N	.20	2.0	N	N
US212	N	500	150	N	N	.50	N	N	N
US212	N	500	70	N	N	.50	N	N	N
US221	N	500	50	<20	20	.50	N	N	<2
US221	N	500	50	<20	20	.50	N	N	N
US222	N	300	50	N	N	.50	N	N	N
US222	N	500	50	N	N	.50	N	N	2
UK111	N	200	50	20	50	1.00	1.5	<10	2
UK111	N	200	70	<20	70	1.50	1.5	10	<2
UK112	<10	200	50	20	150	2.00	1.5	10	2
UK112	N	200	50	<20	100	1.50	N	10	2

Table 1C.--Co

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
UK121	37 0 0	85 15 0	118,296	6.20	.20	.51	.22	.76	50.5	.19	.25
UK121	37 0 0	85 15 0	118,330	6.00	.61	.52	.20	.81	50.6	N	.29
UK122	37 0 0	85 15 0	118,232	14.00	.56	.88	.20	.85	45.7	.19	.14
UK122	37 0 0	85 15 0	118,394	13.40	.69	1.10	.22	.78	46.1	<.01	.15
UK211	37 8 0	85 0 0	118,371	5.30	1.20	.67	.66	1.10	49.8	N	.17
UK211	37 8 0	85 0 0	118,426	5.40	.99	.31	.90	1.00	50.3	<.01	.25
UK212	37 8 0	85 0 0	118,379	4.30	1.10	.48	1.20	1.30	50.1	N	.49
UK212	37 8 0	85 0 0	118,461	4.40	.91	.37	1.30	1.40	50.0	N	.63
UK221	37 8 0	85 0 0	118,201	4.50	.73	.48	.84	.82	50.7	<.01	.16
UK221	37 8 0	85 0 0	118,483	4.00	.46	.49	.74	1.00	51.1	N	.96
UK222	37 8 0	85 0 0	118,315	7.60	1.40	1.00	.46	2.20	47.0	<.01	N
UK222	37 8 0	85 0 0	118,511	7.70	.58	1.10	.58	2.10	47.5	.21	.14
UT111	36 38 0	84 30 0	118,259	12.00	2.20	2.10	.62	14.80	29.3	N	.39
UT111	36 38 0	84 30 0	118,341	12.10	2.40	.45	2.50	15.60	26.4	<.01	.51
UT112	36 38 0	84 30 0	118,237	14.20	2.50	.34	1.60	14.50	27.1	.11	.36
UT112	36 38 0	84 30 0	118,477	13.80	2.40	.65	1.50	15.10	26.5	.11	.98
UT121	36 38 0	84 30 0	118,133	10.40	2.30	.28	1.20	15.90	27.6	N	.42
UT121	36 38 0	84 30 0	118,331	9.70	2.20	.62	.98	14.80	30.3	N	N
UT122	36 38 0	84 30 0	118,399	2.30	.44	.75	.18	4.50	47.7	N	.39
UT122	36 38 0	84 30 0	118,478	2.50	.46	.32	.62	4.50	47.5	N	.84
UT221	36 53 0	84 15 0	118,175	6.20	.93	.91	1.90	10.50	36.8	N	.45
UT221	36 53 0	84 15 0	118,328	5.70	1.50	1.00	1.70	9.80	38.2	<.01	N
UT222	36 53 0	84 15 0	118,236	6.30	1.00	.52	2.80	13.30	33.0	N	.16
UT222	36 53 0	84 15 0	118,429	6.40	1.10	.40	3.00	13.90	32.5	.10	.34
UL111	37 15 0	84 23 0	118,125	2.00	.38	.15	N	.38	52.8	<.01	N
UL111	37 15 0	84 23 0	118,437	1.10	N	N	.10	.22	55.1	<.01	.13
UL112	37 15 0	84 23 0	118,192	1.30	<.01	N	N	.19	54.1	.20	.11
UL112	37 15 0	84 23 0	118,512	1.50	N	<.01	N	.26	54.3	N	N
UL121	37 15 0	84 23 0	118,190	4.40	.43	N	.10	.61	52.2	.28	.26
UL121	37 15 0	84 23 0	118,446	3.80	.58	<.01	.22	.60	52.6	N	.18
UL122	37 15 0	84 23 0	118,176	3.50	<.01	N	.10	.68	52.8	N	<.01
UL122	37 15 0	84 23 0	118,455	3.40	.98	N	N	.59	52.2	.12	.43
UL221	37 15 0	84 0 0	118,124	5.70	.96	.43	.50	1.70	49.2	N	.23
UL221	37 15 0	84 0 0	118,308	5.20	.92	.56	.58	1.90	39.0	N	.30
UL222	37 15 0	84 0 0	118,281	6.80	.44	.68	.66	2.00	47.8	N	.38
UL222	37 15 0	84 0 0	118,332	6.30	1.20	.70	.64	2.10	47.8	<.01	.80
UE111	38 0 0	83 15 0	118,219	5.20	.81	<.01	<.01	.40	51.3	<.01	.15
UE111	38 0 0	83 15 0	118,375	3.70	.98	N	.38	.28	57.8	<.01	.28
UE112	38 0 0	83 15 0	118,139	2.00	.54	<.01	.15	.24	53.9	<.01	.13
UE112	38 0 0	83 15 0	118,339	2.00	.49	N	.36	.45	53.0	<.01	.28
UE121	38 0 0	83 15 0	118,275	3.90	.49	.96	.58	.59	51.8	.10	.26
UE121	38 0 0	83 15 0	118,409	4.10	.63	.47	.18	.60	52.2	N	.34
UE122	38 0 0	83 15 0	118,205	8.40	.90	.41	.90	2.10	46.8	<.01	.41
UE122	38 0 0	83 15 0	118,434	8.60	.99	.40	.82	1.90	47.3	N	.29
UE211	38 30 0	83 0 0	118,112	12.30	.45	.37	.14	.21	47.9	<.01	.10
UE211	38 30 0	83 0 0	118,378	11.50	.47	.15	.23	.24	48.3	N	.20
UE212	38 30 0	83 0 0	118,282	3.20	.48	.46	.18	.37	52.5	N	.47
UE212	38 30 0	83 0 0	118,287	3.40	.63	.29	.18	.48	52.6	N	.34
UE221	38 30 0	83 0 0	118,276	4.20	.71	.33	.38	.26	52.7	.10	.36
UE221	38 30 0	83 0 0	118,494	4.30	.46	.19	.20	.33	51.9	.14	.24

Table 1C.--Cont.

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S
UK121	.38	.10	.03	.07	.03	40.2	.70	.20	>10	.015
UK121	.41	.09	.04	.07	.04	39.8	.50	.20	>10	.010
UK122	.53	.16	.05	.05	.03	36.0	1.00	.20	>10	.010
UK122	.42	.22	.04	<.01	<.01	36.1	.50	.20	>10	.010
UK211	.75	.13	.07	.08	.06	39.8	1.00	.20	>10	.015
UK211	.61	.11	.06	<.01	.03	39.9	1.00	.20	>10	.020
UK212	1.20	.15	.06	.09	.04	39.4	1.00	.20	>10	.100
UK212	.49	.05	.04	.05	.02	40.2	1.00	.50	>10	.010
UK221	.49	.11	.05	.02	.06	40.8	.50	.20	>10	.010
UK221	.47	.10	.04	.03	.03	40.6	1.00	.70	>10	.010
UK222	.54	.11	.04	.03	.04	39.4	1.00	.50	>10	.010
UK222	.41	.09	.03	.02	.03	38.9	1.00	1.00	>10	.015
UT111	1.00	.22	.12	.05	.09	38.4	1.00	10.00	>10	.050
UT111	.80	.20	.11	.04	.11	38.4	1.00	5.00	>10	.050
UT112	1.20	.25	.16	.06	.09	37.1	1.50	10.00	>10	.050
UT112	1.00	.22	.14	<.01	.07	37.3	1.50	10.00	>10	.050
UT121	1.20	.26	.11	.03	.09	39.5	1.00	10.00	>10	.050
UT121	.90	.20	.12	.02	.06	39.6	1.00	10.00	>10	.020
UT122	.56	.09	.04	<.01	.06	42.6	1.00	1.00	>10	.010
UT122	.46	.09	.02	<.01	.05	42.5	1.00	5.00	>10	.010
UT221	.75	.12	.07	<.01	.15	40.6	2.00	5.00	>10	.030
UT221	.60	.11	.08	.03	.15	41.0	2.00	5.00	>10	.020
UT222	.81	.12	.08	.02	.19	41.1	2.00	10.00	>10	.020
UT222	.30	.13	.11	<.01	.07	41.5	3.00	7.00	>10	.020
UL111	.27	.09	.02	.02	.04	43.5	.10	.20	>10	.005
UL111	.35	.11	.02	<.01	.04	42.6	.10	.20	>10	.005
UL112	.25	.08	<.01	<.01	.02	43.3	.10	.10	>10	.002
UL112	.32	.08	.02	.02	<.01	42.6	.10	.20	>10	.005
UL121	.41	.12	.03	<.01	.02	41.0	.20	.20	>10	.010
UL121	.48	.13	.03	<.01	<.01	41.2	.20	.50	>10	.020
UL122	.38	.08	.02	<.01	.02	41.8	.10	.50	>10	.010
UL122	.39	.07	.02	<.01	<.01	41.7	.05	.20	>10	.010
UL221	1.00	.15	.06	.04	.08	39.8	1.00	1.50	>10	.050
UL221	.53	.16	.06	.03	.06	40.0	1.00	1.00	>10	.020
UL222	.49	.19	.04	.05	.05	39.5	1.00	1.00	>10	.020
UL222	.53	.17	.05	.06	.07	39.4	1.00	.50	>10	.020
UE111	.50	.12	.05	.03	.07	41.2	.30	.07	>10	.010
UE111	.33	.14	.04	.02	.06	41.5	.20	.07	>10	.010
UE112	.49	.08	.02	.04	.08	42.0	.20	.30	>10	.010
UE112	.36	.07	<.01	.04	.06	42.1	.20	.10	>10	.010
UE121	.14	.13	.02	.07	.07	40.6	.50	.20	>10	.007
UE121	.29	.35	.03	<.01	.02	40.6	.50	.10	>10	.010
UE122	.36	.13	.11	<.01	.08	38.7	.50	.50	>10	.020
UE122	.62	.16	.06	<.01	.07	38.8	.70	1.00	>10	.020
UE211	.26	.11	.04	.04	.08	37.7	.20	.20	>10	.010
UE211	.67	.13	.03	.02	.06	37.9	.20	.05	>10	.005
UE212	.25	.15	.05	.02	.07	41.6	.50	.20	>10	.020
UE212	.31	.13	.04	.02	.07	41.5	.50	.20	>10	.020
UE221	.40	.09	.04	.04	.10	40.3	.50	.10	>10	.020
UE221	.38	.07	.05	.02	.09	41.2	.30	.20	>10	.020

Table 1C.--Cont.

SAMPLE	Mn ppm-S	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S
UK121	200	<50	20	N	N	15	2	N	10	N
UK121	200	<50	20	N	N	20	5	N	<10	20
UK122	150	<50	30	N	N	15	2	N	10	N
UK122	100	<50	20	N	N	10	<2	N	<10	N
UK211	200	<50	20	N	7	50	2	N	<10	N
UK211	200	<50	20	N	N	70	2	N	10	N
UK212	200	<50	10	N	N	50	<2	N	<10	N
UK212	200	N	10	N	N	50	2	N	<10	N
UK221	200	N	20	N	N	20	2	N	N	N
UK221	200	N	20	N	7	50	2	N	10	N
UK222	200	<50	20	N	N	10	2	N	N	N
UK222	200	<50	20	N	N	10	2	N	N	N
UT111	500	<50	50	N	N	20	5	N	<10	N
UT111	500	<50	50	N	N	15	2	N	<10	N
UT112	200	<50	50	N	N	20	5	N	10	N
UT112	200	<50	50	N	N	20	5	N	10	20
UT121	500	<50	50	N	N	20	5	N	10	N
UT121	300	<50	50	N	N	15	5	N	<10	20
UT122	200	<50	15	N	N	20	2	N	N	N
UT122	300	<50	15	N	N	20	5	N	<10	20
UT221	700	<50	50	N	N	20	2	N	<10	N
UT221	700	<50	50	N	N	15	2	N	30	20
UT222	500	<50	30	N	N	15	5	N	10	N
UT222	1,000	N	30	N	N	15	5	N	N	20
UL111	50	<50	20	N	N	10	<2	N	N	N
UL111	50	N	15	N	N	10	<2	N	N	N
UL112	20	N	10	N	N	20	<2	10	N	N
UL112	50	<50	10	N	N	15	2	N	N	N
UL121	30	N	20	N	N	15	2	10	10	N
UL121	50	N	30	N	N	15	2	N	10	N
UL122	50	<50	30	N	N	10	<2	N	N	N
UL122	50	N	20	N	N	10	<2	N	N	N
UL221	200	<50	30	<2	N	20	5	N	10	N
UL221	500	<50	30	N	N	20	5	N	20	20
UL222	500	<50	50	N	N	20	5	N	20	20
UL222	300	<50	100	N	N	15	5	N	10	20
UE111	200	N	30	N	N	15	2	N	N	N
UE111	200	<50	50	N	N	15	2	N	<10	N
UE112	300	<50	50	N	N	15	5	N	N	N
UE112	300	<50	30	N	N	10	5	N	N	N
UE121	200	<50	300	N	N	15	5	N	10	N
UE121	200	<50	100	N	N	10	5	N	10	<20
UE122	500	N	50	N	7	20	5	N	15	N
UE122	500	<50	70	N	N	15	5	N	N	N
UE211	200	<50	50	2	N	15	2	N	N	N
UE211	200	<50	30	N	N	5	2	N	N	N
UE212	500	N	50	N	N	20	5	N	<10	20
UE212	300	<50	50	N	N	15	5	N	<10	N
UE221	500	<50	50	N	N	10	5	N	10	20
UE221	500	50	50	N	N	15	5	N	<10	20

Table 1C.--Co[illegible]

SAMPLE	Sc ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
UK121	N	500	50	20	N	.50	N	N	<2
UK121	N	500	30	<20	N	.20	N	N	N
UK122	N	500	70	<20	N	.50	N	N	<2
UK122	N	300	50	<20	N	.20	N	N	N
UK211	N	500	150	<20	N	.50	N	<10	<2
UK211	N	700	200	<20	N	.70	N	N	<2
UK212	N	500	150	<20	N	.50	N	N	<2
UK212	N	500	150	<20	50	.50	N	N	N
UK221	N	300	100	N	N	.20	N	N	<2
UK221	N	500	200	N	N	.50	N	N	<2
UK222	N	500	20	N	N	.50	N	N	N
UK222	N	500	50	N	N	.50	N	N	N
UT111	N	500	20	N	50	1.00	N	N	N
UT111	N	300	15	N	20	.70	N	N	N
UT112	N	500	20	N	70	1.00	N	<10	N
UT112	N	500	20	N	20	1.00	1.5	<10	N
UT121	N	300	30	N	N	1.00	N	<10	N
UT121	N	300	20	N	20	.70	N	<10	N
UT122	N	1,000	30	N	N	.50	N	N	N
UT122	N	1,500	20	<20	N	.50	N	N	N
UT221	N	500	20	N	N	1.00	N	<10	<2
UT221	N	700	15	N	N	.70	N	N	N
UT222	N	300	15	N	50	.70	N	N	<2
UT222	N	300	15	N	N	.50	N	N	N
UL111	N	500	<15	N	N	.20	N	N	N
UL111	N	500	15	N	N	.20	N	N	N
UL112	N	500	15	N	N	.07	N	N	N
UL112	N	1,000	15	N	N	.10	N	N	N
UL121	N	1,000	20	N	N	.50	N	N	N
UL121	N	1,000	30	N	N	.50	N	N	N
UL122	N	1,000	20	N	N	.20	N	N	N
UL122	N	1,000	15	N	N	.20	N	N	N
UL221	N	700	20	N	N	1.00	N	N	<2
UL221	N	1,000	20	N	N	.70	N	<10	N
UL222	N	1,000	20	<20	50	.70	N	N	N
UL222	N	1,000	20	N	N	.70	N	N	N
UE111	N	500	15	<20	N	.50	N	N	<2
UE111	N	700	15	N	N	.50	N	N	N
UE112	N	700	20	N	N	.50	N	N	N
UE112	N	1,000	15	N	N	.20	N	N	N
UE121	10	1,000	N	<20	N	.20	N	N	N
UE121	N	1,000	15	<20	N	.10	N	N	<2
UE122	N	500	20	<20	N	1.00	N	N	N
UE122	N	500	20	<20	N	.70	N	N	N
UE211	N	500	15	N	N	5.00	N	N	<2
UE211	N	500	<15	N	N	.10	N	N	N
UE212	N	700	20	N	20	.50	N	N	N
UE212	N	500	15	N	N	.50	N	N	N
UE221	N	500	20	N	50	.50	N	N	N
UE221	N	500	20	N	20	.50	N	N	N

Table 1C.--Cont.

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
UE222	38 30 0	83 0 0	118,117	1.60	N	.10	.22	.16	54.3	<.01	N
UE222	38 30 0	83 0 0	118,272	1.20	N	.20	.26	.29	55.0	N	.27
UMF111	38 15 0	82 52 0	120,984	5.40	.46	N	.12	.41	51.3	.11	.20
UMF111	38 15 0	82 52 0	121,004	4.40	.66	<.01	.32	.55	52.5	.11	.32
UMF112	38 15 0	82 52 0	120,978	3.50	.56	<.01	.28	.44	52.6	N	.18
UMF112	38 15 0	82 52 0	121,061	4.10	.65	.11	.24	.45	51.9	.12	.18
UMF121	38 15 0	82 52 0	120,989	2.00	.27	N	.32	.22	54.0	.15	.15
UMF121	38 15 0	82 52 0	121,014	2.20	.37	<.01	.40	.37	53.5	N	.20
UMF122	38 15 0	82 52 0	121,025	3.60	.83	<.01	10.60	1.50	41.3	.15	.27
UMF122	38 15 0	82 52 0	121,018	3.40	.85	<.01	10.30	1.10	42.5	N	.36
UMF211	38 22 0	82 52 0	121,022	1.20	.55	N	.12	.34	55.1	.30	.18
UMF211	38 22 0	82 52 0	121,032	1.00	.45	<.01	.12	.34	54.3	.18	.18
UMF212	38 22 0	82 52 0	121,054	2.50	.58	.39	.74	.49	53.3	N	.10
UMF212	38 22 0	82 52 0	121,007	2.30	.65	.30	.64	.33	53.2	N	.27
UMF221	38 22 0	82 52 0	121,065	5.00	.73	.11	.24	.41	51.6	.32	.20
UMF221	38 22 0	82 52 0	121,028	4.50	.65	<.01	.44	.42	52.5	.20	.11
UMF222	38 22 0	82 52 0	121,008	.58	.37	N	.24	.22	55.1	N	.16
UMF222	38 22 0	82 52 0	120,998	.58	.37	2.20	.24	.21	53.3	.15	N

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S
UE222	.36	.12	.05	.09	.15	42.2	.20	.10	>10	.002
UE222	.34	.05	<.01	.09	.12	42.0	.15	.03	>10	.001
UMF111	.37	.08	.06	.02	.05	40.6	.20	.20	>10	.020
UMF111	.40	.03	.04	.02	.04	40.5	.20	.50	>10	.020
UMF112	.53	.05	.04	<.01	.09	41.5	.30	.30	>10	.020
UMF112	.51	<.01	<.01	.02	.04	41.3	.50	.30	>10	.020
UMF121	.36	.16	.06	.11	.16	42.0	.50	.20	>10	.015
UMF121	.41	.06	.06	.11	.09	41.6	.50	.20	>10	.010
UMF122	.55	.06	<.01	.20	.57	40.1	10.00	1.00	>10	.015
UMF122	.70	.07	.07	.19	.44	40.0	7.00	1.00	>10	.020
UMF211	.32	.04	<.01	.10	.07	41.5	.20	.20	>10	.010
UMF211	.41	<.01	<.01	.09	.14	42.8	.20	.20	>10	.010
UMF212	.50	.05	<.01	.09	.03	41.2	1.00	.20	>10	.020
UMF212	.32	.04	.06	.08	.06	41.7	.70	.20	>10	.015
UMF221	.39	.02	<.01	.05	.14	40.7	.50	.20	>10	.020
UMF221	.39	<.01	<.01	.04	.03	40.7	.50	.20	>10	.020
UMF222	.23	.04	.04	.10	.11	42.4	.30	.15	>10	.010
UMF222	.30	.04	.04	.10	.05	42.3	.50	.10	>10	.010

Table 1C.--Co.

SAMPLE	Mn ppm-S	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S
UE222	1,000	N	20	<2	N	10	2	N	N	N
UE222	500	N	20	N	N	2	2	N	N	N
UMF111	200	<50	70	N	N	30	10	N	<10	N
UMF111	200	<50	70	N	N	150	7	N	<10	N
UMF112	300	50	70	N	N	20	10	N	10	20
UMF112	200	<50	70	N	N	15	10	N	15	20
UMF121	700	<50	50	N	N	10	<2	N	<10	N
UMF121	500	N	30	N	N	10	2	N	<10	N
UMF122	3,000	N	100	N	N	15	5	N	10	N
UMF122	3,000	<50	100	N	N	20	2	N	10	N
UMF211	200	<50	30	N	N	20	5	N	<10	N
UMF211	200	<50	30	N	N	15	10	N	<10	20
UMF212	1,500	<50	30	N	N	10	2	N	10	20
UMF212	1,000	<50	30	N	N	10	<2	N	<10	N
UMF221	200	<50	30	N	N	10	5	N	10	N
UMF221	500	<50	30	N	N	10	5	N	10	N
UMF222	200	<50	20	N	N	10	2	N	<10	20
UMF222	300	<50	20	N	N	10	2	N	<10	N

SAMPLE	Sc ppm-S	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	Ga ppm-S	Yb ppm-S
UE222	N	500	<15	N	N	.20	N	N	N
UE222	N	150	N	N	N	.05	N	N	N
UMF111	N	1,000	<15	N	100	.50	N	N	N
UMF111	N	700	15	N	50	.20	N	N	N
UMF112	N	700	15	N	70	.70	N	N	N
UMF112	N	700	20	N	50	.50	N	N	<2
UMF121	N	500	20	20	20	.50	N	N	N
UMF121	N	500	15	<20	N	.50	N	N	N
UMF122	N	300	20	50	N	.70	N	<10	2
UMF122	N	500	20	50	N	.70	N	N	2
UMF211	N	500	<15	N	N	.30	N	N	N
UMF211	N	500	<15	N	N	.20	N	N	N
UMF212	N	700	15	20	N	.50	N	<10	<2
UMF212	N	500	15	20	N	.50	N	N	N
UMF221	N	700	<15	N	N	.50	N	<10	N
UMF221	N	500	<15	N	50	.50	N	N	N
UMF222	N	500	<15	N	N	.20	N	N	N
UMF222	N	700	<15	N	N	.20	N	N	N

Table 10.--[illegible]ical analyses of carbonate rocks of Pennsylvanian are in Kentucky. [%, percent; ppm, parts per million; N, not detected, leaders (--) indicate no data; labels ending in "-S" are spectrographic determinations]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
PF132	38 15 0	82 38 0	120,999	21.2	6.00	1.00	4.70	1.20	33.9	.45	.62
PF132	38 15 0	82 38 0	121,036	21.0	5.90	1.00	4.70	1.30	33.4	.32	1.10
PF231	38 22 0	82 38 0	121,052	16.0	6.50	2.40	.44	1.10	37.9	N	.77
PF231	38 22 0	82 38 0	120,996	16.0	6.60	2.70	.40	1.10	38.6	.40	1.00
PI111	37 15 0	87 30 0	118,200	24.6	7.30	.48	5.20	6.90	23.4	.16	1.20
PI111	37 15 0	87 30 0	118,307	24.3	7.20	.48	5.70	7.00	23.5	.33	.95
PI112	37 15 0	87 30 0	118,235	24.7	6.80	1.10	5.20	6.90	23.0	.25	.86
PI112	37 15 0	87 30 0	118,270	24.2	7.20	1.50	5.40	7.50	22.9	.19	1.00
PI121	37 15 0	87 30 0	118,187	14.0	4.00	--	--	1.00	28.6	.17	.80
PI121	37 15 0	87 30 0	118,469	14.4	3.00	--	--	1.10	28.8	.08	.98
PI122	37 15 0	87 30 0	118,268	14.0	4.10	--	--	1.00	29.3	1.00	.59
PI122	37 15 0	87 30 0	118,387	13.9	3.60	--	--	1.10	29.6	N	.82
PI231	37 15 0	87 22 0	120,991	4.0	.85	2.20	.28	.61	49.8	.21	.16
PI231	37 15 0	87 22 0	120,997	2.7	.66	2.10	.24	.79	51.5	.27	.15
PI232	37 15 0	87 22 0	121,045	2.3	.93	.24	.96	1.20	51.4	N	N
PI232	37 15 0	87 22 0	121,006	1.8	.75	.20	1.00	1.20	51.9	.10	.22
PI241	37 15 0	87 22 0	121,017	2.2	.95	.70	.64	1.40	51.6	.13	.24
PI241	37 15 0	87 22 0	121,019	1.5	.95	1.10	.32	1.40	51.2	.14	.31
PI242	37 15 0	87 22 0	121,043	4.1	1.20	.44	.44	6.20	43.5	.18	.23
PI242	37 15 0	87 22 0	120,976	4.3	1.20	.32	.52	6.30	43.7	.21	.23
PJ111	37 53 0	86 45 0	118,146	4.3	1.80	.57	3.30	3.20	45.6	N	.25
PJ111	37 53 0	86 45 0	118,470	4.3	.62	.56	3.40	2.80	46.3	N	.68
PJ112	37 53 0	86 45 0	118,386	4.4	.99	.65	2.50	2.30	47.4	N	.38
PJ112	37 53 0	86 45 0	118,466	4.0	1.10	.33	2.70	2.30	47.6	<.01	.56
PJ121	37 53 0	86 45 0	118,113	13.0	1.70	.67	.28	.88	45.0	<.01	.18
PJ121	37 53 0	86 45 0	118,509	13.0	1.70	.44	.38	.83	45.2	<.01	.20
PJ122	37 53 0	86 45 0	118,123	5.0	.65	.31	.44	.69	51.0	<.01	N
PJ122	37 53 0	86 45 0	118,173	5.4	.15	.40	.52	.74	50.5	<.01	N
PJ311	37 45 0	86 52 0	121,033	5.8	1.40	.76	.40	.91	49.1	.18	.28
PJ311	37 45 0	86 52 0	120,986	5.3	1.40	.95	.32	1.10	48.9	.57	.35
PJ312	37 45 0	86 52 0	121,042	6.8	1.50	.37	.36	1.00	49.2	.16	.36
PJ312	37 45 0	86 52 0	121,062	6.8	1.40	.33	.40	.90	48.8	N	.25
PJ321	37 45 0	86 52 0	120,977	5.9	1.20	.66	1.40	2.50	46.0	.22	.28
PJ321	37 45 0	86 52 0	121,037	5.6	1.40	.46	1.40	2.50	46.6	.13	.20
PJ322	37 45 0	86 52 0	120,995	11.2	1.50	.61	.72	.80	46.5	.39	.38
PJ322	37 45 0	86 52 0	121,047	11.9	1.60	.60	.64	.66	46.3	N	.25
PM111	37 45 0	83 23 0	118,316	37.4	8.50	1.30	2.70	1.60	23.3	.73	1.00
PM111	37 45 0	83 23 0	118,513	38.1	7.90	1.20	2.70	1.50	23.3	.94	1.10
PM112	37 45 0	83 23 0	118,238	36.3	8.00	.59	3.10	1.80	24.3	.80	1.10
PM112	37 45 0	83 23 0	118,505	36.7	8.80	1.00	2.90	1.70	23.5	.80	1.10
PM121	37 45 0	83 23 0	118,195	25.8	6.90	.80	3.60	1.60	30.3	.48	1.20
PM121	37 45 0	83 23 0	118,428	25.8	6.50	.73	3.70	1.60	30.8	.46	1.10
PM122	37 45 0	83 23 0	118,344	25.9	7.10	.85	3.50	1.70	29.9	.55	1.10
PM122	37 45 0	83 23 0	118,348	25.9	7.10	.85	3.50	1.60	30.3	.51	.99
PM211	37 8 0	83 15 0	118,111	25.6	8.60	<.01	.79	1.80	34.1	.28	1.50
PM211	37 8 0	83 15 0	118,182	24.8	8.60	1.90	2.40	1.70	29.2	.61	1.90
PM212	37 8 0	83 15 0	118,359	23.5	7.90	1.50	3.00	1.80	31.2	.34	1.60
PM212	37 8 0	83 15 0	118,515	23.9	8.40	1.60	3.00	1.70	30.6	.63	1.20
PM221	37 8 0	83 15 0	118,244	32.2	9.00	.92	2.80	1.70	25.4	.74	1.60
PM221	37 8 0	83 15 0	118,403	32.2	8.80	.76	3.40	1.70	25.4	.73	1.50

Table 10.--Cont.

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
PF132	1.80	.15	.33	.32	.09	28.0	5.0	1.0	>10	.200	3,000
PF132	1.70	.09	.28	.32	.14	28.5	5.0	.7	>10	.200	3,000
PF231	2.80	.62	.18	.05	.11	30.7	2.0	.7	>10	.100	1,000
PF231	2.00	.67	.25	.05	.16	30.0	3.0	1.0	>10	.150	1,000
PI111	1.70	.31	.38	<.01	.32	27.7	2.0	2.0	>10	.100	1,000
PI111	2.20	.31	.41	.08	.29	27.3	5.0	5.0	>10	.150	1,000
PI112	2.00	.31	.44	.07	.33	27.3	3.0	3.0	>10	.100	500
PI112	1.80	.30	.41	.12	.34	27.2	5.0	2.0	>10	.200	2,000
PI121	1.40	.79	.16	3.00	.31	19.4	10.0	.5	>10	.050	1,000
PI121	1.30	.71	.15	3.10	.29	19.5	10.0	.3	>10	.070	1,500
PI122	2.00	.05	.15	3.00	.28	19.5	10.0	.2	>10	.050	2,000
PI122	1.20	.75	.16	3.00	.28	19.3	10.0	.5	>10	.050	1,000
PI231	.46	.12	.06	.03	.09	40.8	2.0	.2	>10	.010	700
PI231	.63	.10	.09	.02	.20	40.4	2.0	.2	>10	.010	1,000
PI232	.64	.02	<.01	.05	.14	41.6	1.0	.7	>10	.020	1,000
PI232	.46	.04	.04	.05	.11	41.2	1.5	1.0	>10	.015	1,000
PI241	.57	.08	.07	.08	.09	41.2	1.5	1.0	>10	.015	1,500
PI241	.65	.11	.07	.10	.18	42.0	1.5	1.0	>10	.020	1,500
PI242	1.50	.05	<.01	.04	.11	41.8	.7	3.0	>10	.020	1,000
PI242	.73	.09	.04	.03	.13	41.5	.7	5.0	>10	.020	1,000
PJ111	.20	.14	.05	.06	.26	40.4	3.0	2.0	>10	.020	2,000
PJ111	.43	.15	.05	.03	.24	40.4	2.0	2.0	>10	.020	1,000
PJ112	.40	.21	.07	<.01	.18	40.5	2.0	.5	>10	.010	1,000
PJ112	.52	.11	.04	<.01	.18	40.6	2.0	1.0	>10	.050	1,000
PJ121	.69	.21	.07	.07	.18	37.0	1.0	.5	>10	.030	1,000
PJ121	.65	.19	.06	.05	.13	36.7	1.0	.5	>10	.030	1,000
PJ122	.23	.13	.03	.09	.16	40.7	.7	.5	>10	.010	1,000
PJ122	.46	.12	.03	.04	.14	40.9	.5	.2	>10	.010	1,000
PJ311	.65	.07	<.01	.12	.07	39.7	1.0	.7	>10	.030	500
PJ311	.66	.12	.07	.13	.14	39.9	1.0	.5	>10	.050	700
PJ312	1.00	.09	<.01	.13	.07	39.0	.7	.7	>10	.050	700
PJ312	.76	.07	<.01	.12	.14	39.7	.7	.7	>10	.050	700
PJ321	.66	.14	.04	.05	.11	40.4	2.0	1.5	>10	.020	1,000
PJ321	.91	.09	<.01	.06	.14	40.4	2.0	1.5	>10	.020	700
PJ322	.65	.16	.07	.10	.18	36.6	1.5	.5	>10	.030	1,000
PJ322	.70	.08	<.01	.10	.10	36.5	1.0	.3	>10	.020	1,000
PM111	2.10	.23	.54	.19	.11	20.0	2.0	.5	10	.150	500
PM111	2.10	.21	.52	.18	.10	19.8	3.0	.5	>10	.200	500
PM112	2.00	.20	.53	.17	.12	20.4	2.0	.5	>10	.150	200
PM112	2.10	.19	.54	.18	.09	20.2	2.0	.5	>10	.200	300
PM121	2.00	.21	.47	.16	.14	26.3	2.0	.5	>10	.200	500
PM121	.52	.24	.45	<.01	.12	27.8	2.0	.5	>10	.200	1,000
PM122	1.90	.21	.43	.21	.13	26.3	3.0	.5	>10	.150	1,000
PM122	1.90	.23	.43	.21	.13	26.3	2.0	.5	>10	.200	700
PM211	2.30	.30	.43	.18	.15	23.8	3.0	.5	>10	.200	700
PM211	2.30	.30	.44	.16	.12	25.6	2.0	.5	>10	.200	1,000
PM212	2.10	.22	.36	.19	.02	25.3	2.0	.5	>10	.100	500
PM212	2.00	.26	.41	.26	.14	25.1	3.0	1.0	>10	.150	1,000
PM221	1.90	.28	.54	.15	.12	22.2	3.0	.7	>10	.200	500
PM221	2.20	.33	.54	<.01	.09	21.7	2.0	.5	10	.150	500

Table 1D.--Co

SAMPLE	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
PF132	<50	200	N	10	50	20	70	N	15	70	20
PF132	<50	150	N	7	20	20	N	N	10	70	10
PF231	<50	150	N	10	30	30	150	N	50	20	15
PF231	100	200	N	15	50	50	150	N	70	30	20
PI111	<50	150	N	10	50	10	N	N	20	20	N
PI111	<50	200	N	7	30	10	N	N	15	20	10
PI112	<50	150	N	7	30	10	N	N	20	N	10
PI112	50	200	N	10	50	10	N	N	15	20	10
PI121	<50	150	N	20	30	20	100	20	100	200	20
PI121	<50	150	N	30	20	20	100	15	100	150	30
PI122	<50	150	N	20	20	30	N	10	100	200	20
PI122	<50	150	N	20	20	20	100	10	100	100	20
PI231	<50	50	N	N	10	5	N	N	<10	N	N
PI231	<50	50	N	N	10	5	N	N	10	N	N
PI232	<50	300	N	N	15	7	N	N	20	N	N
PI232	<50	300	N	N	15	20	N	N	15	30	N
PI241	<50	300	N	N	15	10	N	N	20	N	N
PI241	<50	500	N	N	20	10	N	N	30	N	N
PI242	<50	100	N	N	15	7	N	N	20	N	N
PI242	<50	100	N	N	20	10	N	N	15	20	N
PJ111	<50	50	N	N	10	5	N	N	N	N	N
PJ111	N	50	N	N	10	5	N	N	<10	N	N
PJ112	<50	30	N	N	10	2	N	N	<10	N	N
PJ112	N	30	N	N	10	2	N	N	N	20	N
PJ121	<50	70	2	N	20	5	N	N	10	N	N
PJ121	<50	70	N	N	20	10	N	N	10	N	10
PJ122	<50	30	<2	N	10	5	N	N	N	N	N
PJ122	<50	50	N	N	10	5	N	N	N	N	N
PJ311	<50	100	N	N	20	7	N	N	20	N	N
PJ311	<50	100	N	N	20	7	N	N	20	N	N
PJ312	<50	50	N	N	30	7	N	N	20	20	N
PJ312	<50	70	N	N	20	7	N	N	20	20	N
PJ321	50	100	N	N	20	10	N	N	15	20	N
PJ321	<50	100	N	10	20	10	N	N	20	20	10
PJ322	50	100	N	10	15	10	N	N	30	N	N
PJ322	<50	70	N	10	20	15	N	N	20	20	N
PM111	50	300	N	7	30	20	N	N	10	20	10
PM111	50	300	N	10	70	20	N	N	20	20	10
PM112	<50	200	N	10	70	20	N	N	20	20	10
PM112	50	300	N	7	50	20	N	N	15	N	10
PM121	<50	200	N	10	50	20	N	N	15	20	10
PM121	<50	300	N	7	50	20	N	N	15	20	N
PM122	<50	200	N	<7	30	20	N	N	10	20	10
PM122	<50	200	N	<7	30	20	N	N	10	20	10
PM211	<50	300	2	10	50	15	N	N	20	20	10
PM211	50	300	N	10	50	10	N	N	20	20	10
PM212	<50	200	N	7	30	15	N	N	10	20	10
PM212	50	300	N	10	70	20	N	N	20	20	10
PM221	<50	300	N	10	50	20	N	N	20	20	15
PM221	<50	300	2	7	70	20	N	N	15	20	10

Table 1D.--Co.

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P%-S	Ce ppm-S	Ga ppm-S	Yb ppm-S
PF132	300	70	70	100	5.0	1.5	N	N	20	5
PF132	200	30	70	100	2.0	1.5	N	N	10	5
PF231	300	50	70	50	3.0	2.0	N	N	15	5
PF231	300	70	70	70	5.0	2.0	N	N	N	5
PI111	300	50	<20	70	2.0	1.5	N	N	10	2
PI111	300	50	<20	70	2.0	2.0	N	N	10	<2
PI112	300	50	<20	70	2.0	2.0	N	N	20	2
PI112	300	70	20	100	3.0	2.0	N	N	20	<2
PI121	500	70	200	30	2.0	N	1.500	N	10	10
PI121	500	50	300	50	2.0	N	2.000	500	10	10
PI122	500	30	150	N	2.0	N	1.000	N	<10	10
PI122	700	50	200	20	1.5	1.5	N	N	10	10
PI231	1,000	<15	N	N	.3	N	N	N	N	N
PI231	2,000	15	N	N	.5	N	N	N	N	N
PI232	3,000	15	N	N	.5	N	N	N	N	N
PI232	5,000	15	N	N	.5	N	N	N	N	N
PI241	1,000	15	N	N	.5	N	N	N	N	N
PI241	1,500	20	N	N	.7	N	N	N	N	N
PI242	1,000	20	N	N	.7	N	N	N	N	N
PI242	1,000	20	N	N	.7	N	N	N	N	N
PJ111	500	20	N	N	.7	N	N	N	N	N
PJ111	500	<15	N	N	.7	N	N	N	N	N
PJ112	700	15	N	N	.7	N	N	N	N	N
PJ112	500	15	N	N	.7	N	N	N	N	N
PJ121	500	30	20	N	1.0	N	N	N	N	2
PJ121	700	50	50	N	1.0	N	N	N	N	2
PJ122	500	15	20	N	.5	N	N	N	N	2
PJ122	700	<15	20	N	.5	N	N	N	N	2
PJ311	1,000	10	20	N	1.0	N	N	N	N	<2
PJ311	1,000	20	20	20	.7	N	N	N	N	N
PJ312	1,500	20	<20	N	1.0	N	N	N	<10	N
PJ312	1,000	20	20	20	1.0	N	N	N	N	<2
PJ321	700	20	N	N	1.0	N	N	N	N	N
PJ321	700	50	20	30	.7	N	N	N	N	<2
PJ322	2,000	50	50	N	1.0	N	N	N	N	2
PJ322	700	50	30	N	.7	N	N	N	N	2
PM111	300	50	30	150	2.0	2.0	N	N	10	2
PM111	500	100	20	100	5.0	5.0	N	N	20	2
PM112	300	50	20	150	3.0	2.0	N	N	20	2
PM112	300	50	20	150	5.0	3.0	N	N	20	2
PM121	300	50	20	70	3.0	1.5	N	N	10	2
PM121	500	50	20	70	5.0	2.0	N	N	20	2
PM122	300	50	<20	100	5.0	1.5	N	N	10	<2
PM122	500	20	<20	70	.2	2.0	N	N	10	<2
PM211	300	100	20	100	5.0	3.0	N	N	20	2
PM211	300	70	20	70	5.0	2.0	N	N	20	2
PM212	300	50	<20	50	2.0	2.0	N	N	10	<2
PM212	500	100	20	70	5.0	7.0	N	N	20	2
PM221	500	50	30	100	3.0	5.0	N	N	20	5
PM221	500	70	N	70	5.0	5.0	N	N	20	2

Table 1D.--Con..

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
PM222	37 8 0	83 15 0	118,441	33.8	8.30	1.00	2.90	1.50	25.7	.94	1.20
PM222	37 8 0	83 15 0	118,518	33.7	8.60	1.00	2.90	1.70	25.2	.88	1.20
PN111	37 38 0	82 15 0	118,109	28.1	5.90	1.20	1.90	.92	31.7	.24	1.10
PN111	37 38 0	82 15 0	118,481	27.5	6.70	1.30	1.80	.99	31.6	.38	1.40
PN112	37 38 0	82 15 0	118,153	19.7	7.80	1.20	1.90	1.20	35.4	.45	1.30
PN112	37 38 0	82 15 0	118,172	18.6	7.30	1.30	1.90	1.00	36.8	N	1.50
PN121	37 38 0	82 15 0	118,207	21.7	5.50	.68	2.20	.93	35.9	.42	1.20
PN121	37 38 0	82 15 0	118,370	21.3	5.20	.46	2.40	.99	36.6	.38	.89
PN122	37 38 0	82 15 0	118,401	25.7	6.30	1.00	2.10	1.00	32.4	.51	1.20
PN122	37 38 0	82 15 0	118,467	25.6	5.70	.10	2.10	.91	33.2	.39	1.50
PN211	37 30 0	82 8 0	118,349	25.5	7.70	1.10	3.10	1.30	30.4	.45	1.70
PN211	37 30 0	82 8 0	118,376	25.7	7.60	1.10	3.10	1.30	30.8	.44	1.40
PN212	37 30 0	82 8 0	118,129	30.5	8.50	.86	3.40	1.40	28.1	.58	1.60
PN212	37 30 0	82 8 0	118,180	27.2	8.40	1.00	3.30	1.50	28.4	.53	1.80
PT111	36 53 0	84 8 0	118,131	22.6	7.80	.91	3.90	3.50	29.9	.43	1.40
PT111	36 53 0	84 8 0	118,472	22.3	7.30	.91	3.90	3.60	29.4	.36	1.50
PT112	36 53 0	84 8 0	118,166	21.3	7.30	.65	4.50	3.80	29.0	.36	1.50
PT112	36 53 0	84 8 0	118,336	21.0	8.50	.83	4.70	3.60	28.7	.42	1.50
PT121	36 45 0	84 0 0	124,186	32.1	6.50	.76	3.40	2.60	26.6	.30	.99
PT211	36 53 0	84 0 0	118,127	40.2	7.20	1.40	3.00	4.70	18.6	.83	1.20
PT211	36 53 0	84 0 0	118,305	39.8	7.00	1.10	3.20	5.00	18.9	.88	1.10
PT212	36 53 0	84 0 0	118,249	43.9	7.00	<.01	2.60	2.90	19.7	.80	1.00
PT212	36 53 0	84 0 0	118,502	43.2	7.80	1.60	2.50	2.80	19.1	.81	.95
PT221	36 53 0	84 0 0	118,263	40.4	7.90	1.50	3.90	4.50	18.2	.79	1.20
PT221	36 53 0	84 0 0	118,411	40.6	7.90	1.50	3.90	4.50	17.3	.72	1.40
PT222	36 53 0	84 0 0	118,204	38.3	6.30	1.10	3.00	3.70	22.0	.87	1.10
PT222	36 53 0	84 0 0	118,448	38.7	6.20	1.10	3.00	3.60	22.0	.91	.97

Table 1D.--Con .

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
PM222	2.10	.21	.53	.12	.04	21.7	2.0	.7	>10	.200	500
PM222	2.10	.21	.54	.18	.09	21.6	2.0	.5	>10	.200	1,000
PN111	1.70	.26	1.40	.13	.46	24.9	2.0	.5	>10	.200	3,000
PN111	1.60	.21	.26	.08	.45	25.5	2.0	.5	>10	.150	1,500
PN112	1.90	.33	.34	.12	.55	27.7	2.0	.2	>10	.150	3,000
PN112	2.10	.31	.33	.09	.55	29.2	2.0	.2	>10	.150	2,000
PN121	1.10	.17	.33	.07	.18	29.7	1.5	.2	>10	.150	1,000
PN121	1.40	.15	.32	.11	.18	29.6	2.0	.2	>10	.100	500
PN122	1.60	.27	.38	.21	.18	27.1	1.5	.1	>10	.100	500
PN122	1.60	.22	.36	.09	.18	27.2	2.0	.5	>10	.150	1,000
PN211	1.80	.25	.41	.16	.21	25.2	2.0	.5	>10	.150	1,000
PN211	1.70	.27	.42	.15	.20	25.4	2.0	.2	>10	.150	500
PN212	1.40	.29	.46	.15	.22	22.5	3.0	1.0	>10	.300	1,000
PN212	2.20	.10	.47	.12	.18	24.6	3.0	.5	>10	.200	1,000
PT111	1.30	.29	.36	.19	.21	26.4	3.0	2.0	>10	.150	1,000
PT111	1.80	.19	.36	.14	.16	27.6	3.0	2.0	>10	.150	500
PT112	2.00	.24	.37	.17	.17	28.5	5.0	1.5	>10	.150	1,000
PT112	1.90	.21	.34	.22	.19	27.7	2.0	1.0	>10	.100	1,000
PT121	1.70	.31	.39	.22	.13	23.8	1.2	--	--	.090	530
PT211	1.90	.22	.45	.15	.18	19.9	2.0	2.0	>10	.300	1,000
PT211	1.70	.21	.47	.12	.15	20.1	3.0	2.0	10	.200	700
PT212	1.50	.23	.51	.13	.17	18.2	2.0	1.0	10	.300	1,000
PT212	1.80	.23	.49	.14	.15	18.3	2.0	1.0	>10	.200	500
PT221	1.50	.24	.49	.17	.16	19.1	3.0	2.0	10	.200	1,000
PT221	1.70	.32	.51	<.01	.15	18.7	2.0	1.0	10	.150	500
PT222	1.30	.16	.39	.11	.16	21.1	2.0	1.0	>10	.150	700
PT222	1.30	.14	.42	.12	.17	21.0	2.0	1.5	>10	.150	1,000

Table 1D.--Cont.

SAMPLE	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
PM222	<50	300	N	10	50	15	N	N	15	20	10
PM222	50	300	N	10	50	20	N	N	20	20	10
PN111	50	300	10	10	70	15	N	10	15	20	10
PN111	<50	300	N	7	50	10	N	N	50	20	10
PN112	50	200	N	10	70	15	N	N	20	20	10
PN112	<50	200	N	10	50	10	N	N	20	20	10
PN121	<50	150	N	7	30	15	N	N	10	N	10
PN121	<50	150	N	7	20	10	N	N	<10	20	<10
PN122	<50	150	N	<7	20	10	N	N	10	20	<10
PN122	<50	200	N	N	30	10	N	N	10	N	<10
PN211	<50	300	N	7	50	20	N	N	15	20	10
PN211	<50	300	N	7	50	20	N	20	10	20	10
PN212	50	200	<2	10	30	20	N	N	15	20	10
PN212	50	300	N	10	50	20	N	N	20	20	10
PT111	<50	200	N	10	30	20	N	N	15	20	10
PT111	<50	300	N	10	30	20	N	N	20	20	10
PT112	<50	300	<2	10	50	15	N	N	10	N	10
PT112	<50	300	N	N	30	15	N	N	10	20	10
PT121	N	200	N	8	24	10	N	N	15	N	11
PT211	<50	200	<2	7	30	7	N	N	15	N	10
PT211	50	300	N	7	30	10	N	N	20	20	10
PT212	<50	500	N	7	30	15	N	N	15	20	10
PT212	<50	300	N	7	50	10	N	N	15	20	10
PT221	<50	300	N	7	30	10	N	N	30	20	10
PT221	<50	200	N	7	30	10	N	N	10	20	10
PT222	<50	150	N	7	20	10	N	N	15	20	N
PT222	<50	300	N	7	30	10	N	N	15	20	<10

Table ID.--Cont.

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P%-S	Ce ppm-S	Ga ppm-S	Yb ppm-S
PM222	500	50	20	100	5.0	2.0	N	N	20	2
PM222	300	70	20	100	5.0	5.0	N	N	20	2
PN111	300	100	20	100	5.0	2.0	N	N	20	2
PN111	300	70	20	100	3.0	3.0	N	N	10	<2
PN112	300	70	20	50	5.0	3.0	N	N	20	2
PN112	200	50	<20	50	3.0	2.0	N	N	20	2
PN121	200	50	20	100	3.0	1.5	N	N	10	2
PN121	200	50	<20	50	2.0	N	N	N	10	<2
PN122	200	20	20	70	1.5	1.5	N	N	10	<2
PN122	200	50	<20	70	2.0	2.0	N	N	10	<2
PN211	500	50	30	50	5.0	5.0	N	N	20	1
PN211	500	50	20	50	3.0	3.0	N	N	10	2
PN212	300	50	20	70	5.0	2.0	N	N	20	2
PN212	300	70	20	70	5.0	2.0	N	N	20	2
PT111	300	50	20	70	5.0	2.0	N	N	10	2
PT111	300	70	20	70	5.0	5.0	N	N	20	2
PT112	300	50	<20	70	3.0	2.0	N	N	15	2
PT112	300	50	<20	50	3.0	2.0	N	N	10	<2
PT121	230	30	30	66	--	--	.008	--	N	--
PT211	300	50	20	200	5.0	1.5	N	N	10	2
PT211	500	50	<20	100	3.0	2.0	N	N	10	<2
PT212	500	50	<20	100	3.0	1.5	N	N	10	2
PT212	500	50	20	200	3.0	2.0	N	N	10	2
PT221	300	50	20	100	2.0	2.0	N	N	20	2
PT221	300	70	20	100	5.0	5.0	N	N	20	2
PT222	300	50	<20	200	2.0	1.5	N	N	10	2
PT222	300	50	30	100	2.0	1.5	N	N	10	3

Table 1E.--Chemical analyses of sideritic rocks in eastern Kentucky. [%, percent; ppm, parts per million; N, not detected; leaders (--) indicate no data; labels ending in "-S" are spectrographic determinations]

SAMPLE	LATITUDE	LONGITUD	LAB. NO.	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%
UL211	37 15 0	84 0 0	118,135	14.1	4.5	1.20	45.3	2.4	3.1	<.01	.37
UL211	37 15 0	84 0 0	118,198	11.6	5.6	1.50	45.5	2.4	2.3	N	.40
UL212	37 15 0	84 0 0	118,274	9.5	4.9	1.70	48.3	2.1	2.1	N	.37
UL212	37 15 0	84 0 0	118,373	10.0	5.7	1.30	48.6	2.1	1.9	N	.39
UT211	36 53 0	84 15 0	118,320	13.8	4.5	4.50	36.1	5.5	5.1	<.01	.59
UT211	36 53 0	84 15 0	118,495	13.7	4.1	3.40	36.5	3.9	4.8	<.01	.61
UT212	36 53 0	84 15 0	118,222	12.8	4.8	1.60	38.2	4.2	4.2	<.01	.71
UT212	36 53 0	84 15 0	118,384	12.4	4.6	3.20	37.7	4.3	4.6	.12	.76
PF111	38 15 0	82 38 0	118,156	10.7	5.0	1.10	40.5	3.1	4.9	.11	.93
PF111	38 15 0	82 37 59	118,376	10.6	4.6	1.20	40.7	3.0	4.5	N	1.10
PF112	38 15 0	82 38 0	118,183	8.8	4.5	4.90	40.7	1.9	4.8	.12	.72
PF112	38 15 0	82 38 0	118,353	9.2	4.7	5.10	40.4	1.8	5.6	<.01	.48
PF131	38 15 0	82 38 0	121,050	20.5	7.6	3.20	30.2	2.0	6.9	.11	1.10
PF131	38 15 0	82 38 0	121,001	21.0	8.3	1.20	32.9	2.2	5.1	.22	1.10
PF211	38 23 0	82 38 0	118,114	9.4	4.1	2.80	33.8	2.1	12.1	N	.59
PF211	38 23 0	82 38 0	118,337	9.9	5.4	1.60	34.8	2.0	12.8	<.01	.62
PF212	38 23 0	82 38 0	118,340	9.2	4.7	1.10	41.9	3.0	5.2	<.01	.68
PF212	38 23 0	82 38 0	118,449	9.2	4.7	1.40	41.8	3.0	5.1	N	.73
PN221	37 30 0	82 8 0	118,402	53.8	9.7	.87	12.3	2.1	4.2	.65	1.60
PN221	37 30 0	82 8 0	118,424	54.7	10.3	1.00	12.2	2.0	3.2	.51	1.70
PN222	37 30 0	82 8 0	118,234	21.1	7.6	1.50	28.5	4.2	5.7	.16	1.10
PN222	37 30 0	82 8 0	118,269	21.8	8.3	1.70	28.5	4.7	7.0	N	1.40
PT122	36 45 0	84 0 0	124,187	35.7	11.6	6.20	17.6	3.8	2.6	.77	1.60

SAMPLE	H2O+%	H2O-%	TiO2%	P2O5%	MnO%	CO2%	Fe%-S	Mg%-S	Ca%-S	Ti%-S	Mn ppm-S
UL211	1.1	.31	.19	1.10	.68	25.0	>10	1.0	1.5	.10	2,000
UL211	1.2	.25	.20	1.20	.26	26.8	>10	.7	1.5	.05	1,000
UL212	1.1	.24	.15	.97	.12	29.9	>10	.5	.5	.03	2,000
UL212	1.2	.31	.16	.99	.74	27.3	>10	.5	.5	.05	2,000
UT211	1.4	.36	.21	.88	.70	25.5	>10	1.0	1.5	.05	2,000
UT211	2.0	.26	.20	.82	.68	28.4	>10	1.0	1.5	.05	1,000
UT212	1.3	.49	.23	.44	.70	29.5	>10	1.0	1.5	.05	1,000
UT212	1.2	.41	.23	.36	.67	29.5	>10	1.0	1.5	.05	1,000
PF111	1.4	.27	.22	.27	.67	30.8	>10	1.0	2.0	.10	3,000
PF111	1.4	.21	.23	.31	.68	30.6	>10	1.0	2.0	.05	1,000
PF112	1.7	.27	.19	.49	.87	27.4	>10	.5	2.0	.05	2,000
PF112	1.7	.26	.16	.47	.86	29.1	>10	.2	1.5	.05	2,000
PF131	2.7	.16	.23	1.50	.61	23.1	>10	1.0	2.0	.10	3,000
PF131	2.1	.16	.26	1.60	.53	23.2	>10	1.0	3.0	.15	3,000
PF211	1.2	.31	.17	1.30	.74	30.5	>10	1.0	7.0	.05	3,000
PF211	1.4	.25	.15	1.30	.74	28.4	>10	.2	5.0	.05	2,000
PF212	1.2	.24	.18	.33	.33	31.9	>10	.5	1.5	.05	1,000
PF212	1.3	.21	.20	.29	.31	31.3	>10	.7	1.5	.05	1,000
PN221	2.3	.35	.78	.08	.22	10.2	7	.5	1.5	.30	500
PN221	1.3	.34	.78	<.01	.21	12.0	10	.5	2.0	.30	700
PN222	1.9	.36	.27	.31	1.00	25.5	>10	1.5	3.0	.10	1,500
PN222	2.0	.33	.25	.34	.45	23.1	>10	1.5	3.0	.10	3,000
PT122	3.7	.83	.58	.48	.50	13.4	10	--	--	.15	2,300

Table 1E.--Cont.

SAMPLE	B ppm-S	Ba ppm-S	Be ppm-S	Co ppm-S	Cr ppm-S	Cu ppm-S	La ppm-S	Mo ppm-S	Ni ppm-S	Pb ppm-S	Sc ppm-S
UL211	<50	100	<2	10	20	7	N	10	20	N	N
UL211	N	100	N	N	15	7	N	10	15	N	N
UL212	<50	100	N	N	10	5	N	10	15	N	10
UL212	<50	100	2	N	10	5	N	N	10	N	N
UT211	<50	100	N	N	20	15	N	10	<10	20	N
UT211	<50	100	N	7	15	20	N	10	15	20	N
UT212	N	100	N	N	15	15	N	N	15	N	N
UT212	<50	150	N	N	10	10	N	7	10	20	N
PF111	<50	200	<2	N	20	10	N	10	20	20	N
PF111	<50	150	2	7	10	15	N	10	10	20	<10
PF112	<50	200	N	N	20	10	N	10	N	20	N
PF112	<50	150	N	N	10	10	N	10	10	N	N
PF131	<50	200	2	15	30	20	70	15	20	20	15
PF131	<50	200	N	15	20	15	70	15	15	30	15
PF211	<50	200	<2	N	20	10	N	<7	10	20	10
PF211	<50	200	N	N	15	10	N	<7	10	20	10
PF212	<50	150	2	N	10	10	N	10	<10	N	N
PF212	N	70	N	N	15	10	N	7	<10	N	N
PN221	<50	200	2	<7	30	10	N	N	10	20	10
PN221	50	300	2	7	50	20	70	20	10	20	10
PN222	<50	150	2	7	30	20	N	7	20	N	20
PN222	N	200	2	10	30	15	N	7	15	20	20
PT122	N	230	N	11	30	30	N	N	28	N	18

SAMPLE	Sr ppm-S	V ppm-S	Y ppm-S	Zr ppm-S	Al%-S	K%-S	P ppm-S	Ga ppm-S	Yb ppm-S
UL211	200	20	20	50	1.5	N	N	10	2
UL211	200	15	20	20	.7	N	N	10	5
UL212	150	N	<20	20	.7	N	N	10	2
UL212	200	15	<20	N	1.0	N	N	10	<2
UT211	300	20	70	20	1.0	N	N	10	5
UT211	300	20	70	20	1.0	1.5	N	10	5
UT212	200	20	20	20	1.5	1.5	N	10	5
UT212	300	20	20	20	1.0	1.5	N	10	1
PF111	100	50	20	50	2.0	N	N	20	5
PF111	150	50	20	20	1.5	1.5	N	10	2
PF112	150	20	20	50	1.5	1.5	N	10	5
PF112	100	20	<20	N	1.0	1.5	N	10	<2
PF131	200	50	100	70	2.0	1.5	N	10	7
PF131	200	50	100	70	1.0	1.5	N	20	7
PF211	200	20	50	N	1.5	N	N	10	5
PF211	200	20	70	N	1.5	1.5	N	10	5
PF212	100	20	<20	20	1.5	1.5	N	10	2
PF212	100	20	<20	N	1.5	1.5	N	10	2
PN221	150	50	50	150	3.0	2.0	N	10	2
PN221	300	100	50	150	5.0	5.0	N	20	5
PN222	150	70	20	50	2.0	1.5	N	20	5
PN222	150	100	20	50	2.0	2.0	N	20	2
PT122	100	81	40	79	--	--	.5	19	--

Table 2.--Elements commonly looked for, but rarely or never detected, by semi-quantitative emission spectrographic analysis, and their approximate lower limits of determination in parts per million.

Element	Lower limit of determination
Ag	1
As	1000
Au	20
B	50
Be	2
Bi	10
Cd	50
Ce	200
Eu	500
Ge	10
Hf	100
In	10
La	20
Li	200
Mo	7
Nb	20
P	2000
Pd	3
Pt	30
Re	50
Sb	100
Sn	10
Ta	200
Te	1000
Th	200
Tl	100
U	500
W	100
Yb	2
Zn	200

Table 3.--Average modes for carbonate rocks of Paleozoic age in Kentucky. [C, Cincinnatian; LM, Lower Mississippian; UM, Upper Mississippian; ₽, Pennsylvanian; Number of thin sections on which each mode is based is shown in parentheses]

Rock unit	Allochems	Sparry calcite	Micrite	Chert	Dolomite	Siderite	Other 1/
Limestone:							
C (20)	18%	15%	47%	<1%	9%	<1%	10%
LM (35)	2/ 39	6	28	1	6	<1	3
UM (71)	48	20	27	1	3	<1	1
₽ (12)	27	7	60	<1	3	<1	3
Dolomite:							
C (12)	<1	<1	<1	<1	84	<1	16
LM (13)	6	<1	4	6	71	<1	12
UM (7)	6	3	3	<1	78	<1	12
Sandy dolomite:							
UM (5)	7	<1	6	<1	69	<1	16
Siderite:							
UM + ₽ (12)	<1	1	<1	<1	<1	87	12
Concretions/nodules:							
LM (3)	<1	59	<1	<1	<1	<1	41
₽ (25)	1	<1	64	<1	<1	<1	35
Calcareous siltstone:							
LM (5)	26	27	<1	<1	<1	<1	46
Pyritic calcite nodules:							
₽ (2)	1	<1	53	<1	<1	<1	3/ 46

1/ Mostly silicate detritus.
2/ Includes 2% chertified allochems (predepositional chertification).
3/ Microspheroidal pyrite.

Table 4A.--Sampling sites for carbonates of Cincinnatian age in Kentucky. [See figure 2 for location of 7-1/2' quadrangles]

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Lithology
Holland	OS111	Mouth of Pinchgut Creek	2.4m below top of Cumberland Fm	Dolomite
	OS112	do	1.5m below top of Cumberland Fm	do
	OS121	Puncheon Creek	12m below top of Cumberland Fm	do
	OS122	do	15m below top of Cumberland Fm	do
Amandaville	OS211	Head of Collins Branch	1.5m below top of Cumberland Fm	Micrite
	OS212	do	3m above base of Cumberland Fm	do
	OS221	4km NW of Amanda-Amandaville	11m below top of Cumberland Fm	do
	OS222	do	9.1m below top of Cumberland Fm	do
New Haven	UOK311	In valley 1km S of Balltown	9.1m below top of Drakes Fm	do
	UOK312	do	24m below top of Drakes Fm	do
	UOK321	0.5km N of New Hope	2.1m below top of Drakes Fm	Dolomite
	UOK322	do	3m below top of Drakes Fm	do
Dunnville	OK211	Mouth of Luttrell Creek	3m below top of Cumberland Fm(?)	Micrite
	OK212	do	4.6m below top of Cumberland Fm(?)	do
	OK221	Mouth of Damron Creek	Top of Cumberland Fm(?)	do
	OK222	do	do	do

Table 4A.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Lithology
Phil	OK111	In South Fork	Top of Cumberland Fm(?)	Dolomite
	OK112	do	do	do
	OK121	do	1.2m below top of Cumberland Fm(?)	do
	OK122	do	2.4m below top of Cumberland Fm(?)	do
Valley View	UOL211	Above Grapevine School	12m below top of Calloway Creek Ls	Biosparrudite
	UOL212	do	16m below top of Calloway Creek Ls	Biomicrudite
	UOL221	2km S of Forest Hill Church	9.1m above base of Ashlock Fm	Micrite
	UOL222	do	12m below top of Calloway Creek Ls	Biopelsparrite
Burtonville	OD111	1.8km SE of Wallingford	11m below top of Drakes Fm	Dolomite
	OD112	do	do	do
	OD121	In Trotter Creek	do	Biosparrudite
	OD122	do	do	do
Manchester Islands	UOE211	2km NE of Covedale	18m below top of Bull Fork Fm	do
	UOE212	do	20m below top of Bull Fork Fm	do
	UOE221	0.4km N of Trinity School	12m below top of Bull Fork Fm	Micrite
	UOE222	0.8km N of Trinity School	27m below top of Bull Fork Fm	Biomicrudite

Table 4B.--Sampling sites for carbonates of Lower Mississippian age in Kentucky.
[See figure 2 for location of 7-1/2' quadrangles]

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Grand Rivers	LH111	3.5km SE of E edge of Barkley Dam (now under waters of reservoir)	34m below top of Ft. Payne	Micrite
	LH112	do	do	do
	LH121	2km E of Suwanee Furnace Church (now under waters of reservoir)	3m below top of Ft. Payne	Pelmicrite, color-banded
	LH122	do	do	Intramicrite
Eddyville	LH211	Behind old Kuttawa Springs swimming pool (now under waters of reservoir)	8m above base of Fort Payne	Micrite, with calcite veins
	LH212	do	do	do
	LH221	2km up Lick Creek (now under waters of reservoir)	37m below top of Fort Payne	Pelmicrite
	LH222	do	do	Biopelmicrite
Fairdealing	LMQ311	At bridge over Jonathan Creek	Unknown	Micrite
	LMQ312	do	do	do
	LMQ321	At mouth of Sugar Bay, south side	6.1m below top of Fort Payne	do
	LMQ322	do	do	do
Canton	LP121	N side of Crooked Creek	30m below top of Fort Payne	Biomicrite

Table 4B.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
	LP122	do	do	Intramicrite
Fenton	LP212	At Ferguson Spring	30m below top of Fort Payne	Biomicrite
	LP222	do	37m below top of Fort Payne	Biomicrite, cherty
Adolphus	LR111	0.5km S of Adolphus	11m above base of Fort Payne	do
	LR112	do	8.5m above base of Fort Payne	Biomicrudite
	LR121	At mouth of Wolf Branch	32m below top of Fort Payne	Pelmicrite, cherty
	LR122	do	33m below top of Fort Payne	Intramicrudite
Meador	LR211	3.8km NE of Meador	1m below top of Fort Payne	Dolomite, cherty
	LR212	do	6.7m below top of Fort Payne	do
	LR221	1.7km SE of Cole School	3m below top of Fort Payne	do
	LR222	do	do	Intramicrudite, dolomitic
Glasgow North	LK111	At mouth of Little Beaver Creek	1.8m below top of Fort Payne	Dolomite, cherty
	LK112	do	2.4m below top of Fort Payne	Dolomite
	LK121	1.9km W of Browders Chapel	5m below top of Fort Payne	Biomicrite
	LK122	do	4m below top of Fort Payne	Biosparrudite

Table 4B.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Knifely	LK211	0.6km W of Dunbar Hill Cemetery	30m below top of Fort Payne	Intrasparrudite, from bioherm
	LK212	do	29m below top of Fort Payne	do
	LK221	0.8km NW of Allen Cemetery	18m below top of Fort Payne	do
	LK222	do	do	do
Waterview	LS111	On Bull Ridge, 2.1km S of Leslie	17m above base of Fort Payne	Biomicrite, from bioherm
	LS112	do	24m above base of Fort Payne	Dolomite
	LS121	0.9km SW of Oliver Ferry	34m above base of Fort Payne	Intramicrudite, dolomitic, from bioherm
	LS122	do	24m above base of Fort Payne	Intramicrite, dolomitic, from bioherm
Cumberland City	LS211	1.6km NE of Pine Grove School	9.1m below top of Fort Payne	Biomicrudite, from bioherm
	LS212	do	do	do
	LS221	1.7km SW of Cabell	30m below top of Fort Payne	Intramicrudite, from bioherm
	LS222	do	do	do
Eli	LL111	1.1km S of Union School	15m below top of Fort Payne	Intrasparite, dolomitic, from bioherm
	LL112	do	17m below top of Fort Payne	Dolomite, from bioherm
	LL121	1.9km N of Free Union School	24m above base of Fort Payne	do
	LL122	do	do	do

Table 4B.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Shopville	LL211	1.2km SW of Elrod	7.6m below top of Borden	Dolomite
	LL212	do	6.1m below top of Borden	do
	LL221	0.7km SE of Flat Lick Church	1.5m below top of Borden	Dolomite, aphanitic
	LL222	do	do	Dolomite (sphalerite in outcrop)
Wesleyville	LME211	1.1km W of Souths Creek	6.1m below top of Borden	Siltstone, calcareous
	LME212	do	3m below top of Borden	Limestone concretion
	LME221	do	2.4m below top of Borden	Siltstone, calcareous
	LME222	do	4m below top of Borden	Biomicrite, glauconitic, silty
Tygarts Valley	LE111	2km up Clark Branch	7.6m below top of Borden	Limestone concretion
	LE112	do	do	do
	LE121	1.2km S of Gesling	3.1m below top of Borden	Siltstone, calcareous
	LE122	do	do	Biomicrite, silty

Table 4C.--Sampling sites for carbonates of Upper Mississippian age in Kentucky.
[See figure 2 for location of 7-1/2' quadrangles]

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Grand Rivers	UH111	0.5km W of Doom Chapel	88m above base of Salem	Intrasparite, weathered?
	UH112	do	89m above base of Salem	Biomicrudite
	UH121	On road at Macedonia Church	170m above base of Salem	Intramicrudite, pyrite
	UH122	do	do	do
Eddyville	UH211	0.6km E of Kausas School	41m above base of Warsaw	Biomicrudite
	UH212	0.8km NE of Kausas School	35m above base of Warsaw	do
	UH221	0.7km up Bells Creek	72m above base of Salem	Intramicrite, dolomitic
	UH222	0.9km up Bells Creek	56m above base of Salem	Biomicrudite
Briensburg	UP111	SW corner of Sledd Creek Cabin area	Near top of Warsaw	Biosparrudite, pyrite
	UP112	do	do	do
	UP121	On point E of Taylor Creek	do	Intramicrite
	UP122	do	do	Biosparrudite
Mont	UP211	0.9km W of Center Furnace (Ruins)	4.6m above base of Salem	Pelmicrite, dolomitic, pyrite
	UP212	do	3m above base of Salem	Biosparite, pyrite
	UP221	S of Motley Creek	6m below top of Warsaw	Pelmicrite, dolomitic, pyrite
	UP222	do	3m below top of Warsaw	Biomicrite, pyrite

Table 4C.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Cadiz	UQ111	3.5km N of Pleasant Hill Church	130m above base of Salem	Biomicrudite
	UQ112	do	do	do
	UQ121	S of Jefferson Cemetery	93m above base of Salem	Pelmicrudite, dolomitic
	UQ122	do	91m above base of Salem	Micrite, dolomitic
Honey Grove	UQ211	3.5km E of West Union Church	15m above base of Menard	Micrite
	UQ212	do	11m above base of Menard	Dismicrite
	UQ221	1.7km NW of West Union Church	6m above base of Waltersburg	Biosparite
	UQ222	do	do	do
Mattingly	UJ111	In South Fork of Pouch Shot Creek	3m above base of Haney Limestone Member (Golconda)	Intrasparrudite
	UJ112	do	4.6m above base of Haney Limestone Member (Golconda)	Biosparite
	UJ121	1.7km N of Flood School	3m below top of Beech Creek Lime-stone Member (Golconda)	Intrasparrudite, pyrite
	UJ122	do	2m below top of Beech Creek Limestone Member (Golconda)	Biomicrite

Table 4C.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Bristow	UJ211	1.4km N of Sunnyside	17m(?) above base of Ste. Genevieve	Intrasparrudite
	UJ212	do	do	Intramicrudite
	UJ221	1.5km S of Penns Chapel	3m below top of Haney Limestone Member (Golconda)	Biosparrudite
	UJ222	do	do	Biomicrudite
Adolphus	UR111	1.1km N of Walkers Chapel School	7.6m above base of Salem-Warsaw	Dolomite
	UR112	do	6.7m above base Salem-Warsaw	Shale, dolomitic, pyrite
	UR121	1.2km SW of Walkers Chapel School	18m above base of Salem-Warsaw	Biosparite, pyrite
	UR122	do	26m above base of Salem-Warsaw	do
Petroleum	UR211	2km NE of Mt. Pleasant Church	4.6m above base of Salem-Warsaw	Dolomite
	UR212	do	3m above base of Salem-Warsaw	do
	UR221	1.6km NW of Dover Church	12m above base of Salem-Warsaw	Biosparrudite, pyrite
	UR222	do	do	Biosparite, pyrite
Sulphur Lick	US111	1.3km SW of Bowman School	At top of Salem-Warsaw	Pelsparite, dolomitic (in float block)
	US112	do	do	Pelsparite, pyrite
	US121	0.8km E of Persimmon	6.1m above base of St. Louis	Dolomite, sandy, pyrite
	US122	do	do	Dolomite, sandy

Table 4C.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Breeding	US211	1km E of United Brethren Church	9.1m above base of Salem-Warsaw	Biosparrudite do
	US212	do	do	do
	US221	2.5km E of White Hill Church	1m above base of Salem-Warsaw	Biosparrudite, pyrite
	US222	2.2km E of White Hill Church	3m above base of Salem-Warsaw	do
Columbia	UK111	0.2km N of Grider Cemetery	1.5m above base of Salem-Warsaw	Dolomite, sandy, pyrite
	UK112	do	2.7m above base of Salem-Warsaw	do
	UK121	0.4km E of Furkin Cemetery	1.2m above base of Salem-Warsaw	Biosparrudite
	UK122	do	do of Salem-Warsaw	do
Dunnville	UK211	0.3km S of Thomas-town Cemetery	2.4m above base of Salem-Warsaw	Biosparrudite, pyrite
	UK212	0.4km S of Thomas-town Cemetery	6.1m above base of Salem-Warsaw	Intrasparrudite, pyrite
	UK221	2.5km E of Wilson School	1.5m above base of Salem-Warsaw	Biosparrudite, pyrite,
	UK222	do	do	Biosparrudite, dolomitic, pyrite
Barthell	UT111	1.5km W of Coffey Cemetery	52m below top of Pennington	Dolomite
	UT112	do	do	do
	UT121	0.5km SW of Coffey Cemetery	49m below top of Pennington	do
	UT122	do	do	Biosparite, pyrite (sphalerite in outcrop)

Table 4C.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Sawyer	UT211	At mouth of Ned Branch	9.1m below top of Pennington	Siderite nodule
	UT212	do	do	do
	UT221	At mouth of Goodin Branch (Boat Dock)	17m below top of Pennington	Dolomite, pyrite (barite in outcrop)
	UT222	do	15m below top of Pennington	Dolomite, pyrite
Maretburg	UL111	1.7km E of Willailla	At base of Ste. Genevieve Limestone Member (Newman)	Biomicrite
	UL112	do	12m above base of St. Louis Limestone Member (Newman)	Biosparite
	UL121	1.6km SW of Patten Moore School	15m above base of Ste. Genevieve Limestone Member (Newman)	Intramicrite
	UL122	do	9.1m above base of Ste. Genevieve Limestone Member (Newman)	do
Parrot	UL211	At mouth of Alum Cave Branch	6.1m below top of Pennington	Siderite concretion
	UL212	do	do	do
	UL221	1.1km E of South Tree Church	24m below top of Pennington	Biosparite
	UL222	do	do	Biosparrudite, pyrite

Table 4C.--Cont.

Quadrangle	Sample No.	Sample site	Stratigraphic Position	Remarks
Wrigley	UE111	3.2km W of Blairs Mills	1.5m below top of Newman	Intramicrite
	UE112	do	3m below top of Newman	Biomicrite, brecciated?
	UE121	2km N of Ditney School	12m above base of Newman	Oosparite, pyrite
	UE122	do	do	Intramicrite, dolomitic
Brushart	UE211	2km E of Zion Hill School	At base of Newman	Intramicrite
	UE212	do	6.4m above base of Newman	Dismicrite
	UE221	In Old She Hollow	1.5m above base of Newman	Biomicrite, (sulfide? in outcrop)
	UE222	do	2.1m above base of Newman	Biomicrudite, pyrite
Grayson	UMF111	5km W of Lindsay Chapel	1m below top of Newman	Pelsparite
	UMF112	do	do	Pelmicrite
	UMF121	3.4km W of Lindsay Chapel	At top of Newman	Intrasparite
	UMF122	do	do	Intramicrite, sideritic, pyrite
Oldtown	UMF211	0.4km SE of North Fork School	do	Biosparite
	UMF212	0.3km SE of North Fork School	do	Intramicrudite, sideritic
	UMF221	1.6km SW of Mt. Olive School	2.4m below top of Newman	Sparite
	UMF222	do	do	Intrasparite

Table 4D.--Sampling sites for carbonates of Pennsylvanian age. [See figure 2 for location of 7-1/2' quadrangles]

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Madisonville	PI111	Below strip mine, 3.8km SW of Hecla	Hanover Limestone Member (Carbondale)	Limestone
	PI112	do	do	do
	PI121	Below strip mine, 2.8km E of Richland	do	Calcite-pyrite concretion(?)
	PI122	do	do	do
Madisonville East	PI231	In abandoned L&N RR roadbed 1.5km E of center of Madisonville	At base of Madisonville Limestone Member (Sturgis)	Dismicrite, weathered
	PI232	On northbound offramp of US 41, E of Madisonville	do	Biomicrudite, weathered
	PI241	In strip mine, 3km SE of East Diamond Mine	Providence(?) Ls (Carbondale)	Biomicrudite, pyritic, from float
	PI242	do	do	do
Maceo	PJ311	4km NE of Scythia	Lead Creek Limestone of Crider (1913)	Micrite
	PJ312	do	do	Biomicrite
	PJ321	W end of Iron Ore Hill	No. 7 Ls	Micrite, pyritic
	PJ322	do	do	do
Tell City	PJ111	1.1km NW of Petri	Lead Creek Limestone of Crider (1913)	Pelmicrite, dolomitic, from float
	PJ112	do	do	Pelmicrite, from float
	PJ121	0.3km SE of Hilldale Church	do	Biopelmicrite
	PJ122	do	do	do

Table 4D.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Vox	PT111	1.4km E of Eatontown	60m above Jellico Coal (Breathitt)	Limestone concretion, pyritic, argillaceous
	PT112	do	do	Limestone concretion, argillaceous
Rockholds	PT121	1.3km NW of King Cemetery	6m above Jellico Coal (Breathitt)	Limestone concretion, pyritic, silty
	PT122	do	2.4m above Jellico Coal (Breathitt)	Siderite nodule, argillaceous
Corbin	PT211	3.1km NE of Wilton	50m above Jellico Coal (Breathitt)	Limestone concretion, pyritic, silty, from float
	PT212	do	do	do
	PT221	2.5km NE of Wilton	do	do
	PT222	do	do	do
Hyden East	PM211	0.9km SW of Avawam	At base of Magoffin Member (Breathitt)	Limestone concretion, pyritic, argillaceous
	PM212	do	do	do
	PM221	0.6km SW of Avawam	12m below Magoffin Member (Breathitt)	Limestone concretion(?)
	PM222	do	do	do

Table 4D.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Hazel Green	PM111	4.4km SE of Hazel Green	Kendrick Sh(?) (Breathitt)	Limestone concretion, silty
	PM112	do	do	Limestone concretion, pyritic, silty
	PM121	5.1km SE of Hazel Green	do	Limestone concretion, silty, from float
	PM122	5.0km SE of Hazel Green	do	do
Matewan	PN211	0.7km W of Hatfield Cemetery	Cannelton Ls (Breathitt)	Limestone concretion, argillaceous
	PN212	do	do	do
	PN221	At N edge of Phelps	Eagle Ls (Breathitt)	Siltstone, sideritic
	PN222	do	do	Siderite nodules, argillaceous
Williamson	PN111	0.8km SW of Bent Branch School	12m above base of Magoffin Limestone Member (Breathitt)	Limestone concretion, silty
	PN112	0.9km SW of Bent Branch School	At base of of Magoffin Limestone Member (Breathitt)	Limestone concretion, pyritic
	PN121	2.4km N of Point Truth Church	Kendrick Sh (Breathitt)	do
	PN122	do	do	Limestone concretion, silty

Table 4D.--Cont.

Quadrangle	Sample No.	Sample Site	Stratigraphic Position	Remarks
Boltsfork	PF111	0.6km SE of Prichard Cemetery	18m above Princess No. 7 Coal (Breathitt)	Siderite nodule
	PF112	do	do	Siderite concretion, with calcite veins, argillaceous
	PF131	0.5km N of Arthur Cemetery	Brush Creek Ls(?) (Conemaugh)	Siderite nodule, argillaceous
	PF132	do	do	Limestone, nodular
Ashland	PF211	1.7km W of Cannonsburg	9m above base of Princess No. 7 Coal (Breathitt)	Siderite concretion, with calcite veins
	PF212	do	do	Siderite concretion
	PF231	2.5km NE of Cannonsburg	Brush Creek Ls(?) (Conemaugh)	Limestone nodules

Table 5A.--Components of geochemical variance for carbonates of Cincinnatian age in Kentucky. [Components given as percentages of total logarithmic variance, V(Log X); *, component significantly different from zero at the 0.05 probability level; see text for explanation of v(m); the top entry of each pair estimates the variance for limestone and dolomite combined, the bottom entry estimates the variance for limestone only]

Oxides:	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m)
SiO2	0.1689	48%	25%*	3%	25%*	<1	<1.0
	.2177	55*	19	<1	26*	<1	
Al2O3	.1040	10	53*	<1	32*	5	<1.0
	.0965	14*	40*	<1	39*	8	
Fe2O3	.0708	<1	26*	22	30*	20	<1.0
	.0620	<1	42	<1	45*	13	
FeO	.1618	<1	36	43*	13*	8	<1.0
	.0723	42*	<1	<1	31*	27	
MgO	.3256	<1	59*	34*	6*	<1	<1.0
	.0626	45*	<1	<1	54*	1	
CaO 1/	138.8	<1	58*	34*	8*	<1	<1.0
	53.5	63*	6	<1	31*	<1	
Na2O	.0970	23*	14	15*	<1	48	1.7
	.1074	38*	15	<1	<1	47	
K2O	.0997	25	35*	<1	32*	9	<1.0
	.0743	19*	17	<1	52*	12	
H2O+	.0530	13	35*	11*	2	39	<1.0
	.0431	13*	21	<1	13	52	
P O	.2783	11	<1	58*	8	23	<1.0
	.2754	2/ 42	<1	<1	15*	30	
CO2 1/	25.7	11	45*	14	28*	<1	<1.0
	26.7	50*	14	<1	35*	<1	
Elements:							
Ba	.3979	<1	71*	11*	2	17	<1.0
	.6391	<1	71*	15*	<1	14	
Cr	.0805	18	32*	<1	34*	16	<1.0
	.0885	<1	37*	<1	46*	17	

Table 5A.--Cont.

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m)
Cu	.0591	<1	20*	22	30*	28	<1.0
	.0276	15	<1	<1	45*	40	
Mn	.0777	17	32*	<1	15	37	<1.0
	.0488	<1	68*	<1	20*	12	
Sr	.1422	<1	55*	32*	<1	13	<1.0
	.0506	66*	<1	<1	10	23	
Ti	.1887	28	31*	<1	22*	18	<1.0
	.1873	20	41*	<1	29*	10	
V	.0499	18	41*	<1	22*	19	<1.0
	.0296	2	6	<1	59*	33	
Zr	.0842	42*	<1	10*	12	37	6.7
	.0933	30	<1	27*	9	33	

1/ Computed on untransformed data.
2/ Significant at the 0.1 probability level.

Table 5B.--Components of geochemical variance for carbonates of Lower Mississippian age in Kentucky. [Components given as percentages of total logarithmic variance, V(Log X); *, component significantly different from zero at the 0.05 probability level; see text for explanation of v(m); the top entry of each pair estimates the variance for limestone and dolomite combined, the bottom entry estimates the variance for limestone only]

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m)
Oxides:							
SiO_2	0.1630	26%	<1%	62%*	12%*	<1%	<1.0
	.1966	35*	<1	51*	14*	<1	
Al_2O_3	.2072	19	<1	42*	17*	22	<1.0
	.1809	<1	25	41*	<1	34	
Fe_2O_3	.2163	3	<1	59*	9	29	<1.0
	.2539	<1	<1	65*	5	30	
FeO	.2155	37*	9	29*	8*	17	2.7
	.1023	19	<1	47*	<1	34	
MgO	.2218	13	58*	16*	14*	<1	<1.0
	.1130	<1	47	42*	10*	<1	
CaO 1/	147.6	42*	8	31*	18*	<1	3.0
	94.3	58*	<1	17	24*	<1	
K_2O	.1408	24*	12	19*	5	42	1.7
	.1282	10	9	23*	<1	58	
H_2O+	.0530	12*	7	7	38*	36	1.0
	.0388	1	15	4	32*	48	
P_2O_5	.2039	18*	11	12*	11	49	1.4
	.2112	22*	15	3	24*	36	
CO_2 1/	73.7	52*	<1	32*	15*	<1	5.0
	71.7	52*	<1	26*	21*	<1	
Elements:							
Ba	.1588	18	<1	43*	34*	6	<1.0
	.1248	<1	35*	26	31*	9	
Cr	.1040	30*	<1	32*	22*	16	2.4
	.1244	44*	<1	35*	4	17	
Cu	.0719	<1	7	34*	22*	37	<1.0
	.0564	1	3	22*	17	57	

Table 5B.--Cont.

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m)
Mn	.1847	22	43*	13*	4	19	<1.0
	.1816	37*	14	19*	6	25	
Ni	.0650	36*	10	<1	25*	29	3.5
	.0530	24*	28	11*	6	31	
Sr	.1124	57*	2	23*	9*	8	6.8
	.0693	52*	<1	22*	12*	14	
Ti	.1644	24*	4	42*	18*	13	1.5
	.1473	12	20	50*	1	17	
V	.0635	12	11	26*	30*	21	<1.0
	.0379	<1	9	39*	15	37	

1/ Computed on untransformed data.

Table 5C.--Components of geochemical variance for carbonates of Upper Missisippian age in Kentucky. [Components given as percentages of total logarithmic variance, V(Log X); *, component significantly different from zero at the 0.05 probability level; see text for explanation of v(m); the top entry of each pair estimates the variance for limestone and dolomite combined, the bottom entry estimates the variance for limestone alone]

Oxides:	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m) 1/
SiO2	0.1298	20%*	<1%	34%*	44%*	2%	1.4
	.1223	2/ 20	<1	30*	48*	2	
Al2O3	.1797	1	3	45*	19*	32	<1.0
	.1667	<1	9	34*	18*	38	
Fe2O3	.1734	23*	<1	32*	12*	34	2.0
	.1502	2/ 14	<1	32*	15*	39	
FeO	.1971	35*	17*	9	19*	20	2.4
	.1521	14	25*	9	26*	27	
MgO	.2373	54*	11	14*	18*	3	4.6
	.1308	2/ 27	16*	17	33*	7	
CaO 3/	49.7	44*	<1	30*	23*	3	4.2
	13.1	11*	<1	23	54*	12	
K2O	.1054	<1	7	19*	<1	74	<1.0
	.0900	<1	6	10	<1	83	
H2O+	.0307	6	16*	6	24*	48	<1.0
	.0249	<1	15	<1	30*	55	
CO2 3/	5.0	2	<1	59*	36*	3	<1.0
	3.5	9	<1	34*	53*	4	
Elements:							
Ba	.1088	8	<1	58*	19*	15	<1.0
	.1050	15	<1	50*	17*	17	
Cr	.0717	<1	<1	36*	34*	30	<1.0
	.0789	<1	<1	37*	35*	27	
Cu	.0601	3	<1	38*	26*	32	<1.0
	.0530	2	10	24*	27*	37	

Table 5C.--Cont.

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m)1/
Mn	.1897	27	33*	19*	12*	9	1.2
	.1876	21	35*	22*	12*	9	
Sr	.0477	15*	<1	1	23*	61	2.2
	.0427	13*	4	<1	10	72	
Ti	.1475	4	1	39*	36*	21	<1.0
	.1243	<1	6	24	45*	25	
V	.0890	49*	5	23*	12	12	4.7
	.0916	42*	20	14*	13*	11	
Zr	.0344	1	<1	40*	<1	58	<1.0
	.0271	<1	<1	38*	4	58	

1/ v(m) is slightly biased to the high side because of an imbalance in the sample design due to sample rejection.
2/ Significant at the 0.1 probability level.
3/ Computed on untransformed data.

Table 5D.--Components of geochemical variance for carbonates of Pennsylvanian age in Kentucky. [Components given as percentages of total logarithmic variance, V(Log X); *, component significantly different from zero at the 0.05 probability level; see text for explanation of v(m); leaders (--), no data; the top entry of each pair estimates the variance for limestone and limestone concretions combined; the bottom entry estimates the variance for limestone alone]

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m) 1/
Oxides:							
SiO_2	0.1794	2/ 51%	39%*	2%	7%*	<1%	2.4
	.0141	11	40	37*	12*	<1	<1.0
Al_2O_3	.2095	59*	31*	<1	6*	4	3.6
	.0038	9	24*	2/ 34	23*	11	<1.0
Fe_2O_3	.1192	2/ 11	<1	<1	2/ 28	62	1.5
	.1165	1	<1	9	<1	90	<1.0
FeO	.1730	5	2/ 50	33*	9*	3	<1.0
	.0682	<1	83*	4	6*	8	<1.0
MgO	.0884	32*	11	29*	28*	<1	2.0
	.0919	94*	2	<1	3*	<1	55.8
CaO 3/	130.1	2/ 48	45*	4*	3*	<1	2.0
	36.93	42*	28	22*	6*	2	2.1
Na_2O	.1622	56*	18*	3	<1	23	5.0
	.0848	2/ 20	17	22*	<1	40	1.2
K_2O	.1626	60*	17	15*	2	6	4.7
	.0104	9	41*	6	7	36	<1.0
H_2O+	.0795	2/ 52	27*	1	5	15	3.3
	.0127	<1	<1	20	3	77	<1.0
P 0	.0720	26	39*	2	13*	21	1.1
	.1704	<1	8	2	4	86	<1.0
MnO	.0572	21*	21	22*	<1	36	1.1
	.0808	51*	<1	23*	<1	25	7.0
CO_2 3/	71.86	68*	25*	5*	2*	<1	4.9
	14.01	12	32	45*	9*	2	<1.0

Table 5D.--Cont.

	Total V(Log X)	Between Areas V(A)	Between Quads V(B)	Between Localities V(C)	Between Samples V(D)	Between Replicates V(E)	v(m) 1/
Elements:							
Ba	.1122	60*	4	<1	29*	7	10.0
	.0185	22	<1	25*	4	49	2.2
Co	--	--	--	--	--	--	--
	.0123	<1	2/ 4	2/ 17	22	57	<1.0
Cr	.0685	46*	16	18*	<1	20	3.4
	.0429	14	<1	42*	<1	44	1.1
Cu	.0685	2/ 48	22*	6	12*	12	3.2
	.0311	27	46*	2/ 7	3	17	1.0
Ga	--	--	--	--	--	--	--
	.0302	3	<1	25*	18	53	<1.0
Ni	.0536	<1	2/ 47	20*	5	27	<1.0
	.0460	<1	24	34*	<1	41	<1.0
Pb	.0153	35	40*	<1	<1	24	1.7
	.0182	31	51*	2/ 3	<1	14	1.1
Sc	--	--	--	--	--	--	--
	.0099	41*	<1	2/ 14	<1	44	6.4
Sr	.0196	25	49*	2/ 7	2/ 6	13	<1.0
	.0167	<1	20	29*	7	45	<1.0
Ti	.2339	59*	30*	3*	2	6	3.7
	.0201	<1	27	23*	3	48	<1.0
V	.0888	34*	19	15*	7	25	2.2
	.0289	<1	<1	39*	<1	62	<1.0
Y	--	--	--	--	--	--	--
	.0426	75*	<1	8*	<1	17	25.1
Yb	--	--	--	--	--	--	--
	.0763	35*	<1	9	8	47	5.7
Zr	.1567	62*	30*	2/ 1	<1	6	3.9
	.0310	<1	40*	2/ 14	9	37	<1.0

1/ v(m) is slightly biased to the high side because of an imbalance in the sample design due to sample rejection.
2/ Significant at the 0.01 probability level.
3/ Computed on untransformed data.

Table 6A.--Summary geochemical statistics for selected carbonates of Ordovician age in Kentucky. [Data are in parts per million except where noted as percent (%); GM, geometric mean; GD, geometric deviation; GE, geometric error; Ratio, number of analyses in which constituent was determined to total number of analyses; leaders (--) indicate insufficient data]

Part I. Statewide summary

	Lexington Ls-Clays Ferry Fm 1/						Cincinnatian rocks							
	High-Ca Ls			Argillic Ls			Limestone			Dolomite			Ls + Dol	
Oxides:	GM	GD	Ratio	GM	GD	Ratio	GM	GD	Ratio	GM	GD	Ratio	GM	GE
SiO2, %	2.5	1.96	9:9	23.0	1.43	15:15	7.9	2.57	40:40	11.0	2.01	24:24	9.1	<1.10
Al2O3, %	.69	1.47	9:9	6.0	1.51	15:15	1.6	1.87	40:40	2.4	2.11	24:24	1.9	1.18
Fe2O3, %	.29	1.42	9:9	1.1	1.25	15:15	.52	1.55	40:40	.85	2.02	24:24	.62	1.32
FeO, %	.15	1.69	9:9	1.1	1.60	15:15	.36	1.69	39:40	1.3	1.66	24:24	.58	1.30
MgO, %	1.2	--	9:9	3.5	1.49	15:15	1.8	1.63	40:40	2/15	2/1.5	24:24	4.0	1.06
CaO, % 2/	50	3.3	9:9	30	7.1	15:15	45	6.6	40:40	25	6.2	24:24	38	<1.2
Na2O, %	.12	1.74	9:9	.23	1.47	15:15	.18	2.03	31:40	.14	1.97	16:24	.17	1.62
K2O, %	.22	1.39	9:9	1.9	1.48	15:15	.53	1.71	40:40	.62	2.36	24:24	.56	1.24
H2O+, %	.53	1.30	9:9	1.8	1.43	15:15	.53	1.55	40:40	.85	1.64	24:24	.64	1.39
P2O5, %	3/ .93	3.21	9:9	.69	1.60	15:15	.19	2.95	38:40	.12	2.84	22:24	.16	1.79
CO2, % 2/	40	2.0	9:9	26	5.6	15:15	37	4.7	40:40	37	5.2	24:24	37	<.5
S, %	.22	1.36	9:9	.40	1.51	15:15	--	--	--	--	--	--	--	--
Elements:														
B	<30	--	0:9	32	1.73	10:15	32	1.47	12:40	42	1.45	14:24	24	1.27
Ba	13	1.43	9:9	200	1.41	15:15	4/ 91	3.79	40:40	62	2.27	24:24	79	1.82
Be	--	--	--	--	--	--	<2	--	0:40	<2	--	1:24	<2	--
Ce	<150	--	0:9	120	1.40	12:15	--	--	--	--	--	--	--	--
Co	<10	--	0:9	3.9	1.54	14:15	<7	--	1:40	5.5	1.38	11:24	1.6	1.15
Cr	3.5	1.36	9:9	31	1.61	15:15	11	1.75	40:40	13	2.02	24:24	11	1.30
Cu	.57	2.65	9:9	7.3	1.50	15:15	4.9	1.39	40:40	7.8	1.92	23:23	5.8	1.34
Ga	<3	--	0:9	5.7	1.41	15:15	1.5	2.84	4:40	4.3	2.14	8:24	2.5	1.19
La	<30	--	0:9	38	1.56	12:15	<20	--	0:24	<20	--	0:24	<20	--
Mn	350	2.42	9:9	410	1.72	14:15	620	1.47	40:40	430	2.13	24:24	540	1.48
Mo	--	--	--	--	--	--	<10	--	2:40	<10	--	0:24	<10	--
Ni	<30	--	0:9	21	1.49	4:15	6.9	1.73	15:40	9.1	1.58	14:24	5.5	1.29
Pb	3.2	3.43	5:9	4.8	1.43	14:15	18	1.18	20:40	19	1.08	16:24	14	1.15
Sc	<3	--	0:9	5.3	1.45	15:15	<10	--	1:40	1.3	2.97	2:24	<10	--
Sr	530	1.31	9:9	630	1.27	15:15	580	1.58	40:40	180	1.50	24:24	370	1.37
Ti	890	3.62	9:9	780	2.91	15:15	450	2.40	40:40	480	2.68	24:24	460	1.53
V	7.6	1.34	9:9	25	1.50	15:15	16	1.44	30:40	22	1.83	21:24	16	1.25
Y	3.9	1.93	6:9	13	1.26	15:15	15	1.21	6:40	15	1.20	4:24	5.5	1.11
Yb	<1	--	0:9	1.3	1.26	15:15	1.4	1.29	9:40	1.6	1.19	5:24	.73	1.15
Zn	--	--	--	--	--	--	200	--	0:40	<200	--	2:24	<200	--
Zr	7.6	1.25	3:9	35	1.35	15:15	3.6	2.03	31:40	39	2.08	18:24	33	1.50

Table 6A.--Cont.

Part II. Medians by areas (quadrangle pairs)

	GD	Holland-Amandaville	New Haven-Dunnville	Phil-Valley View	Burtonville-Manchester Islands
Limestones + dolomites:					
Na_2O, %	1.88	0.36	0.23	0.17	0.085
Zr	1.66	70	50	50	<20
Limestones only:					
SiO_2, %	2.06	21	15	4.8	2.8
Al_2O_3, %	1.93	2.9	--	.97	--
FeO, %	1.60	--	--	.18	.59
MgO, %	1.53	3.3	--	1.1	--
CaO, % 2/	4.4	37	42	50	50
Na_2O, %	1.81	.42	--	--	<.12
K_2O, %	1.76	.76	--	--	.38
H_2O+, %	1.56	--	.75	--	.37
CO_2, % 2/	3.6	33	34	40	41
Sr	1.35	300	500	1000	600

1/ Summaries based on data in Cressman (1973, table 2).
2/ Computed on untransformed data.
3/ 6% P_2O_5 measured in sample LC-6 from the Tanglewood Member.
4/ 3000 ppm Ba measured in sample UOE222 (Bull Fork Formation, Manchester Islands quadrangle).

Table 6B.--Summary geochemical statistics for carbonates of Lower Mississippian age in Kentucky. [Data are in parts per million except where noted as percent (%); GM, geometric mean; GD, geometric deviation; GE, geometric error; M, median; Ratio, number of analyses in which constituent was determined to total number of analyses; leaders (--) indicate insufficient data]

Part I. Statewide summary

	Limestone			Dolomite			Ls + Dol		Calcareous 1/ Siltstone		Limestone 1/ Concretions	
	GM	GD	Ratio	GM	GD	Ratio	GM	GE	M	Ratio	M	Ratio
Oxides:												
SiO2, %	13.0	2.33	70:70	21.0	2.09	26:26	15.0	<1.01	46.0	10:10	22	6:6
Al2O3, %	.70	2.64	66:70	2.2	1.90	26:26	.95	1.63	4.2	10:10	4.5	6:6
Fe2O3, %	.20	3.42	50:70	.62	1.86	25:26	.28	1.78	1.6	10:10	.78	5:6
FeO, %	.15	2.25	51:70	.74	2.74	25:26	.22	1.55	.56	10:10	.61	5:6
MgO, %	1.6	1.86	70:70	2/ 12	2/ 1.3	26:26	2.7	2.85	.52	10:10	.72	6:6
CaO, % 2/	42	8.9	70:70	24	7.2	26:26	37	<1.2	24	10:10	34	6:6
Na2O	580	2.22	22:70	1200	2.76	15:26	640	1.60	2400	7:10	1400	5:6
K2O, %	.24	2.33	61:70	.62	1.77	26:26	.31	1.75	1.3	10:10	1.2	6:6
H2O+, %	.51	1.57	70:70	.88	1.67	26:26	.59	1.37	1.0	10:10	1.1	6:6
P2O5,	210	3.85	47:70	140	4.17	15:26	190	2.07	250	8:10	3800	5:6
CO2, % 2/	35	7.4	70:70	32	8.0	26:26	33	<.9	19	10:10	28	6:6
Elements:												
Ag	<1	--	0:70	<1	--	1:26	<1	--	<1	0:10	<1	0:6
B	19	1.96	10:70	33	1.54	9:26	24	1.38	50	9:10	50	5:6
Ba	34	2.14	70:70	87	2.23	26:26	44	1.25	150	10:10	150	6:6
Co	<7	--	3:70	1.1	2.87	3:26	<7	--	7.0	8:10	7	5:6
Cr	14	2.05	70:70	19	1.95	26:26	15	1.35	85	10:10	30	6:6
Cu	3.0	1.78	67:70	5.2	1.88	25:26	3.5	1.46	5.0	10:10	15	6:6
Ga	3.5	1.56	2:70	6.7	1.53	8:26	4.2	<1.01	<10	4:10	10	5:6
La	<70	--	1:70	<70	--	0:26	<70	--	<70	2:10	<70	2:6
Mn	110	2.55	70:70	200	2.37	26:26	130	1.54	700	10:10	400	6:6
Mo	<7	--	2:70	<7	--	0:26	<7	--	<7	0:10	<7	0:6
Ni	7.1	2.53	40:70	12	2.41	20:26	8.3	1.37	20	10:10	17	6:6
Pb	10	1.83	13:70	17	1.14	10:26	13	1.15	20	7:10	20	4:6
Sc	3.5	1.56	2:70	6.1	1.36	4:26	4.6	1.25	10	10:10	10	6:6
Sr	540	1.72	70:70	160	1.45	26:26	390	1.24	300	10:10	250	6:6
Ti	170	2.35	70:70	390	2.17	26:26	210	1.40	1500	10:10	1200	6:6
V	18	1.56	60:70	32	2.04	25:26	21	1.30	130	10:10	85	6:6
Y	24	1.51	5:70	<20	--	0:26	4.7	1.57	20	10:10	40	6:6
Yb	.78	1.68	4:70	1.3	1.25	2:26	.92	1.25	2	9:10	2	6:6
Zr	11	2.06	18:70	21	2.78	13:26	11	1.29	300	10:10	85	6:6

Table 68.--Con

Part II. Medians by areas (quadrangle pairs)

	GD	Grand River-Eddyville	Fair Dealing-Canton-Fenton	Adolphus-Meador	Glasgow North-Knifely	Waterview-Cumberland City	Eli-Shopville
Limestone and Dolomite:							
FeO, %	2.34	0.14	0.14	0.33	0.18	0.28	0.86
CaO, % 2/	9.3	47	42	17	47	41	31
K2O, %	2.12	.16	.31	.82	.16	.36	.44
H2O, %	1.64	.51	.57	1.1	.47	.64	.58
P2O5, %	2.56	.06	.06	<.01	<.01	.03	.02
CO2,% 2/	8.6	38	34	21	40	37	36
Cr	1.86	30	20	20	7.5	15	10
Ni	1.60	10	<10	25	<10	10	10
Sr	1.66	600	1000	150	500	500	200
Ti	2.26	200	500	600	85	250	200
Limestone only:							
SiO2, %	2.28	--	--	44	6.9	--	--
CaO, % 2/	6.3	47	42	29	49	42	41
P2O5, %	2.55	.06	.06	<.01	<.01	--	--
CO2, % 2/	8.5	38	34	23	41	39	35
Cr	1.84	30	--	--	5	--	5
Mn	2.18	50	--	--	--	--	600
Ni	1.59	--	<10	20	<10	<10	<10
Sr	1.52	600	1000	200	500	500	500

1/ In the Tygarts Valley-Wesleyville quadrangles only.
2/ Computed on untransformed data.

Table 6C.--Summary geochemical statistics for carbonates of Upper Mississippian age in Kentucky. [Data are in parts per million except where noted as percent (%); GM, geometric mean; GD, geometric deviation; GE, geometric error; M, median; Ratio, number of analyses in which constituent was determined to total number of analyses; leaders (--) indicate insufficient data]

Part I. Statewide summary

	Limestone			Limestone and dolomite 1/		Dolomite 1/		Sandy dolomite 2/	
	GM	GD	Ratio	GM	GE	M	Ratio	M	Ratio
Oxides:									
SiO_2 %	4.1	2.15	142:142	4.5	1.12	13.0	14:14	38.0	10:10
Al_2O_3 %	.40	2.46	120:142	.46	1.74	2.4	14:14	4.0	10:10
Fe_2O_3 %	.18	2.87	94:142	.20	1.75	.65	14:14	1.2	10:10
FeO %	.19	2.60	116:142	.22	1.58	1.3	14:14	.54	10:10
MgO %	.85	2.26	141:142	1.1	1.21	14	14:14	10	10:10
CaO % 3/	50	3.5	142:142	49	1.2	30	14:14	20	10:10
Na_2O %	.054	2.38	35:142	.058	1.79	<.10	7:14	.18	7:10
K_2O %	.20	1.93	120:142	.21	1.90	.44	12:14	.89	10:10
H_2O+ %	.42	1.42	142:142	.44	1.32	.95	14:14	1.1	10:10
P_2O_5 %	170	3.34	88:142	170	2.26	200	9:14	400	9:10
CO_2 % 3/	41	1.9	142:142	40	.4	38	14:14	24	10:10
Elements:									
B	12	1.86	4:142	14	1.44	<50	2:14	50	8:10
Ba	25	2.06	142:142	27	1.34	50	14:14	130	10:10
Be	<2	--	1:142	<2	--	<2	0:14	<2	0:10
Co	1.9	1.70	3:142	1.8	1.27	<7	0:14	<7	3:10
Cr	15	1.84	142:142	16	1.40	20	14:14	25	10:10
Cu	2.4	1.83	108:142	2.5	1.38	5	14:14	5	10:10
Ga	<10	--	0:142	2.7	1.29	<10	2:14	10	7:10
Mn	150	2.66	142:142	160	1.35	400	14:14	150	10:10
Mo	.96	3.50	11:142	.87	1.78	<7	0:14	<7	1:10
Ni	6.5	1.58	43:142	6.5	1.43	10	7:14	18	10:10
Pb	14	1.28	22:142	14	1.22	<20	5:14	<20	3:10
Sc	2.8	1.64	2:142	2.7	1.29	<10	0:14	<10	1:10
Sr	640	1.60	142:142	600	1.48	500	14:14	150	10:10
Ti	100	2.19	142:142	120	1.50	500	14:14	1000	10:10
V	20	2.11	117:142	20	1.27	18	14:14	50	10:10
Y	3.5	2.66	7:142	3.3	1.17	<20	0:14	<20	3:10
Yb	1.0	1.33	3:142	1.0	1.18	<2	1:14	<2	4:10
Zr	4.2	3.88	20:142	6.1	1.38	20	10:14	50	9:10

Table 6C.--Con.

Part II. Medians by areas (quadrangle pairs)

	GD	Grand Rivers-Eddyville	Briensburg-Mont	Cadiz-Honey Grove	Mattingly-Bristow	Adolphus-Petroleum	Sulphur Lick-Breeding	Columbia-Dunnville	Barthell-Sawyer	Maretburg-Parrot	Wrigley-Brushart	Grayson-Oldtown
Limestone and Dolomite:												
SiO2 %	2.10	4.2	10.0	6.5	1.7	4.3	6.3	6.0	7.1	3.7	4.0	3.0
Fe2O3 %	2.32	.20	.22	.16	<.10	.59	.38	.52	.57	<.10	.31	<.10
FeO %	2.28	.10	.10	.22	.15	.15	.31	.62	1.6	.10	.23	.30
MgO %	2. 14	.83	1.5	1.1	.68	.68	1.8	1.0	14	.61	.35	.41
CaO % 3/	5.3	52	47	48	53	51	49	50	31	52	53	53
Sr	1.59	600	700	700	1000	500	500	500	500	1000	500	500
V	1.63	20	15	15	15	40	50	85	20	20	15	15
Limestone only:												
CaO % 3/	3.4	--	47	--	53	--	--	--	--	--	53	53
Sr	1.56	--	--	--	--	500	500	500	1300	--	500	500
V	1.70	--	15	15	15	--	--	85	--	--	15	15

1/ Sample UR112 (Adolphus quadrangle) excluded from average because it is a normative shale.
2/ In south-central Kentucky only; stratigraphically near and lithically similar to the sandy shale of Lower Mississippian age. in that area.
3/ Computed on untransformed data.

Table 6D.--Summary geochemical statistics for carbonates of Pennsylvanian age in Kentucky. [Data are in parts per million except where noted as percent (%); GM, geometric mean; GD, geometric deviation; GE, geometric error; M, median; Ratio, number of analyses in which constituent was determined to total number of analyses; nd, no data; Leaders (--) indicate insufficient data]

Part I. Statewide summary

	Concretions/Nodules			Limestone			Concretions/Nodules + Limestone		Siderite 1/				Pyritic calcite Nodules	
	GM	GD	Ratio	GM	GD	Ratio	GM	GE	GM	GD	GE	Ratio	M	Ratio
Oxides:														
SiO2, %	28.0	1.30	49:49	4.8	1.79	24:24	16.0	1.08	15.0	1.73	1.05	23:23	14.0	4:4
Al2O3, %	7.3	1.15	49:49	1.0	1.69	24:24	3.8	1.25	5.8	1.38	1.10	23:23	3.8	4:4
Fe2O3, %	.89	2.01	47:49	.55	1.81	24:24	.76	1.87	1.9	1.81	1.38	23:23	nd	nd
FeO, % 2/	2.8	1.70	49:49	.68	2.28	24:24	1.8	1.18	35	10.1	.6	23:23	nd	nd
MgO, %	2.0	1.85	49:49	1.4	1.98	24:24	1.8	1.07	2.8	1.41	1.09	23:23	1.0	4:4
CaO, % 3/	28	5.6	49:49	48	2.6	24:24	35	.7	4.6	1.61	1.14	23:23	29	4:4
Na2O, %	.47	1.75	47:49	.11	2.20	13:24	.29	1.56	.067	3.62	1.51	9:23	.12	3:4
K2O, %	1.2	1.25	49:49	.23	1.73	21:24	.70	1.27	.77	1.62	1.12	23:23	.81	4:4
H2O+, %	1.8	1.29	49:49	.59	1.52	24:24	1.2	1.29	1.6	1.37	1.42	23:23	1.4	4:4
P2O5, %	.11	2.46	45:49	.052	2.20	22:24	.086	1.33	.47	3.16	1.69	22:23	3.0	4:4
MnO, %	.16	1.79	49:49	.14	1.41	24:24	.15	1.39	.51	1.73	1.60	23:23	.28	4:4
CO2, % 2/3/	25	3.6	49:49	40	1.7	24:24	30	.5	26	6.1	1.3	23:23	19	4:4
Elements:														
B	29	1.62	13:49	19	1.66	2:24	26	1.48	<50	--	--	1:23	<50	0:4
Ba	240	1.33	49:49	84	2.13	24:24	170	1.23	150	1.45	1.26	23:23	150	4:4
Be	3.4	2.53	3:49	<2	--	1:24	3.0	2.00	1.7	1.15	1.18	8:23	<2	0:4
Ce	<500	--	0:49	<500	--	0:24	<500	--	<500	--	--	0:23	<500	1:4
Co	8.0	1.28	44:49	1.9	2.67	3:23	6.8	1.22	4.8	1.96	1.32	9:23	20	4:4
Cr	39	1.45	49:49	15	1.40	24:24	29	1.31	18	1.58	1.35	23:23	20	4:4
Cu	15	1.46	49:49	6.8	1.70	24:24	12	1.24	12	1.57	1.25	23:23	20	4:4
Ga	14	1.44	47:49	<10	--	0:24	10	1.34	12	1.36	1.29	23:23	10	3:4
La	<70	--	3:49	<70	--	0:24	<70	--	37	1.45	1.18	3:23	100	3:4
Mo	.80	3.80	2:49	<10	--	0:24	.55	1.74	8.1	1.58	1.44	17:23	12	4:4
Ni	16	1.55	48:49	13	1.81	17:24	15	1.32	12	1.52	1.35	19:23	100	4:4
Pb	20	1.34	42:49	16	1.30	8:24	19	1.15	18	1.19	1.17	13:23	180	4:4
Sc	10	1.22	42:49	5.0	1.44	2:24	8.9	1.18	7.6	1.81	1.12	10:23	20	4:4
Sr	320	1.33	49:49	970	1.82	24:24	460	1.28	170	1.45	1.25	23:23	500	4:4
Ti	.16	1.34	49:49	.021	1.70	24:24	.083	1.32	.073	1.84	1.29	23:23	.05	4:4
V	54	1.39	49:49	18	1.84	21:24	38	1.41	30	1.98	1.27	22:23	50	4:4
Y	20	1.63	34:49	15	1.76	10:24	19	1.27	28	2.14	1.11	18:23	200	4:4
Yb	1.7	1.92	36:48	.39	3.32	6:24	1.2	1.23	3.0	2.09	1.90	20:22	10	4:4
Zr	84	1.45	49:49	23	1.26	3:24	43	1.25	30	2.37	1.50	18:23	25	3:4

Table 6D.--Cont.

Part II. Medians by area (quadrangle pairs)

	GD	Madisonville West-Madisonville East	Maceo-Tell City	Rockholds-Vox-Corbin	Hyden East-Hazel Green	Matewan-Williamson	Boltsfork-Ashland
Concretions + Limestone:							
Al_2O_3, %	1.96	1.1	1.4	7.3	8.4	7.0	6.2
MgO, %	1.76	3.8	.95	3.6	1.7	1.0	1.2
Na_2O, %	1.85	.19	<.1	.79	.68	.43	.36
K_2O, %	1.80	.23	.25	1.2	1.2	1.4	.89
MnO, %	1.63	.16	.14	.16	.12	.20	.13
CO_2, % 3/	4.8	41	40	21	23	26	29
Ba	1.63	270	70	300	300	200	170
Cr	1.56	17	20	30	50	50	40
Ti	2.04	.02	.025	.15	.20	.15	.17
V	1.75	20	20	50	50	50	60
Zr	1.75	<20	<20	100	100	70	85
Concretions only:							
MgO, %	1.19	7.0	nd	3.6	1.7	1.0	1.2
CaO, % 3/	4.6	23	nd	22	27	34	36
MnO, %	1.58	.33	nd	.16	.12	.20	.13
Sc	1.19	10	nd	10	10	10	17
Y	1.27	<20	nd	20	20	20	70
Yb	1.67	<2	nd	2	2	2	5

1/ Includes 8 analyses of siderite collected from the Upper Mississippian Pennington Formation.
2/ For siderite, computed on untransformed data.
3/ For concretion and limestone, computed on untransformed data.

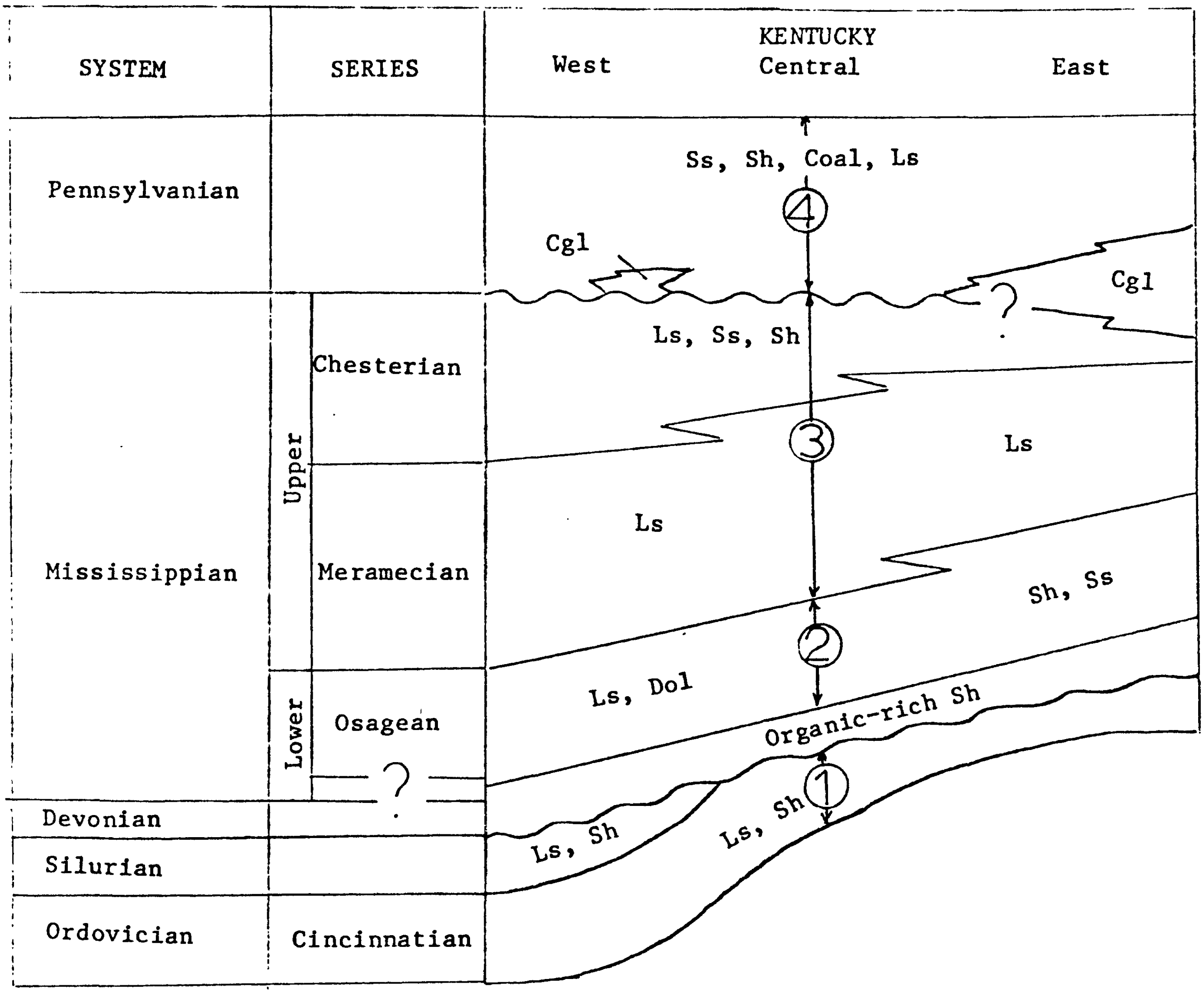


Figure 1. Regional stratigraphic relations of Paleozoic rocks in Kentucky. Sampled carbonate units are numbered.

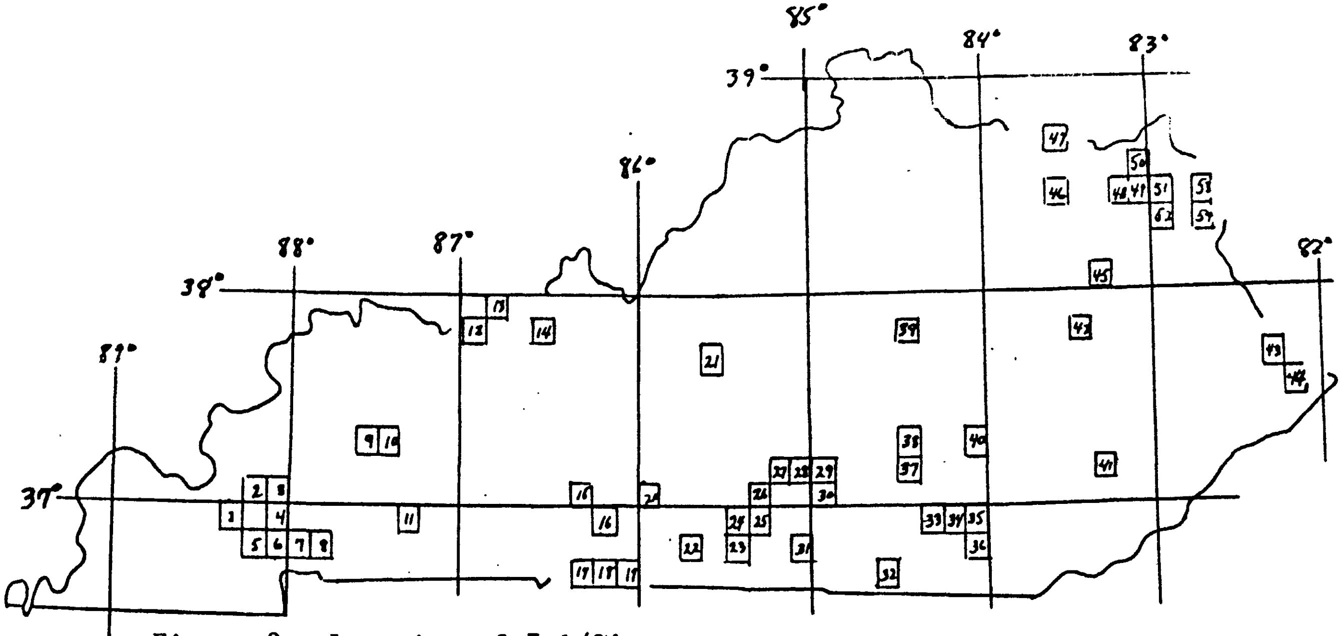


Figure 2.--Location of 7-1/2' quadrangles from which carbonate rocks of Paleozoic age were collected. [C, rocks of Cincinnatian age; LM, rocks of Lower Mississippian age; UM, rocks of Upper Mississippian age; P, rocks of Pennsylvanian age]

Quadrangle No. Name	Unit sampled	U.S.G.S. Map GQ-	Author and year
1. Briensburg	UM	327	T. W. Lambert and L. M. MacCary, 1964
2. Grand Rivers	LM,UM	328	W. H. Hays, 1964
3. Eddyville	LM,UM	255	W. B. Rogers, 1963
4. Mont	UM	305	P. L. Weis and P. K. Theobald, 1964
5. Fairdealing	LM	320	E. W. Wolf, 1964
6. Fenton	LM	317	R. W. Schnabel and J. A. MacKallor, 1964
7. Canton	LM	279	K. F. Fox, Jr., and D. A. Seeland, 1963
8. Cadiz	UM	412	K. F. Fox, Jr., 1965
9. Madisonville West	P	346	T. M. Kehn, 1964
10. Madisonville East	P	252	T. M. Kehn, 1963
11. Honey Grove	UM	376	Harry Klemic, 1965
12. Maceo	P	570	R. H. Calvert, 1966
13. Tell City	P	356	F. D. Spencer, 1964
14. Mattingly	UM	361	L. D. Clark and M. D. Crittenden, Jr., 1965
15. Bristow	UM	216	Benjamin Gildersleeve, 1963
16. Meador	LM	288	W. H. Nelson, 1963
17. Adolphus	LM,UM	299	W. H. Nelson, 1964
18. Petroleum	UM	352	W. B. Myers, 1964
19. Holland	C	174	W. H. Nelson, 1962
20. Glasgow North	LM	339	D. D. Haynes, 1964
21. New Haven	C	506	W. L. Peterson, 1966
22. Sulphur Lick	UM	323	L. D. Harris, 1964
23. Waterview	LM	286	J. M. Cattermole, 1963
24. Breeding	UM	287	A. R. Taylor, 1964
25. Amandaville	C,UM	186	A. R. Taylor, 1962
26. Columbia	UM	249	R. Q. Lewis, Sr., and R. E. Thaden, 1963
27. Knifely	LM	294	C. H. Maxwell, 1964
28. Dunnville	C,UM	367	C. H. Maxwell, 1965
29. Phil	C	395	C. H. Maxwell, 1965
30. Eli	LM	393	R. E. Thaden and R. Q. Lewis, Sr., 1965

Quadrangle No. Name	Unit sampled	U.S.G.S. Map GQ-	Author and year
31. Cumberland City	LM	475	R. Q. Lewis, Sr., and R. E. Thaden, 1965
32. Barthell	UM	314	J. B. Pomerene, 1964
33. Sawyer	UM	179	W. P. Puffett, 1962
34. Vox	P	224	W. P. Puffett, 1963
35. Corbin	P	231	W. P. Puffett, 1963
36. Rockholds	P	677	J. H. Smith, 1967
37. Shopville	LM	282	N. L. Hatch, Jr., 1964
38. Maretburg	UM	338	S. O. Schlanger, 1965
39. Valley View	C	470	R. C. Greene, 1966
40. Parrot	UM	236	D. F. Crowder, 1963
41. Hyden East	P	423	H. J. Prostka, 1965
42. Hazel Green	P	266	W. B. Cashion, 1963
43. Williamson	P	187	D. C. Alvord and V. A Trent, 1962
44. Matewan	P	373	V. A. Trent, 1965
45. Wrigley	UM	170	J. W. Hosterman, S. H. Patterson, and J. W. Huddle, 1961
46. Burtonville	C	396	R. H. Morris, 1965
47. Manchester Islands	C	581	J. H. Peck and K. L. Pierce, 1966
48. Wesleyville	LM	1305	J. C. Philley and J. R. Chaplin, 1976
49. Tygarts Valley	LM	289	R. A. Sheppard, 1964
50. Brushart	UM	324	C. S. Denny, 1964
51. Oldtown	UM	353	C. L. Whittington and J. C. Ferm, 1965
52. Grayson	UM	640	C. L. Whittington and J. C. Ferm, 1967
53. Ashland	P	196	Ernest Dobrovolny, J. A. Sharps, and J. C. Ferm, 1963
54. Boltsfork	P	316	F. D. Spencer, 1964

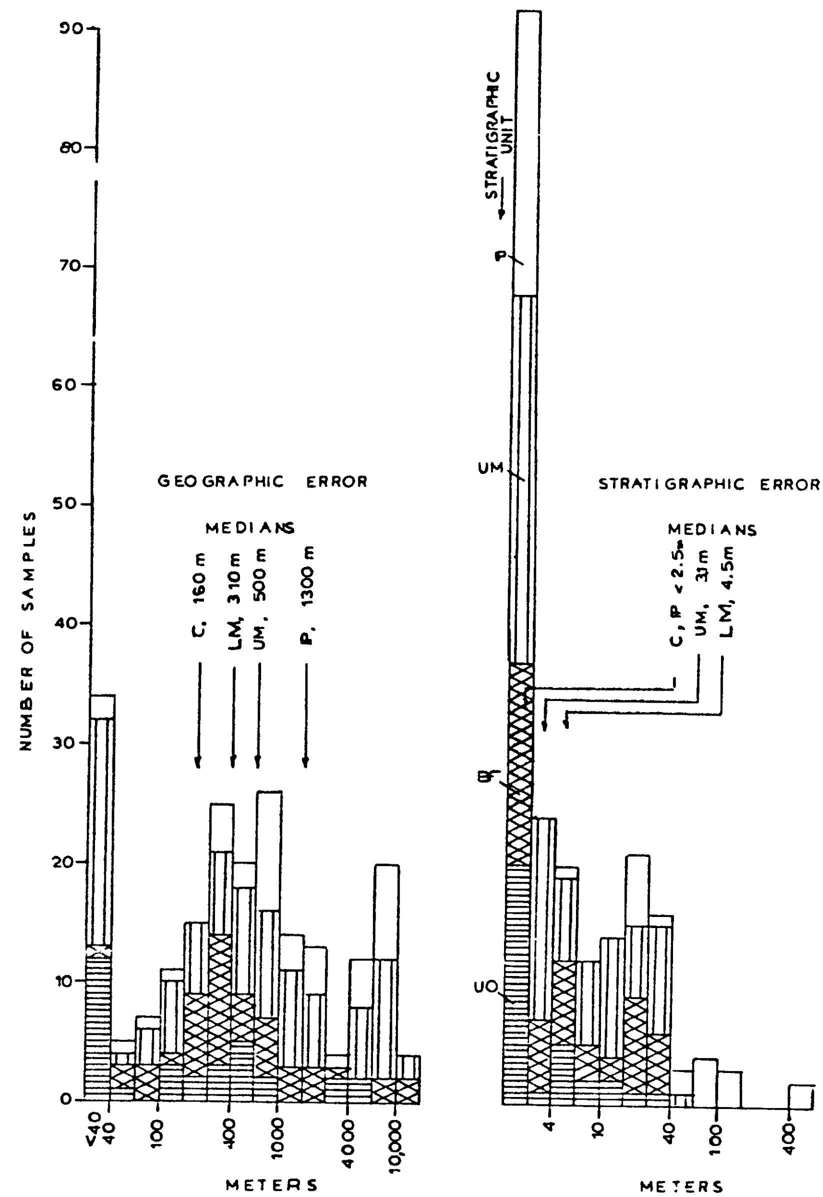


Figure 4.--Average distance (error) between planned and actual sampling sites for samples of Paleozoic carbonate rocks in Kentucky. [C, Cincinnatian; LM, Lower Mississippian; UM, upper Mississippian; P, Pennsylvanian]

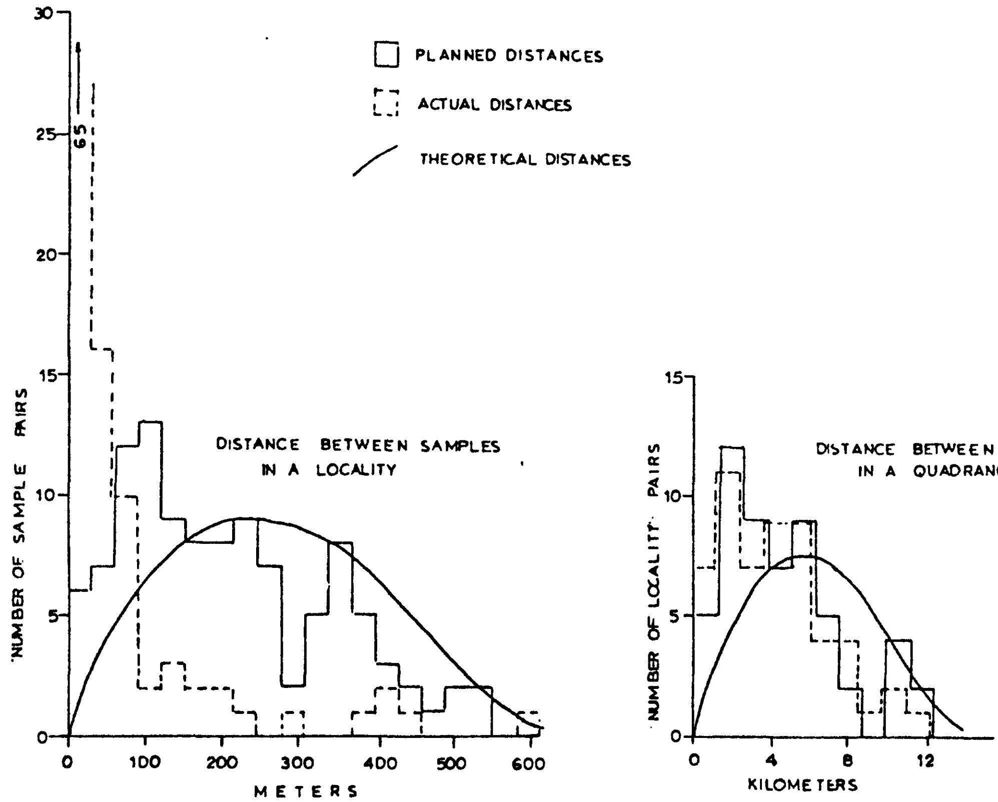


Figure 3.--Comparison of theoretical, planned, and actual distances between samples and between sampling localities in the hierarchical sampling plan used in the study of Paleozoic carbonate rocks in Kentucky.

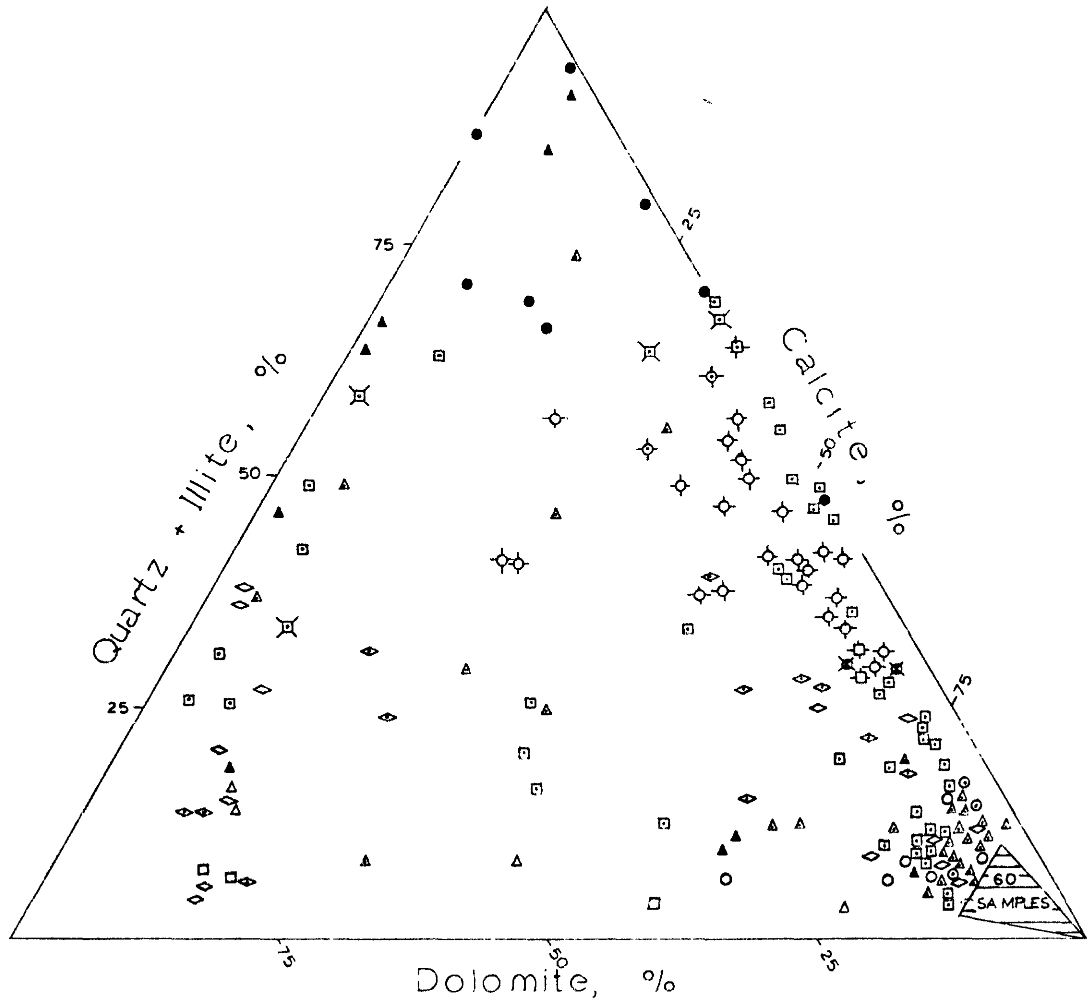


Figure 5.--Plot of normative mineralogy of Paleozoic carbonate rocks in Kentucky.

Stratigraphic Unit	Calcarenite Q<I	Calcarenite Q>I	Concretions Nodules	Siderite	Modal Chert (>15%)	Modal Pyrite (>40%)
Pennsylvanian	○	⊙	✧	●		⌧
Upper Mississippian	△	▲		▲	⌑	
Lower Mississippian	□	⊡	✧			
Cincinnatian	◇	◈				

EXPLANATION OF FREQUENCY DISTRIBUTIONS

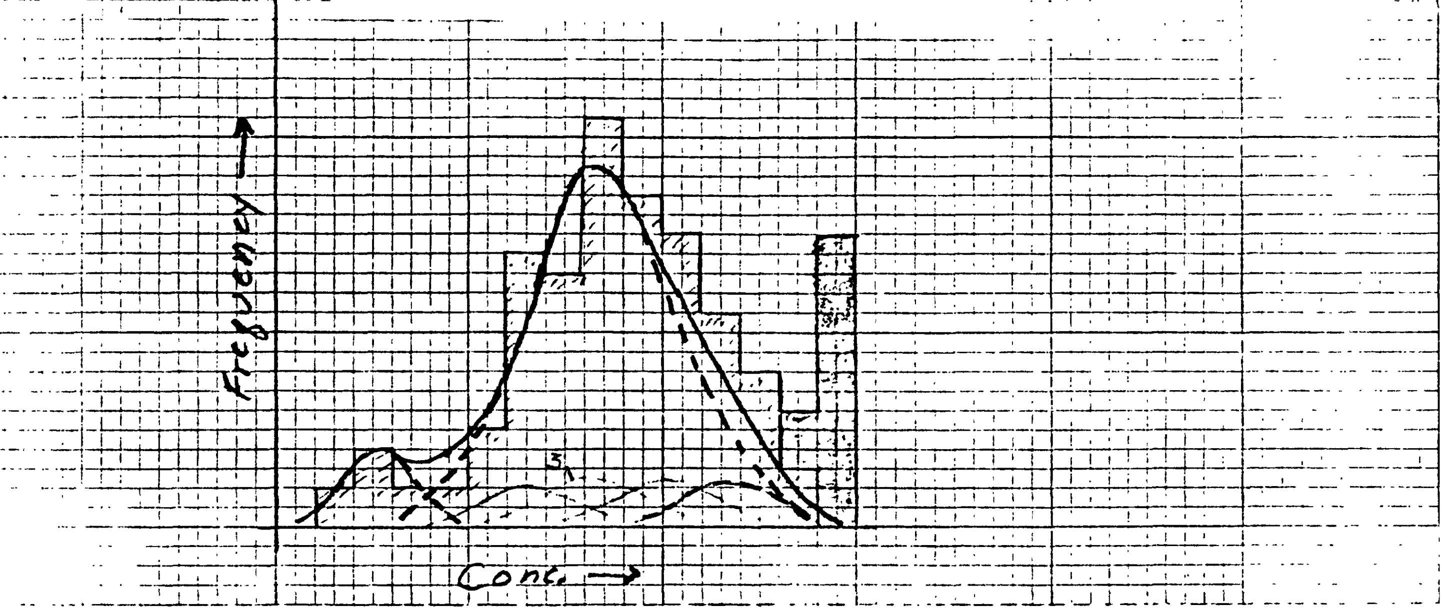
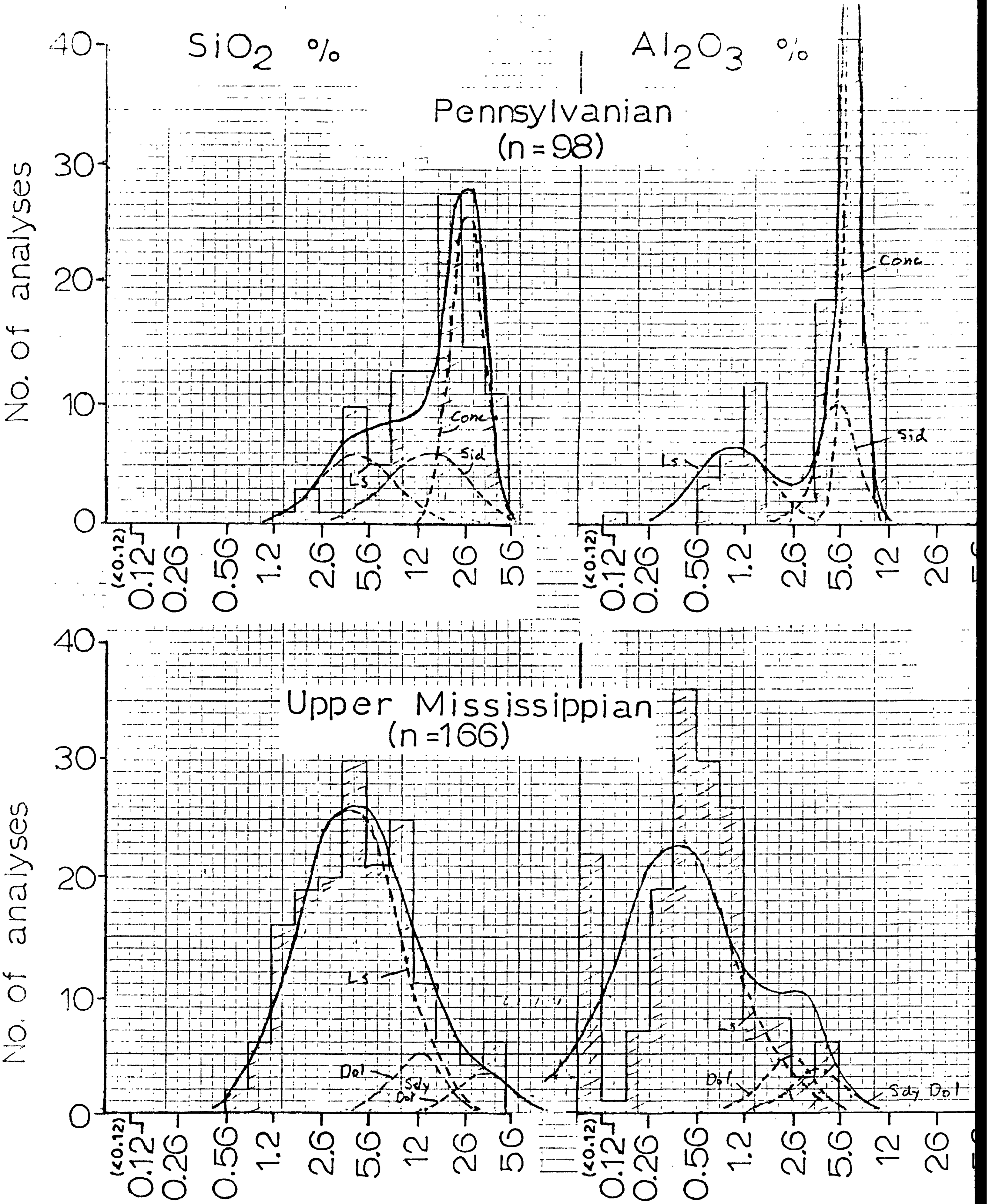


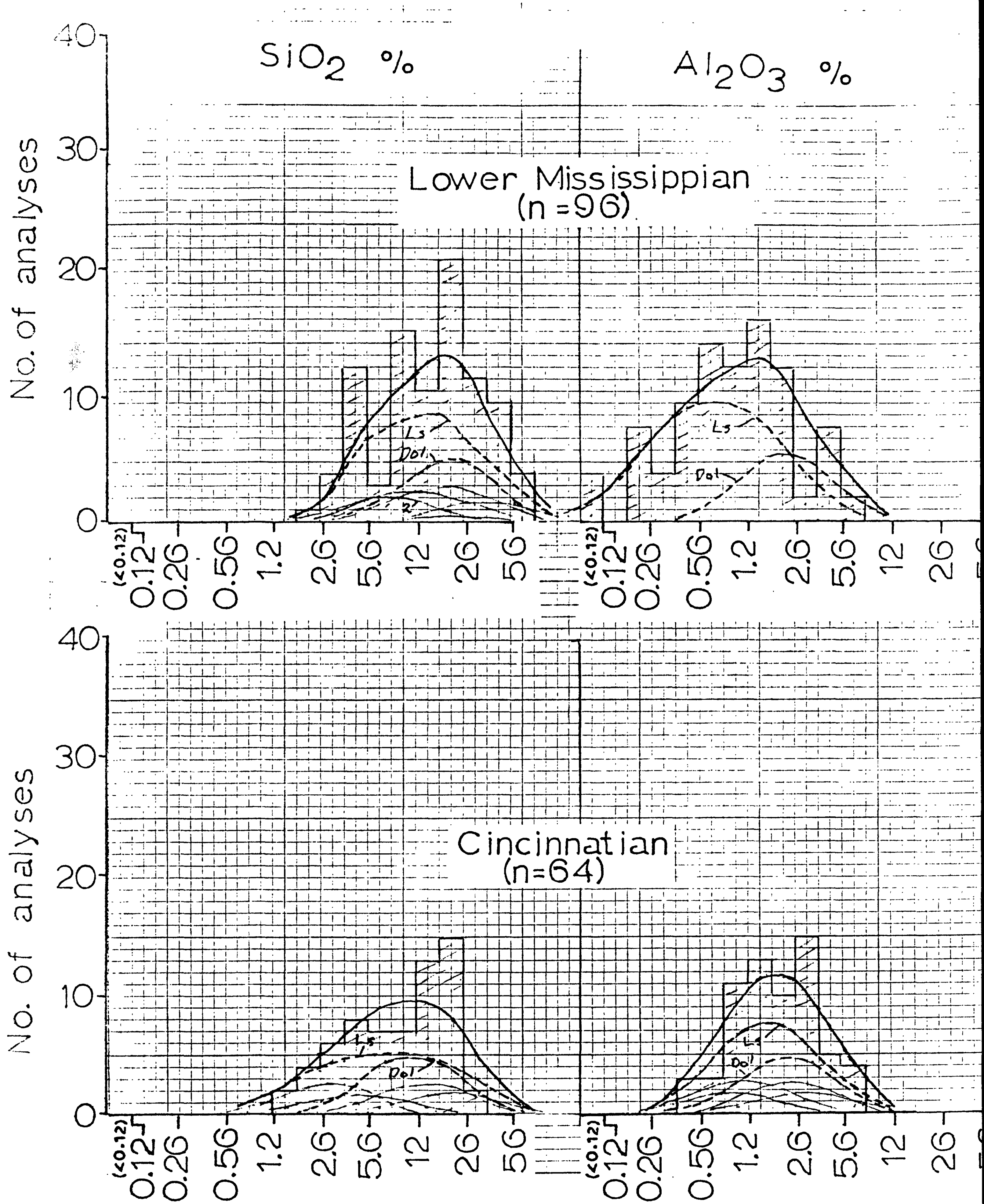
Figure 6.--The geochemical frequency distributions on the following pages are meant to be visualizations of the summary data in tables 6A-6D. Histograms for each geochemical variable in each of the four major carbonate units are outlined by hachures. Each histogram is modeled by a heavy black solid line, which is the "sum" of two or more subpopulations. Subpopulations shown by a heavy, dashed, black line represent subpopulations as given in Part I, tables 6A-6D, as follows:

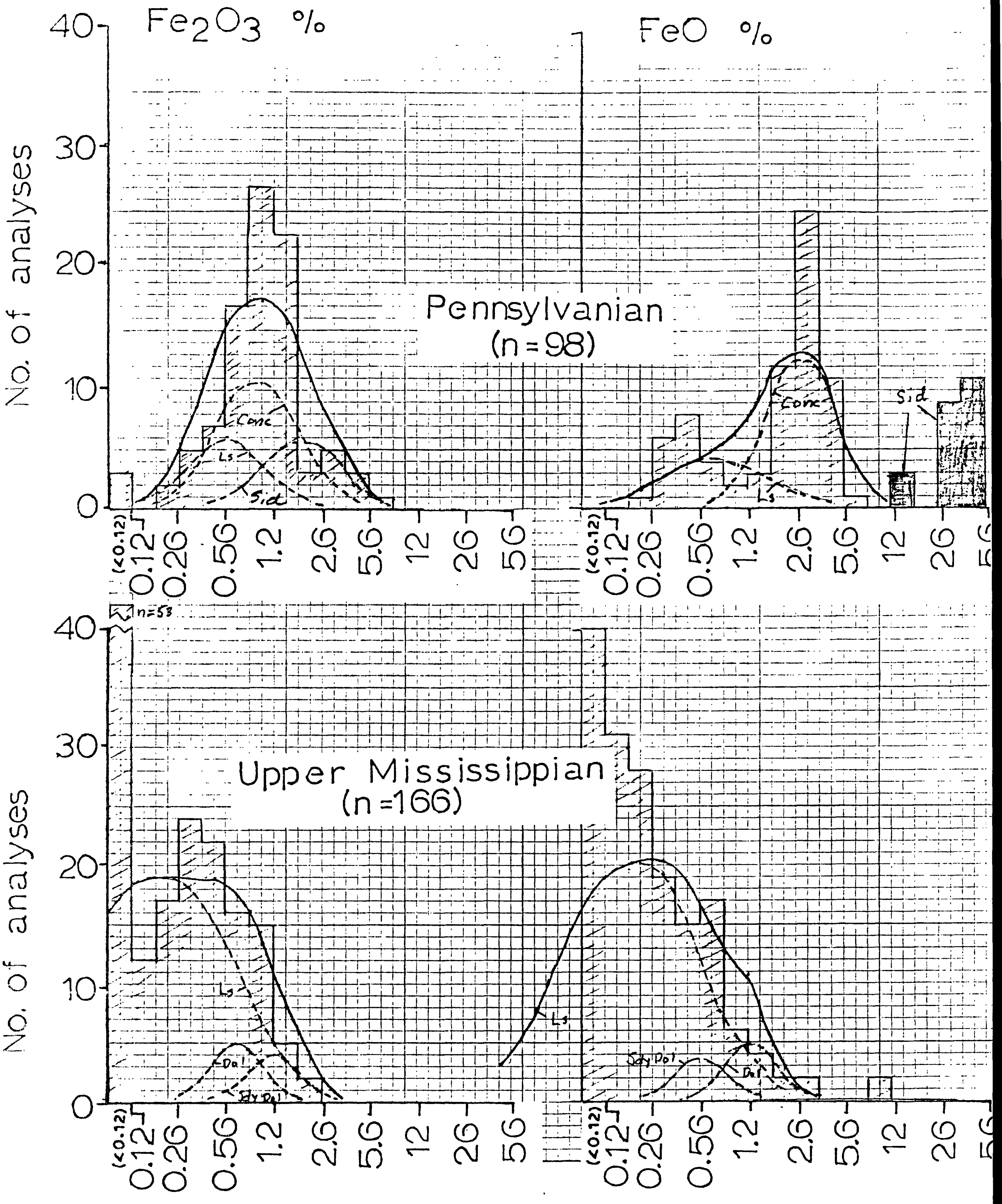
Table 6A	Limestone (Ls) Dolomite (Dol)
Table 6B	Limestone (Ls) Dolomite (Dol)
Table 6C	Limestone (Ls) Dolomite (Dol) Sandy Dolomite (Sdy Dol)
Table 6D	Concretions/Nodules (Conc) Limestone (Ls) Siderite (Sid)

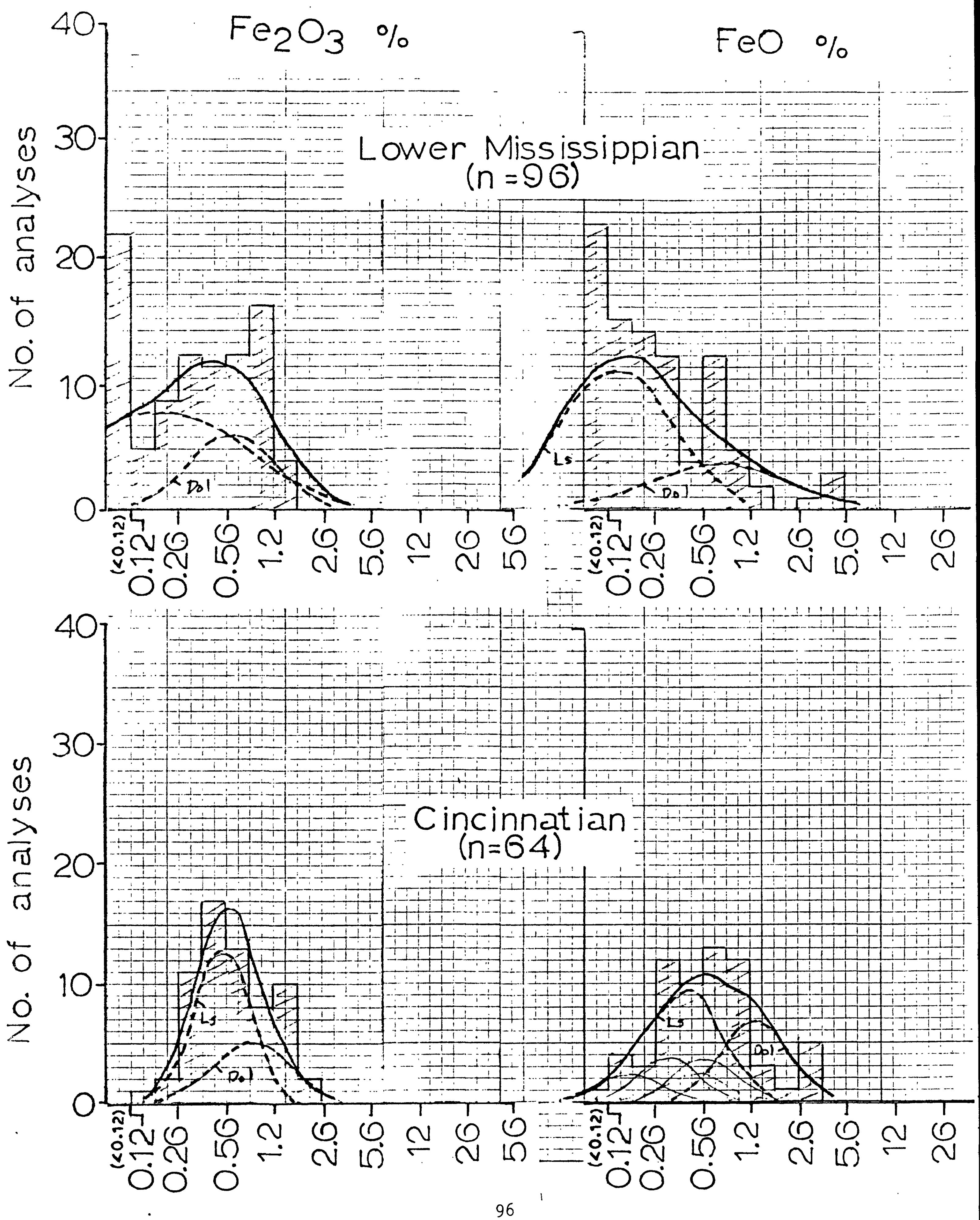
Subpopulations shown by light solid lines are based on the area means of Part II, tables 6A-6D. A number attached to one of these indicates that that line represents more than one such subpopulation. All subpopulations are based on the lognormal model. If a geometric deviation (GD) was not computed for a subpopulation, a GD of 1.5 was assumed. Where part of the histogram is shaded, that part represents data for which no frequency distribution was fit.

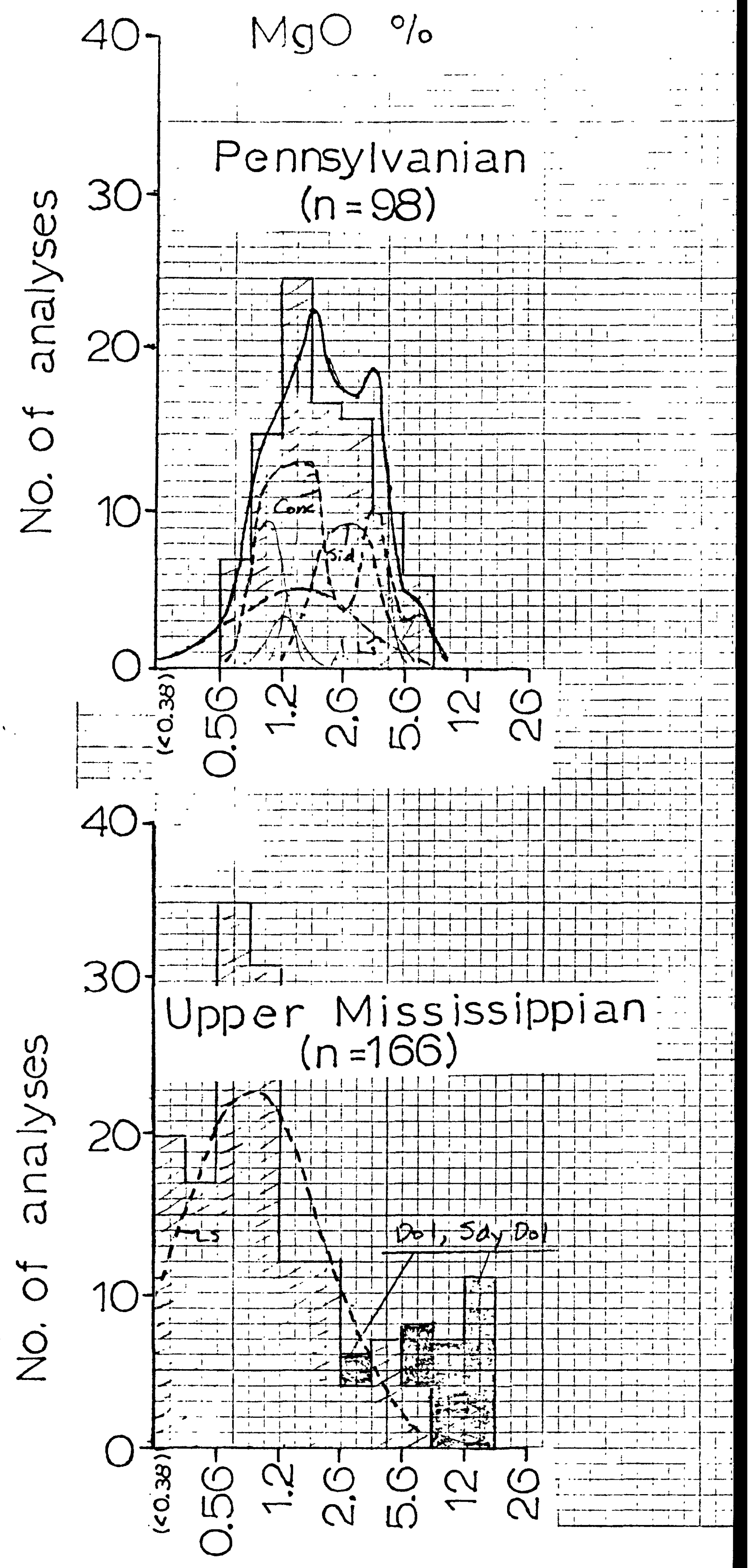


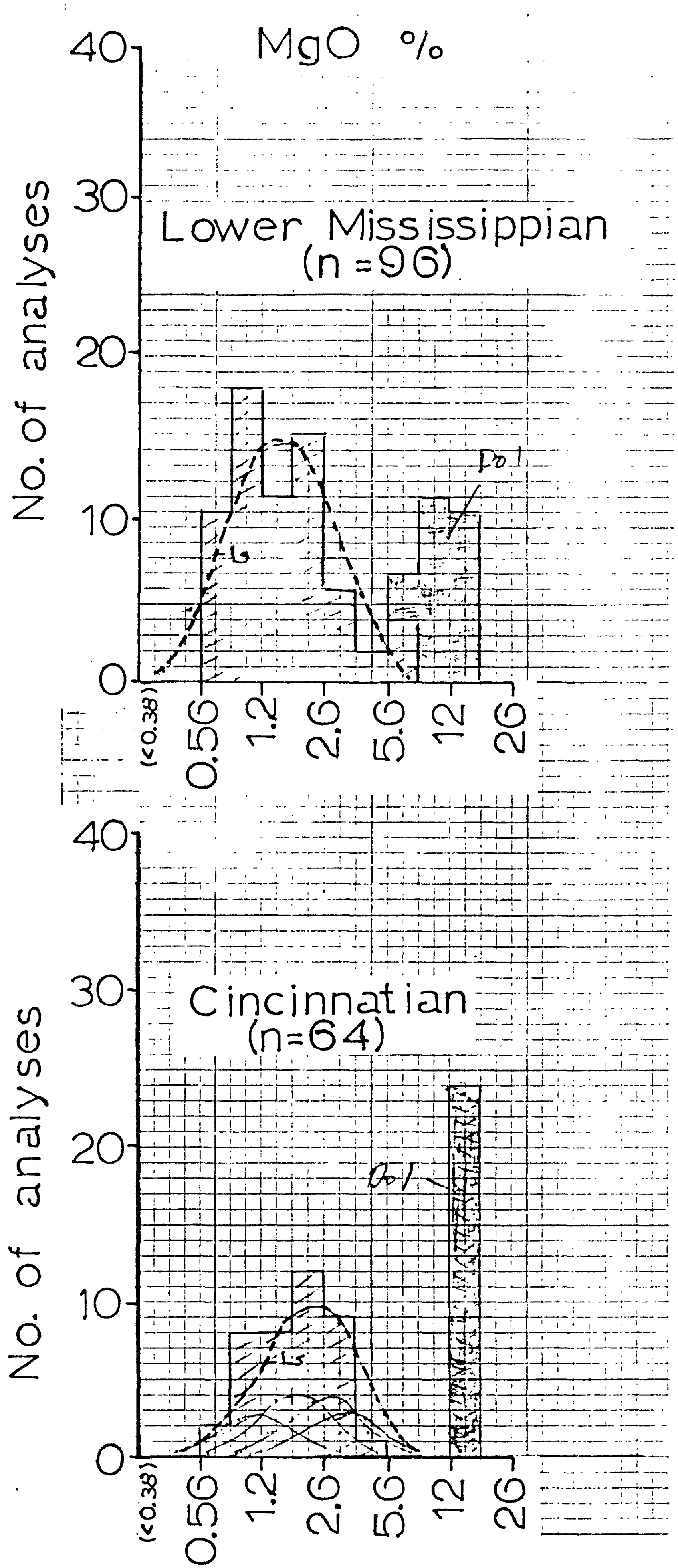
SiO2 %
Al2O3 %
Pennsylvanian
(n=98)
No. of analyses
Conc
Sid
Ls
0.12
0.26
0.56
1.2
2.6
5.6
12
26
56
(<0.12)
Upper Mississippian
(n=166)
Ls
Dol
Sdy Dol
Sdy Dol

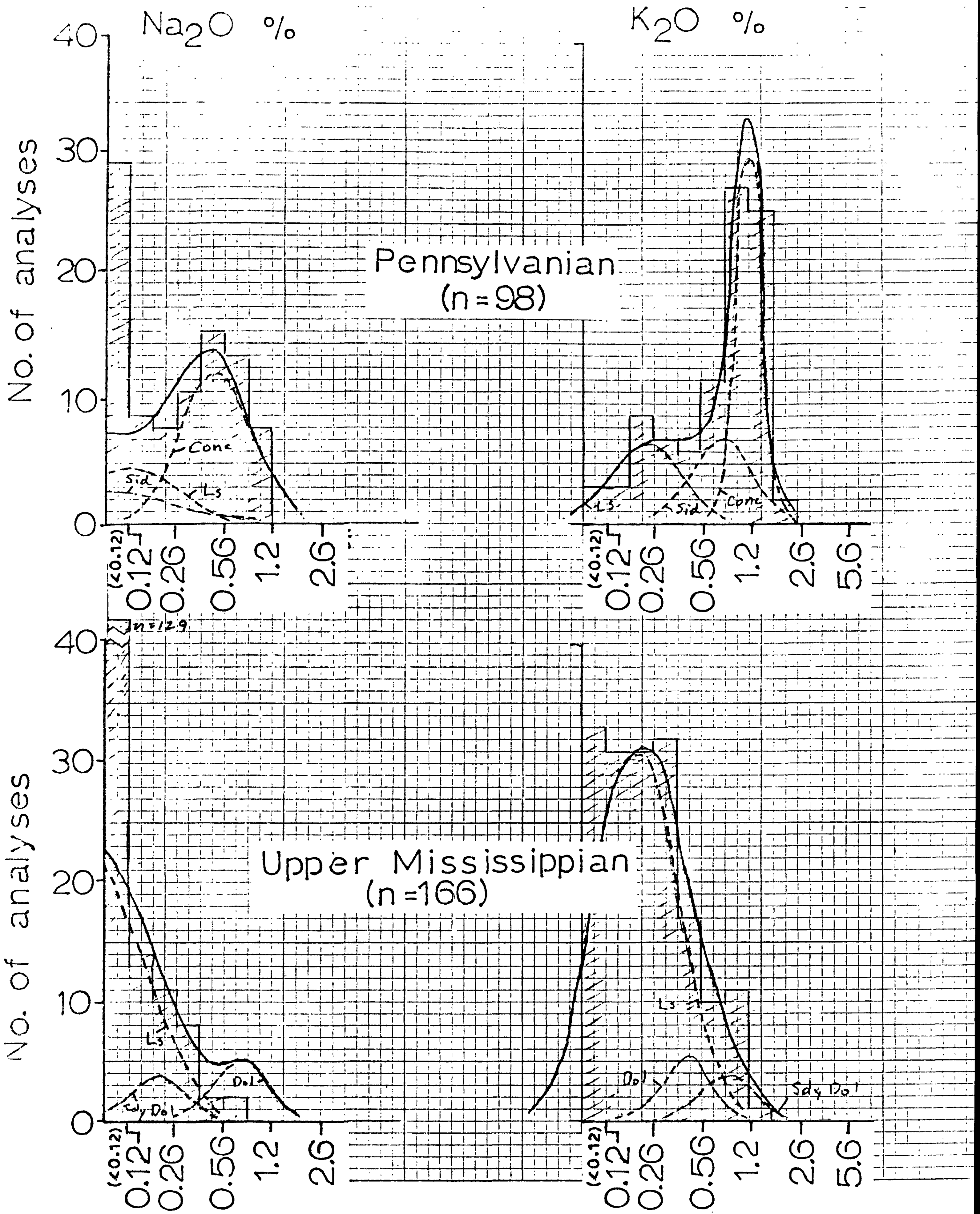

SiO2 %
Al2O3 %
No. of analyses
Lower Mississippian
(n =96)
Ls
Dol
0
10
20
30
40
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
12
26
56
Cincinnatian
(n=64)
No. of analyses


Fe2O3 %
FeO %
No. of analyses
Pennsylvanian
(n=98)
Upper Mississippian
(n=166)
Conc
Ls
Sid
Dol
Sdy Dol
n=53
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
12
26
56

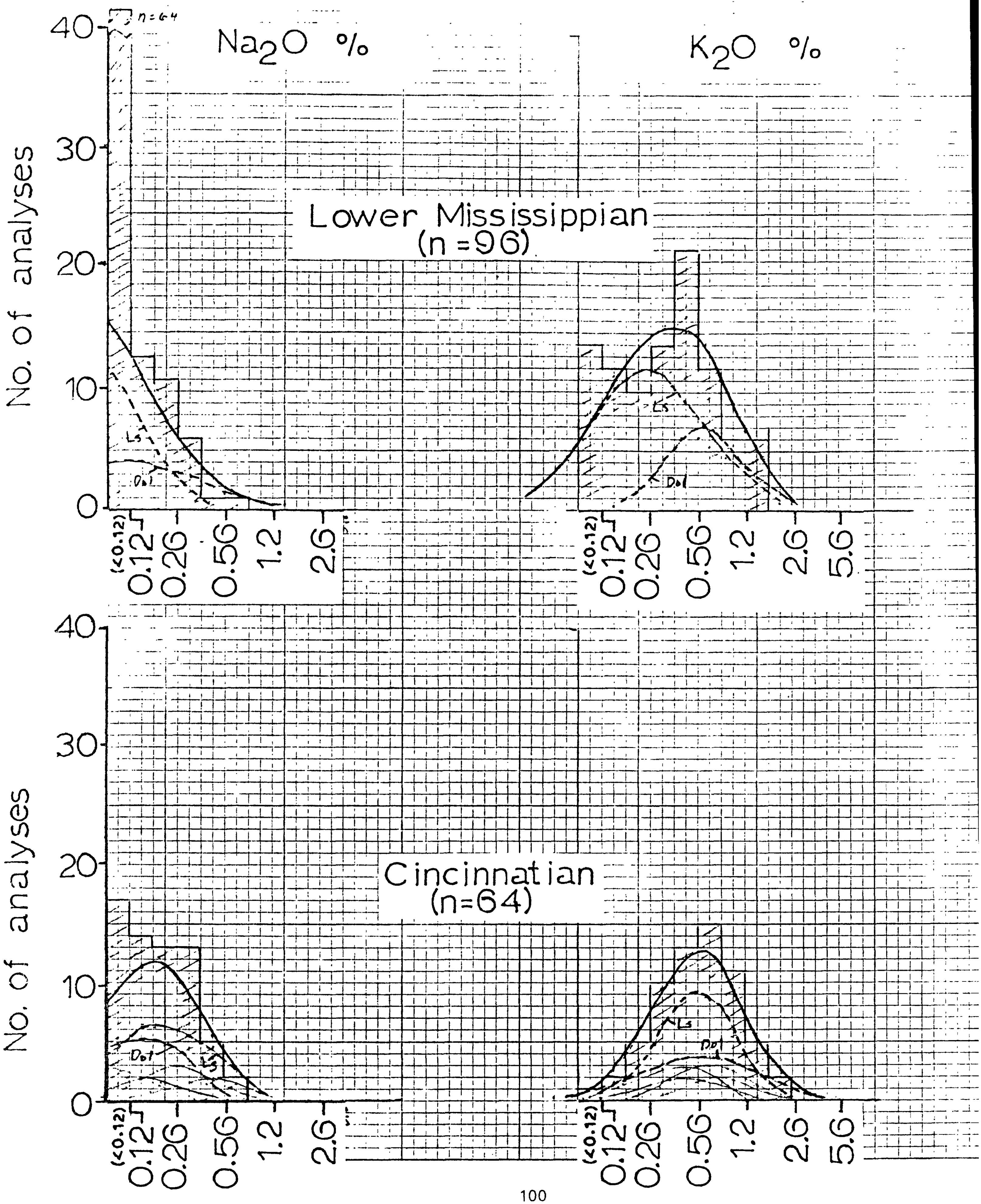

Fe2O3 %
FeO %
No. of analyses
Lower Mississippian
(n = 96)
Cincinnatian
(n=64)
Ls
Dol
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
12
26
56
0
10
20
30
40


MgO %
Pennsylvanian
(n = 98)
No. of analyses
Conc
Sid
(<0.38)
0.56
1.2
2.6
5.6
12
26
Upper Mississippian
(n =166)
No. of analyses
LS
Dol, Sdy Dol
(<0.38)
0.56
1.2
2.6
5.6
12
26

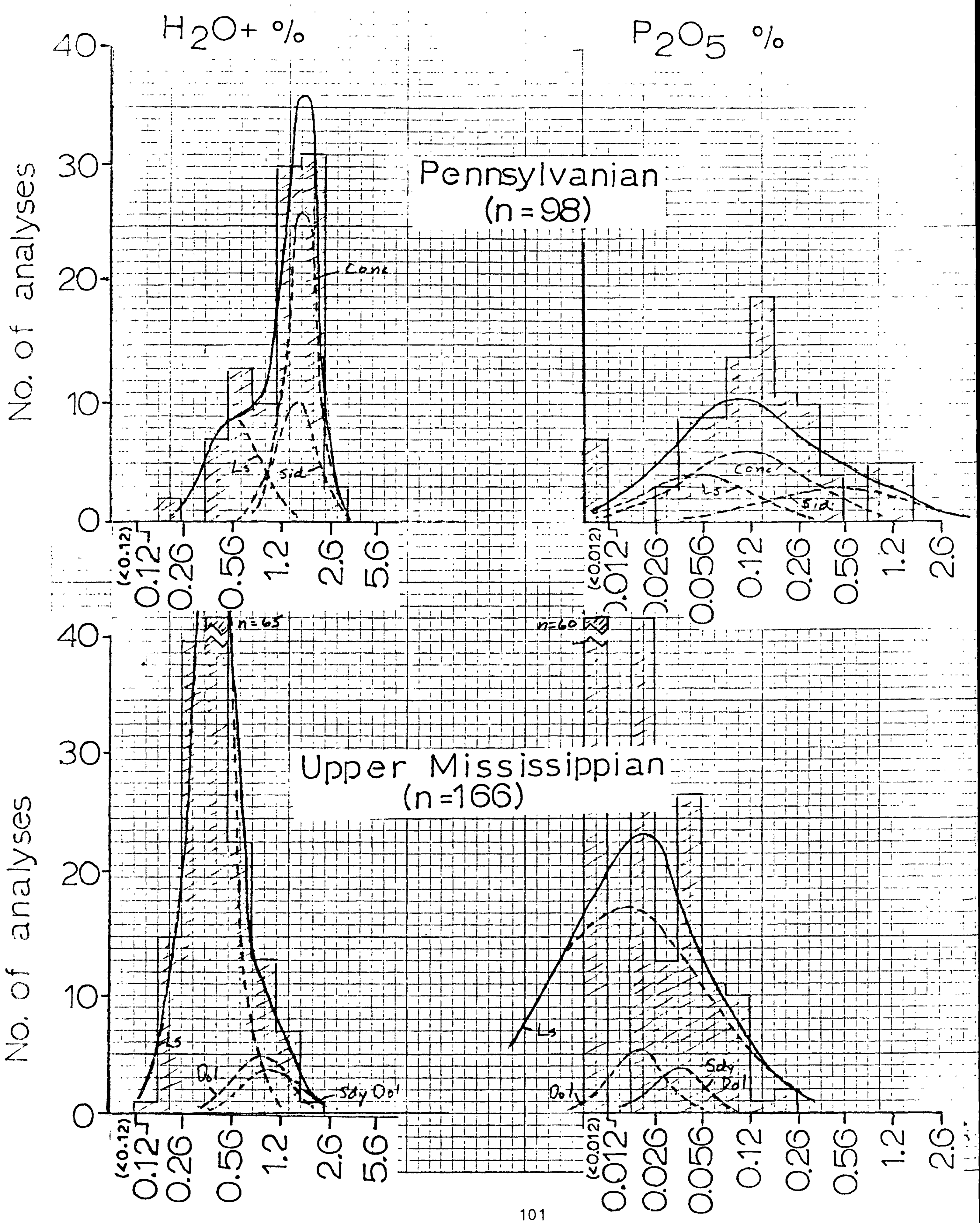

MgO %
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
No. of analyses
No. of analyses
0
10
20
30
40
(<0.38)
0.56
1.2
2.6
5.6
12
26



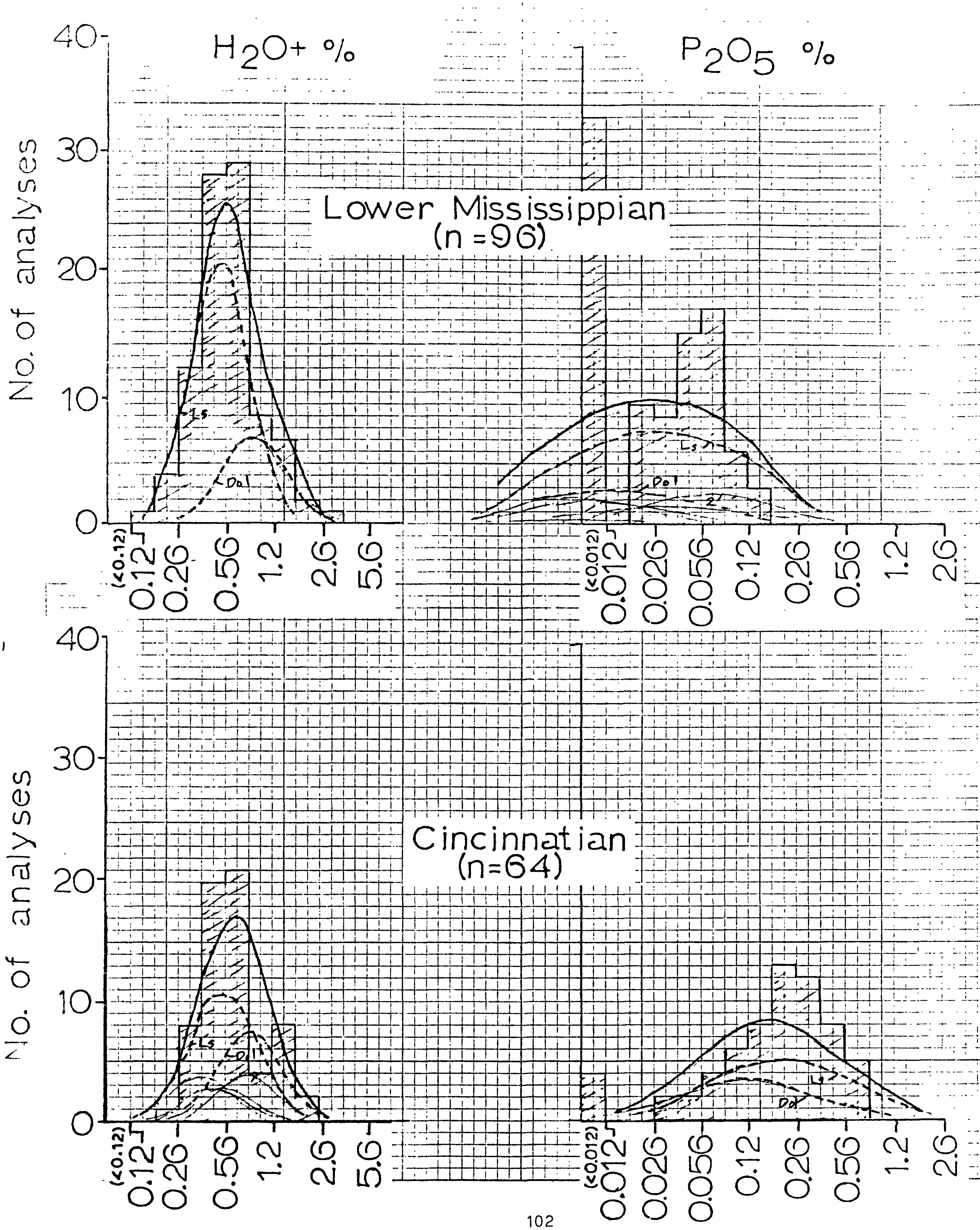
Na2O %
K2O %
No. of analyses
Pennsylvanian
(n = 98)
Conc
Sid
Ls
Upper Mississippian
(n =166)
n=129
Dol
Sdy Dol
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
0
10
20
30
40



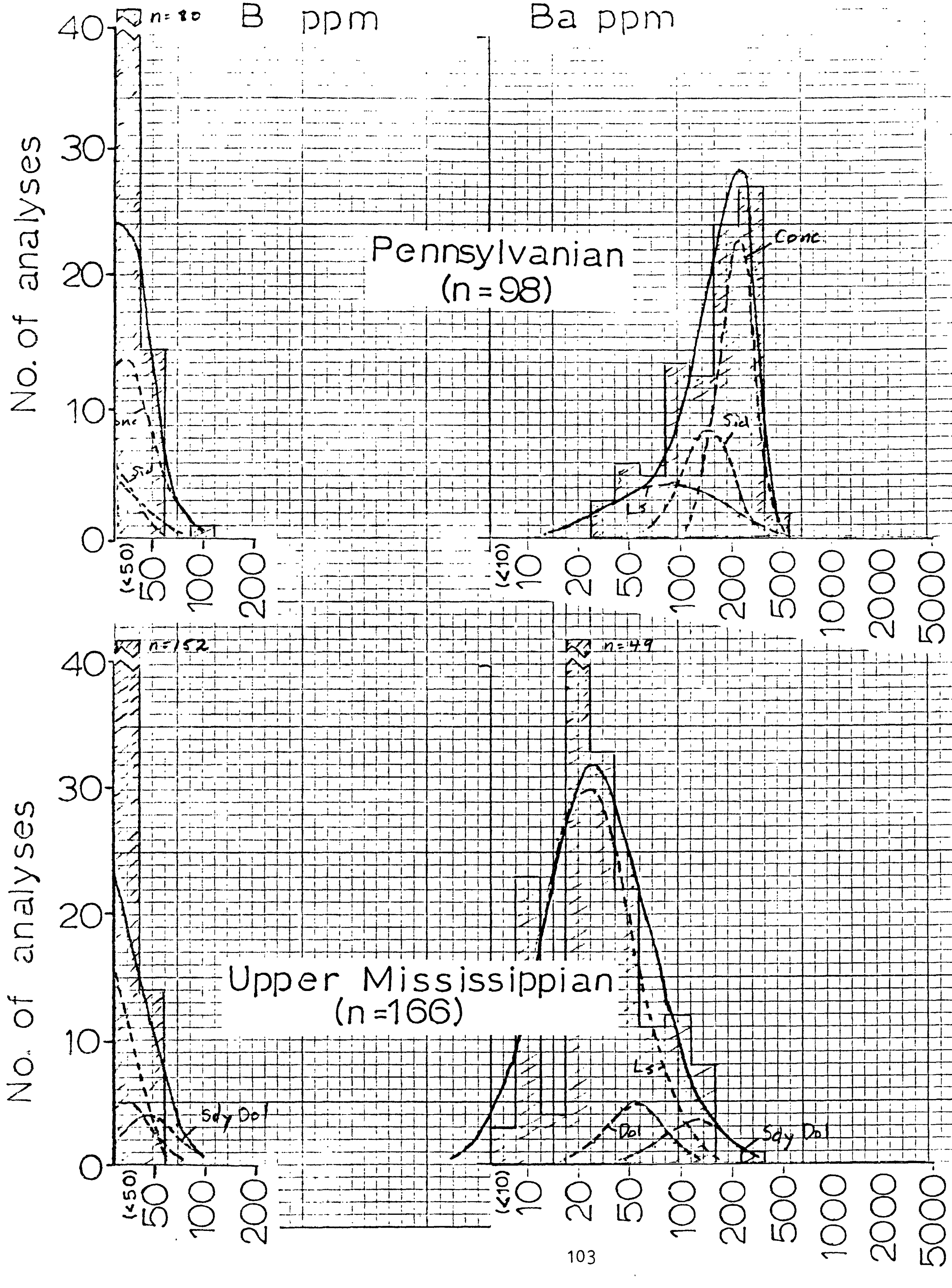
n=64
Na2O %
K2O %
Lower Mississippian
(n=96)
No. of analyses
40
30
20
10
0
Ls
Dol
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
Cincinnatian
(n=64)
No. of analyses
40
30
20
10
0
Dol
Ls
Ls
Dol
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6

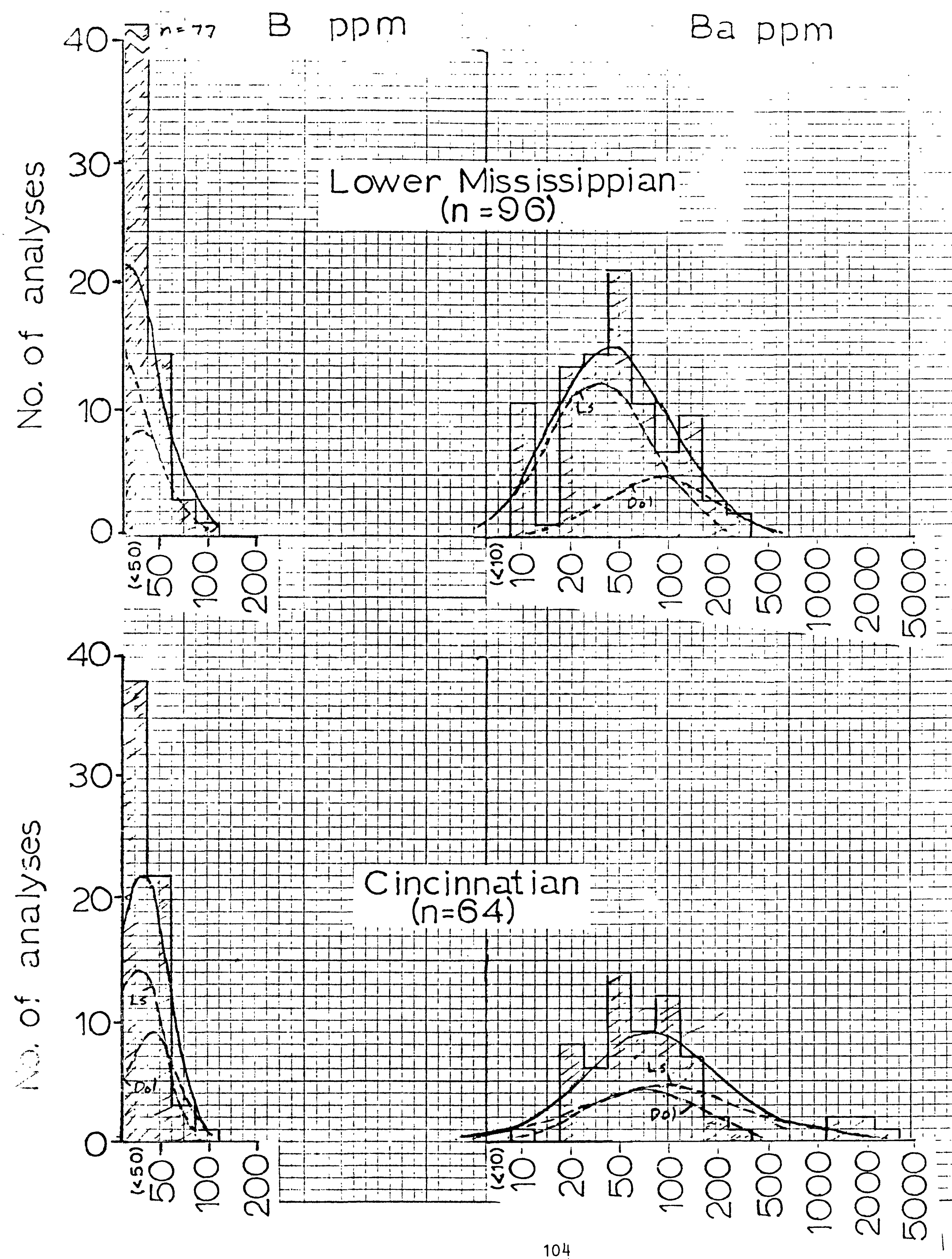


H2O+ %
P2O5 %
Pennsylvanian
(n=98)
Upper Mississippian
(n=166)
No. of analyses
No. of analyses
Conc
Ls
Sid
n=65
n=60
Dol
Sdy Dol
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
(<0.012)
0.012
0.026
0.056
0.12
0.26
0.56
1.2
2.6

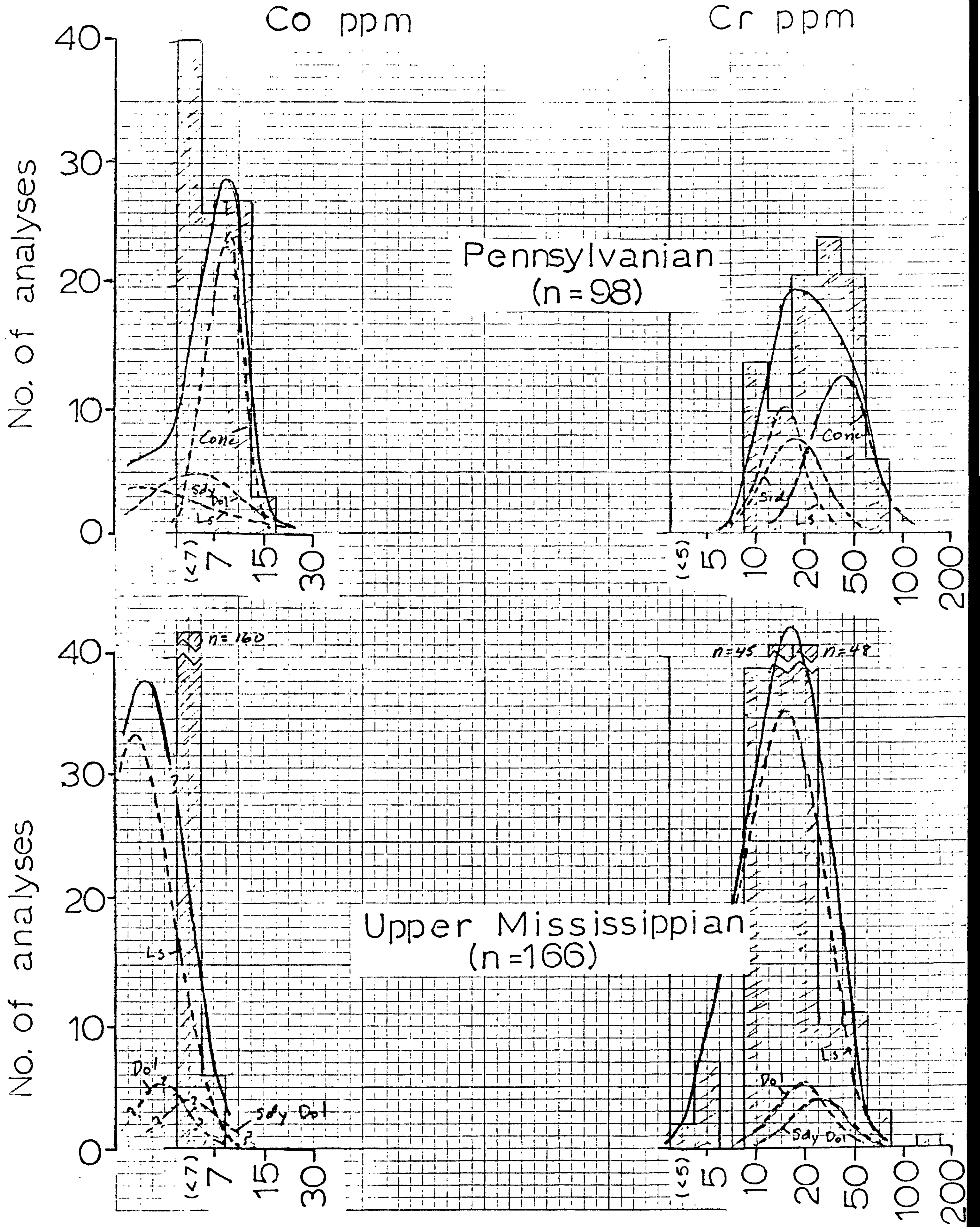


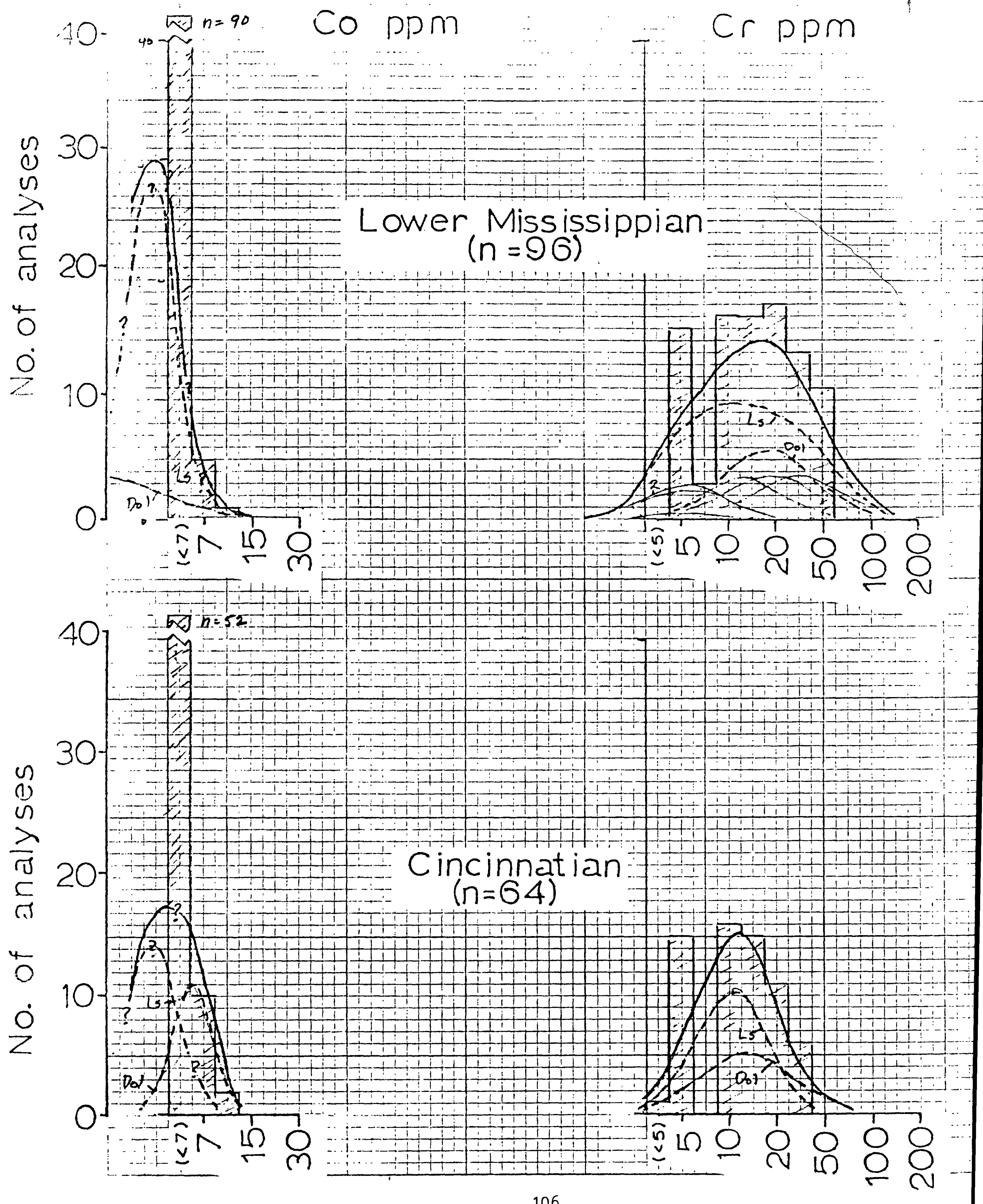
H2O+ %
P2O5 %
Lower Mississippian
(n =96)
No. of analyses
Ls
Dol
0
10
20
30
40
(<0.12)
0.12
0.26
0.56
1.2
2.6
5.6
(<0.012)
0.012
0.026
0.056
0.12
0.26
0.56
1.2
2.6
Cincinnatian
(n=64)

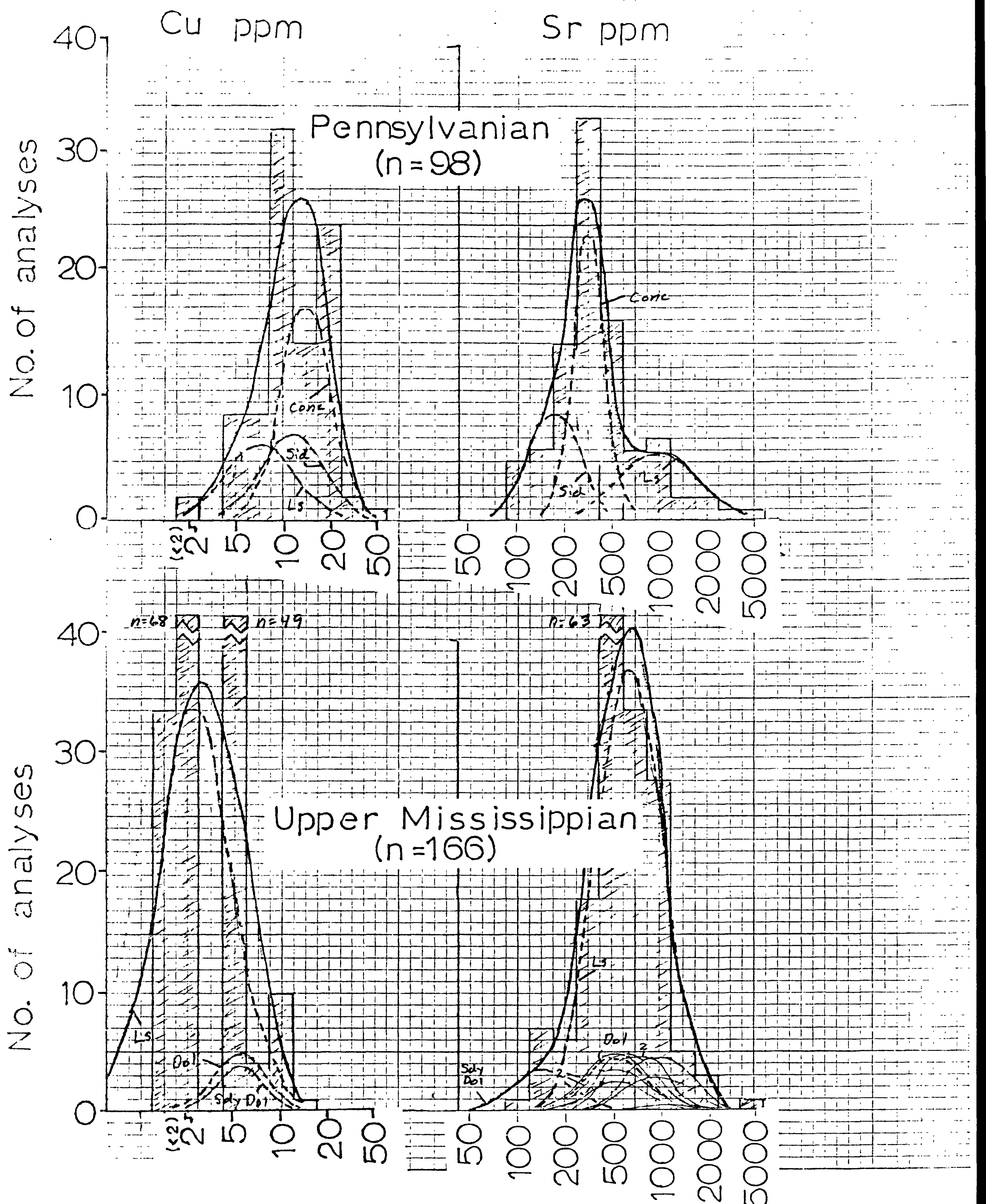

B ppm
Ba ppm
No. of analyses
Pennsylvanian
(n=98)
n=80
Conc
Sid
Ls
Upper Mississippian
(n=166)
n=152
n=49
Sdy Dol
Dol
Ls
(<50)
(<10)



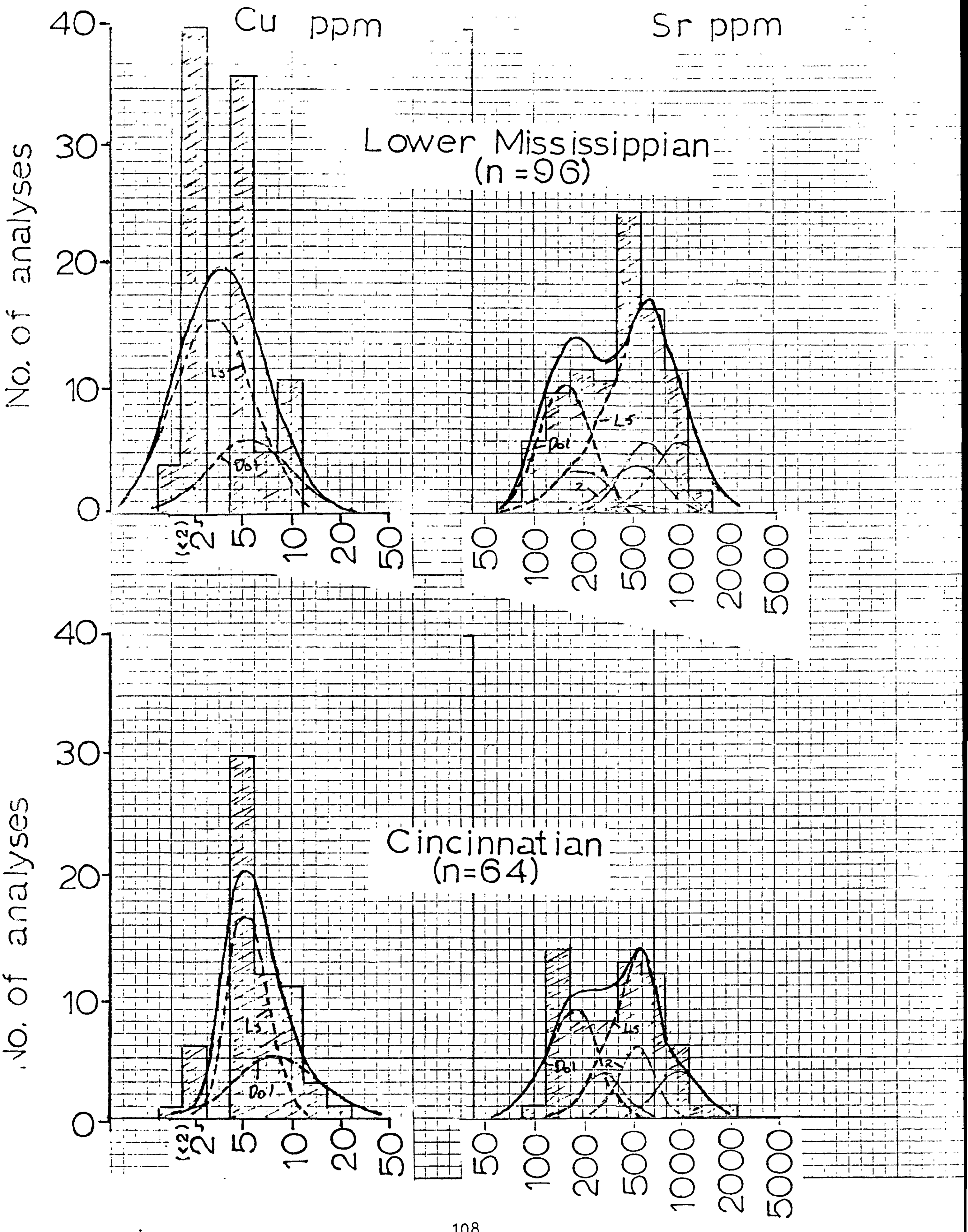
B ppm
Ba ppm
n=77
No. of analyses
Lower Mississippian
(n=96)
Ls
Dol
(<50)
50
100
200
(<10)
10
20
50
100
200
500
1000
2000
5000
No. of analyses
Cincinnatian
(n=64)
Ls
Dol


Co ppm
Cr ppm
No. of analyses
40
30
20
10
0
Pennsylvanian
(n = 98)
Conc
Sdy Dol
Ls
Sd
(<7)
7
15
30
(<5)
5
10
20
50
100
200
n = 160
n=45
n=48
Upper Mississippian
(n =166)
Ls
Dol
Sdy Dol

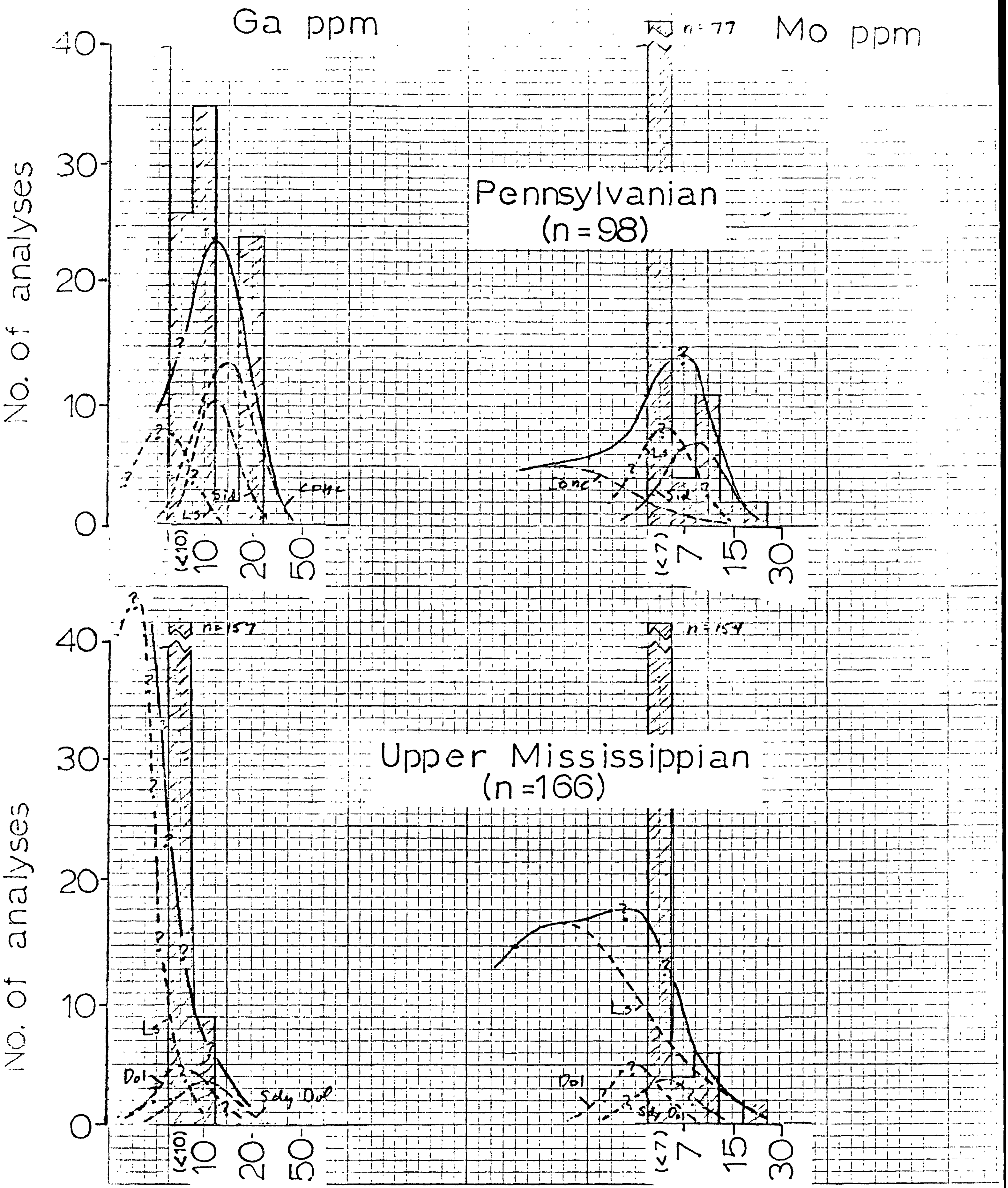

Co ppm
Cr ppm
n = 90
n=52
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
No. of analyses
No. of analyses
40
30
20
10
0
(<7)
7
15
30
(<5)
5
10
20
50
100
200
Ls
Dol

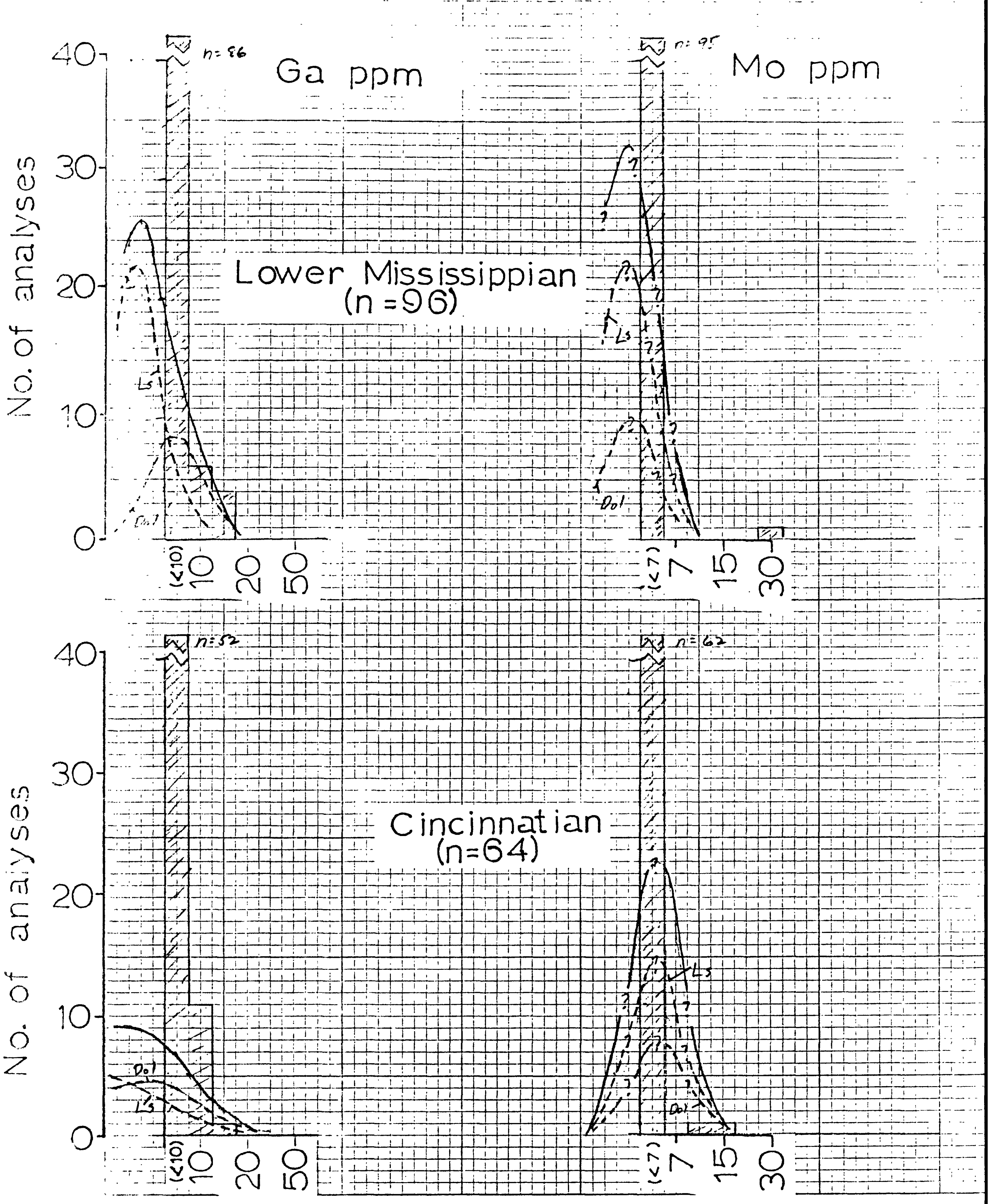


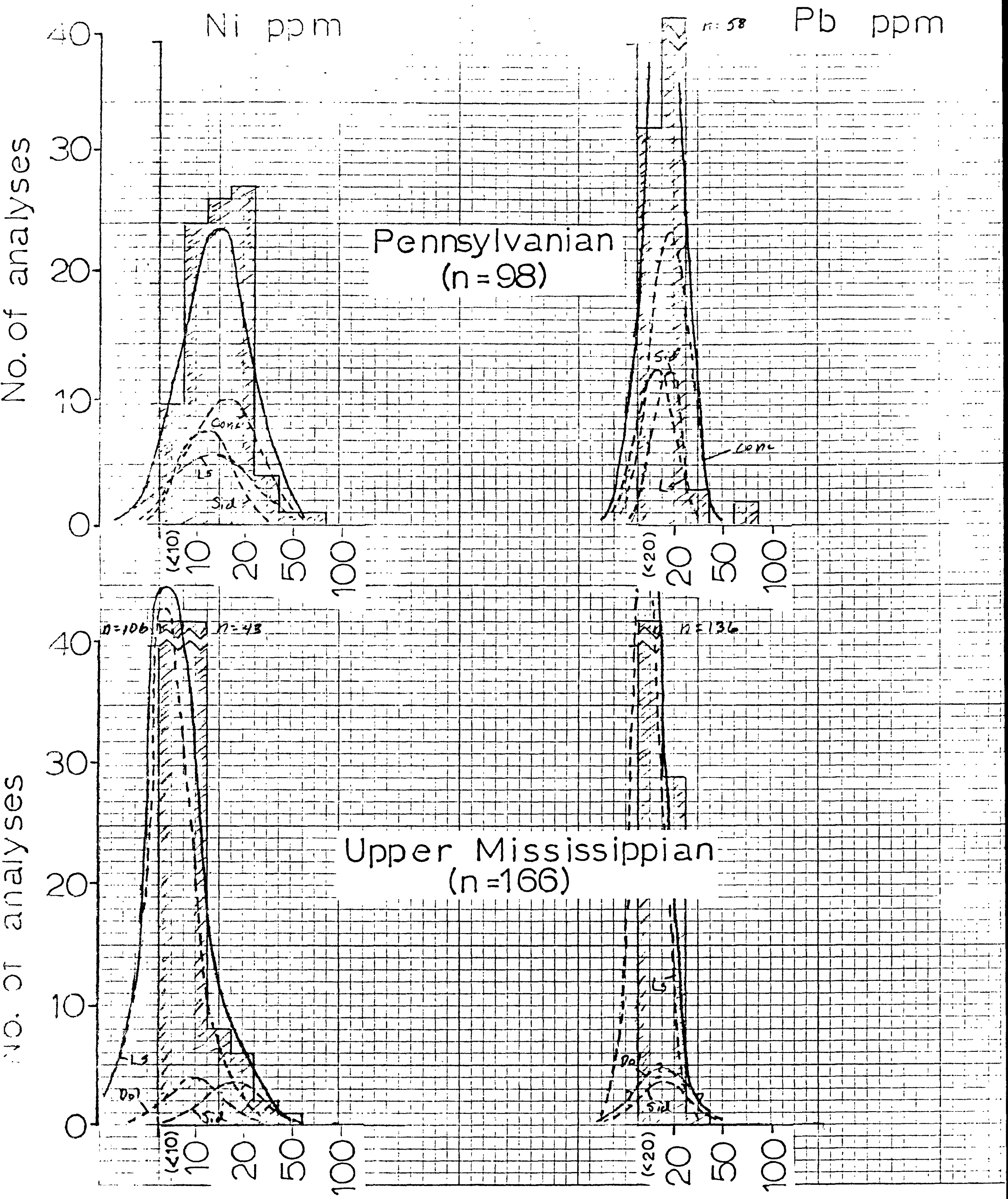
Cu ppm
Sr ppm
Pennsylvanian
(n = 98)
Upper Mississippian
(n =166)
No. of analyses
No. of analyses
0
10
20
30
40
(<2)
2
5
10
20
50
100
200
500
1000
2000
5000
Conc
Sid
Ls
Dol
Sdy Dol
n=68
n=49
n=63

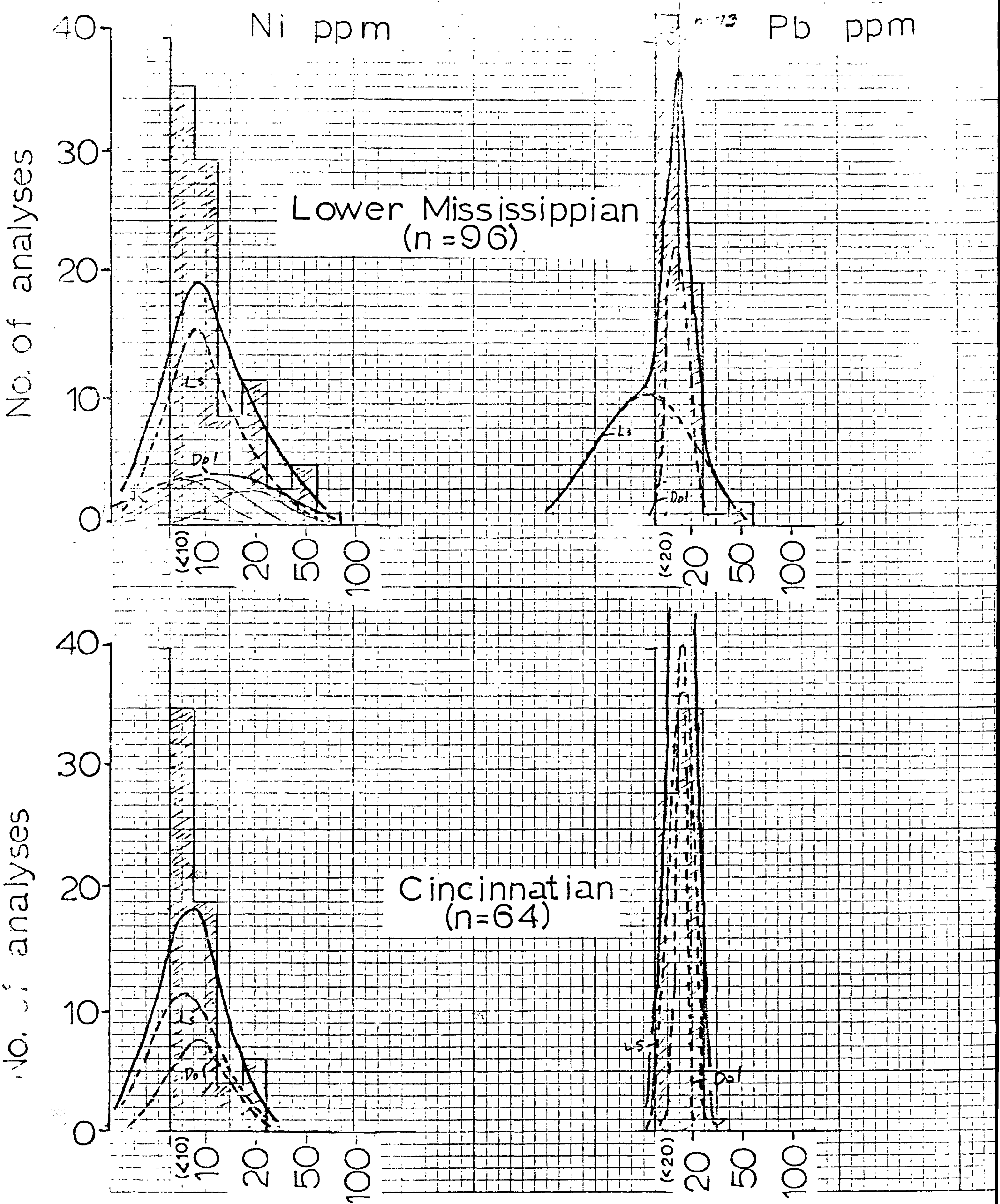


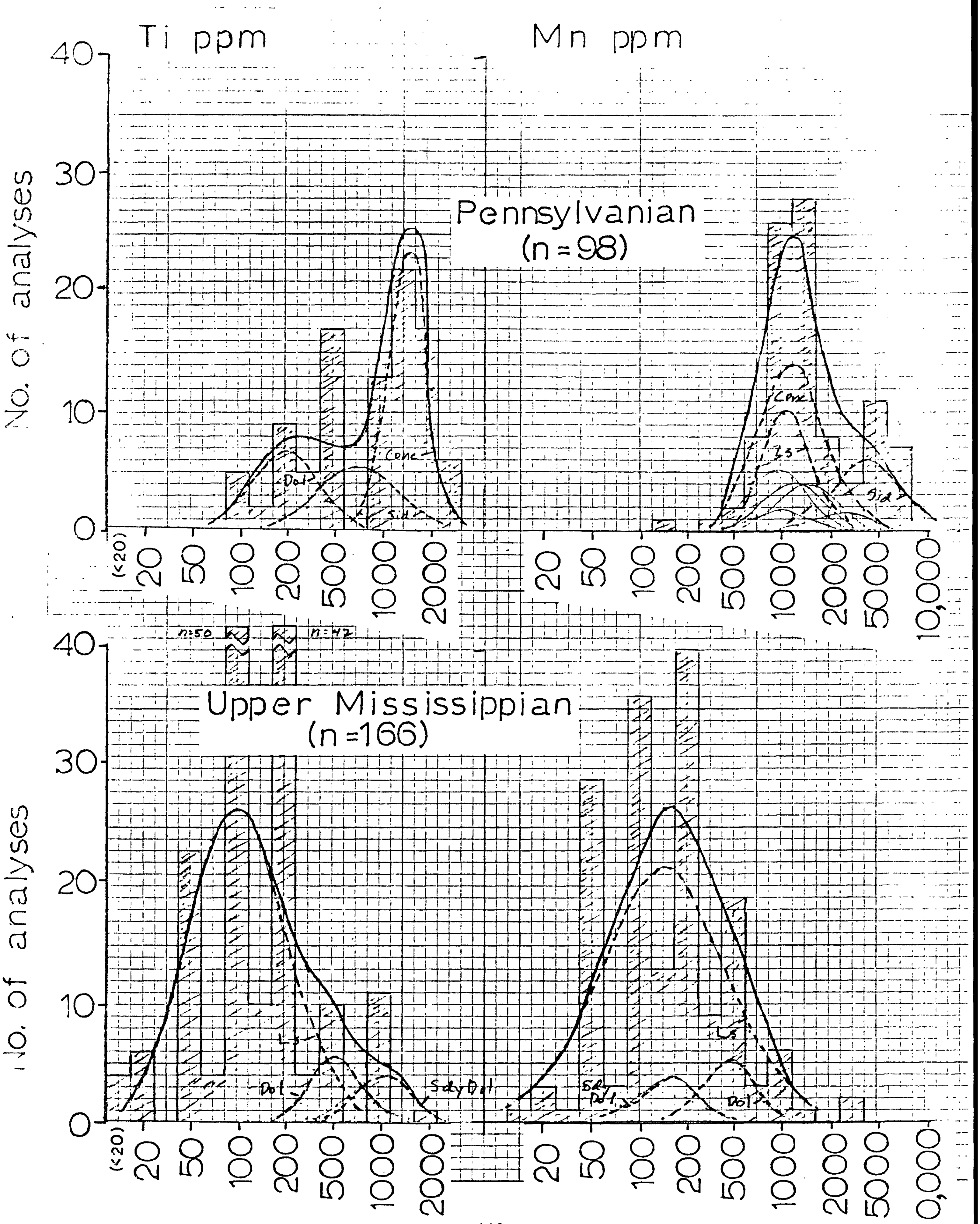
Cu ppm
Sr ppm
No. of analyses
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
Ls
Dol
0
10
20
30
40
(<2)
2
5
10
20
50
100
200
500
1000
2000
5000

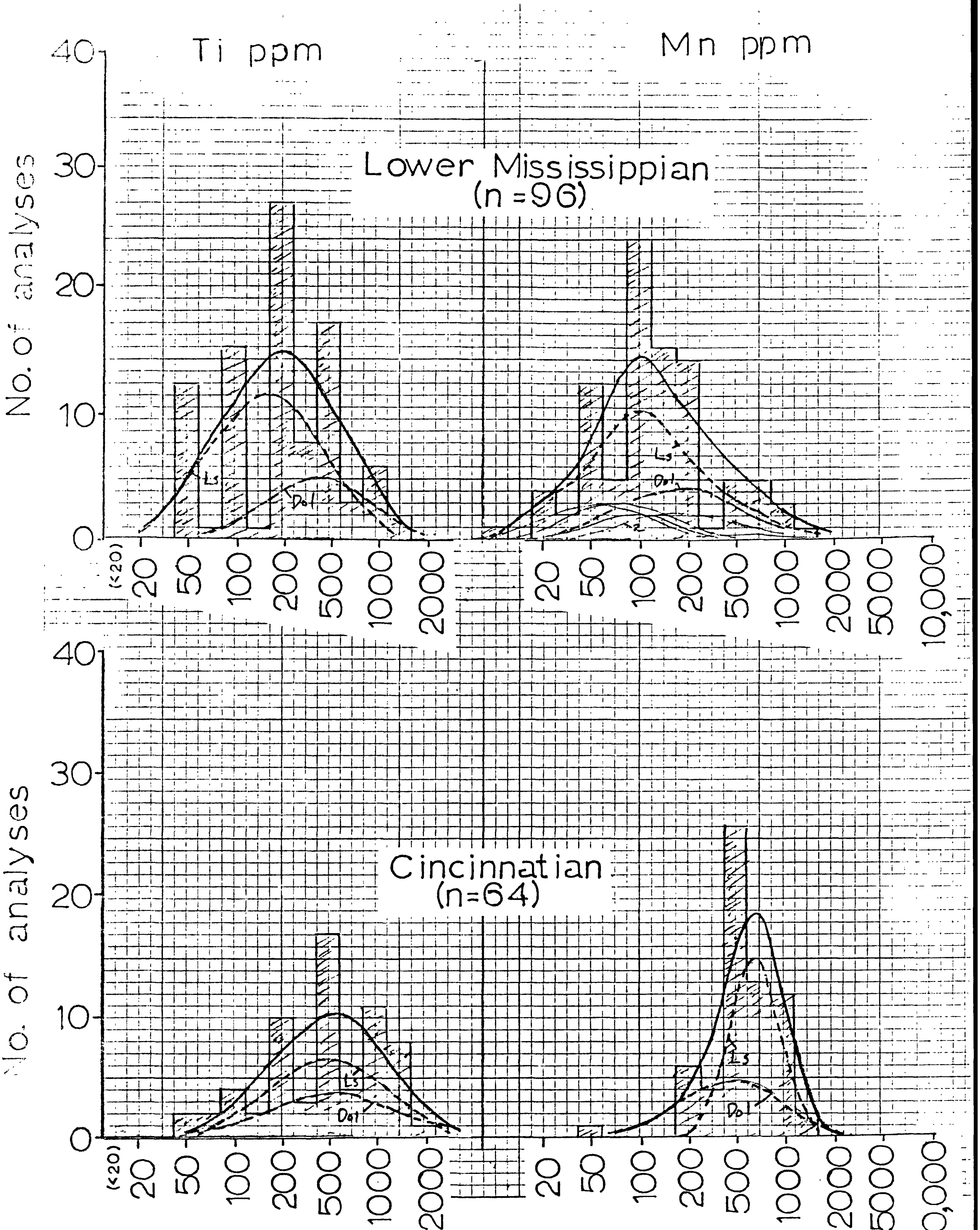

Ga ppm
Mo ppm
Pennsylvanian
(n = 98)
Upper Mississippian
(n =166)
No. of analyses
No. of analyses
n = 77
n = 157
n = 154
0
10
20
30
40
(<10)
10
20
50
(<7)
7
15
30
Ls
Sid
Conc
Dol
Sdy Dol

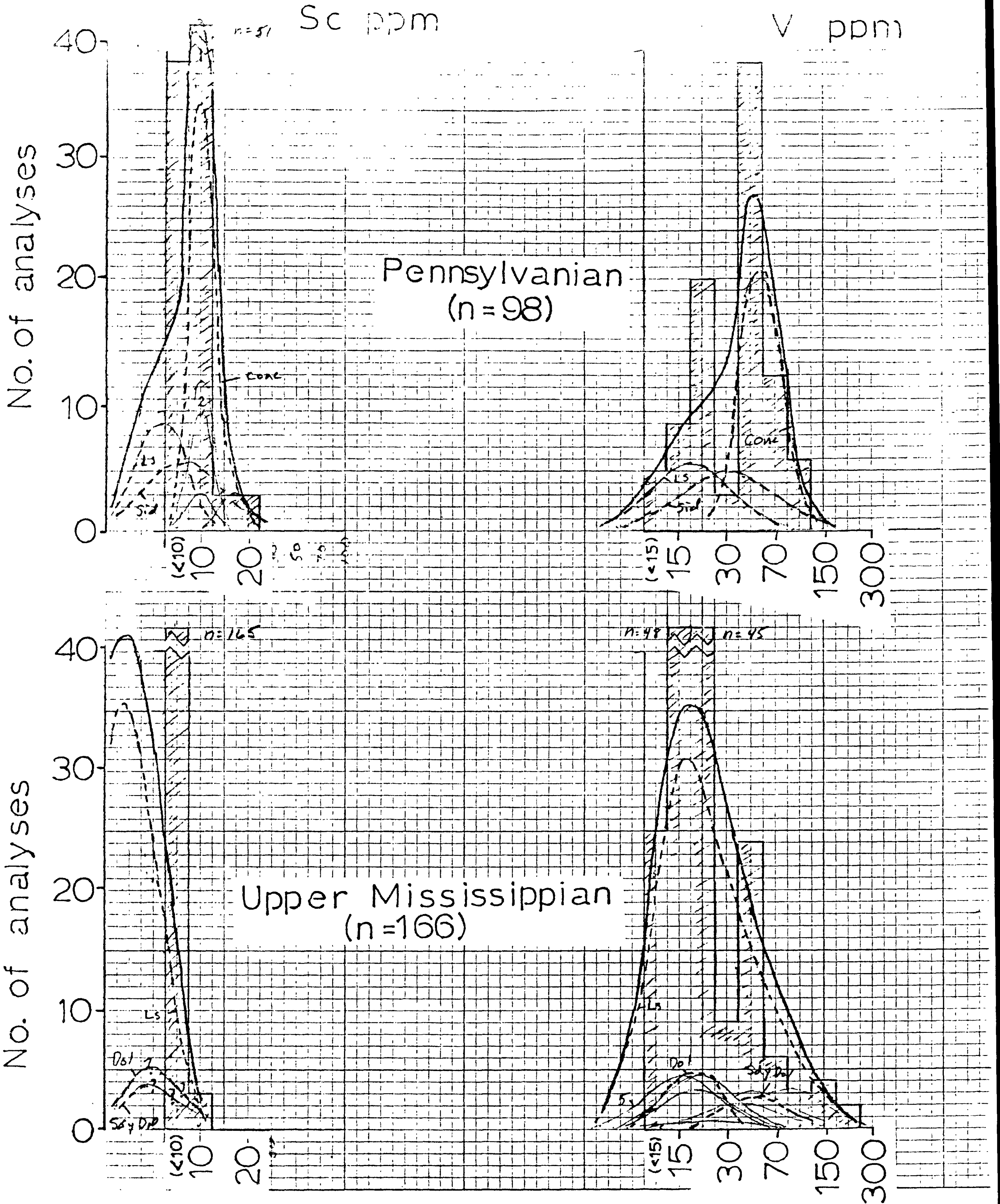

Ga ppm
Mo ppm
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
No. of analyses
No. of analyses
n=86
n=95
n=52
n=62
Ls
Dol
(<10)
10
20
50
(<7)
7
15
30

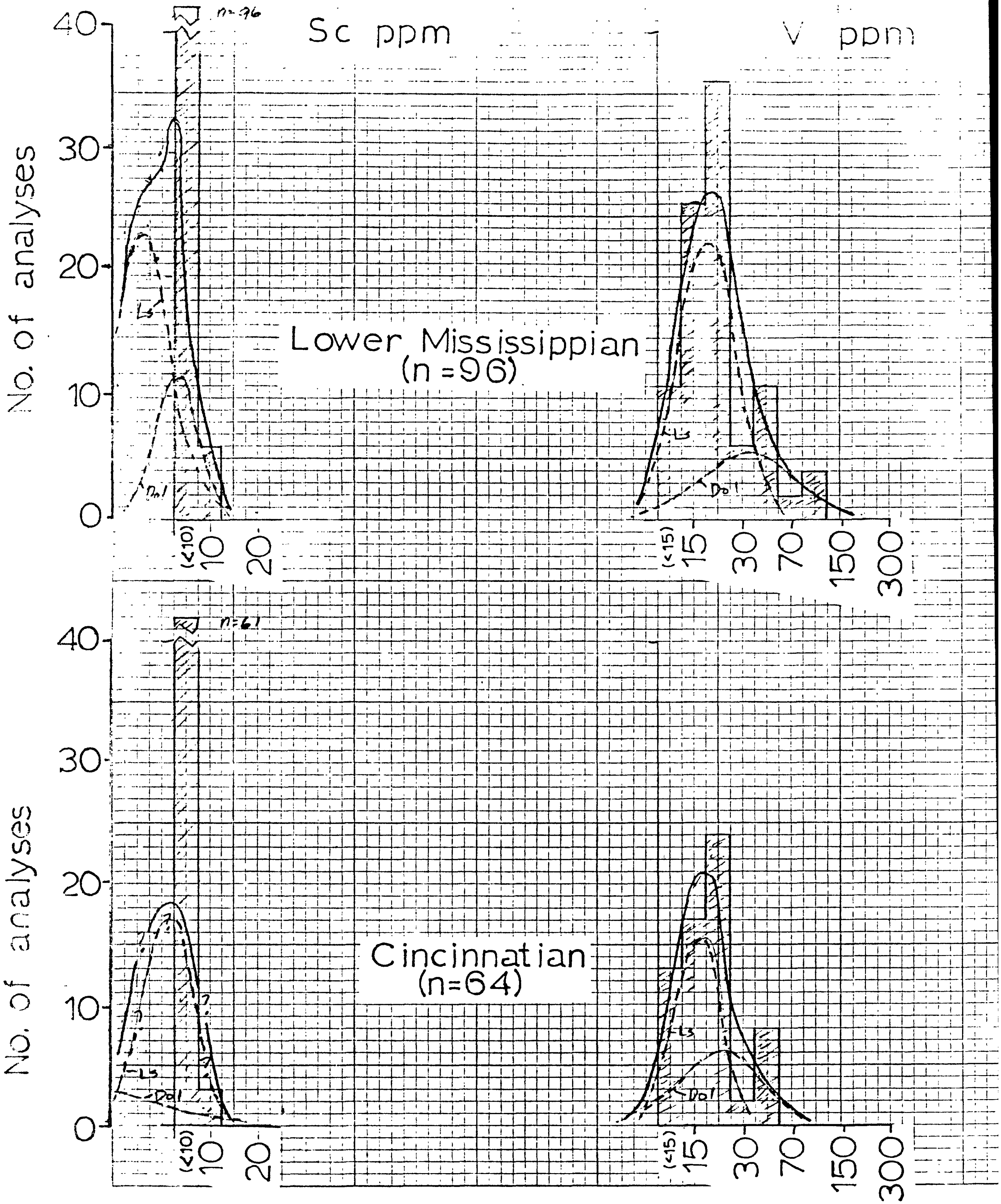

Ni ppm
Pb ppm
No. of analyses
Pennsylvanian
(n=98)
Upper Mississippian
(n=166)
n=58
n=106
n=43
n=136
Conc
LS
Sid
Dol
0
10
20
30
40
(<10)
(<20)
50
100


Ni ppm
Pb ppm
No. of analyses
40
30
20
10
0
Lower Mississippian
(n=96)
Ls
Dol
(<10)
10
20
50
100
(<20)
20
50
100
Cincinnatian
(n=64)

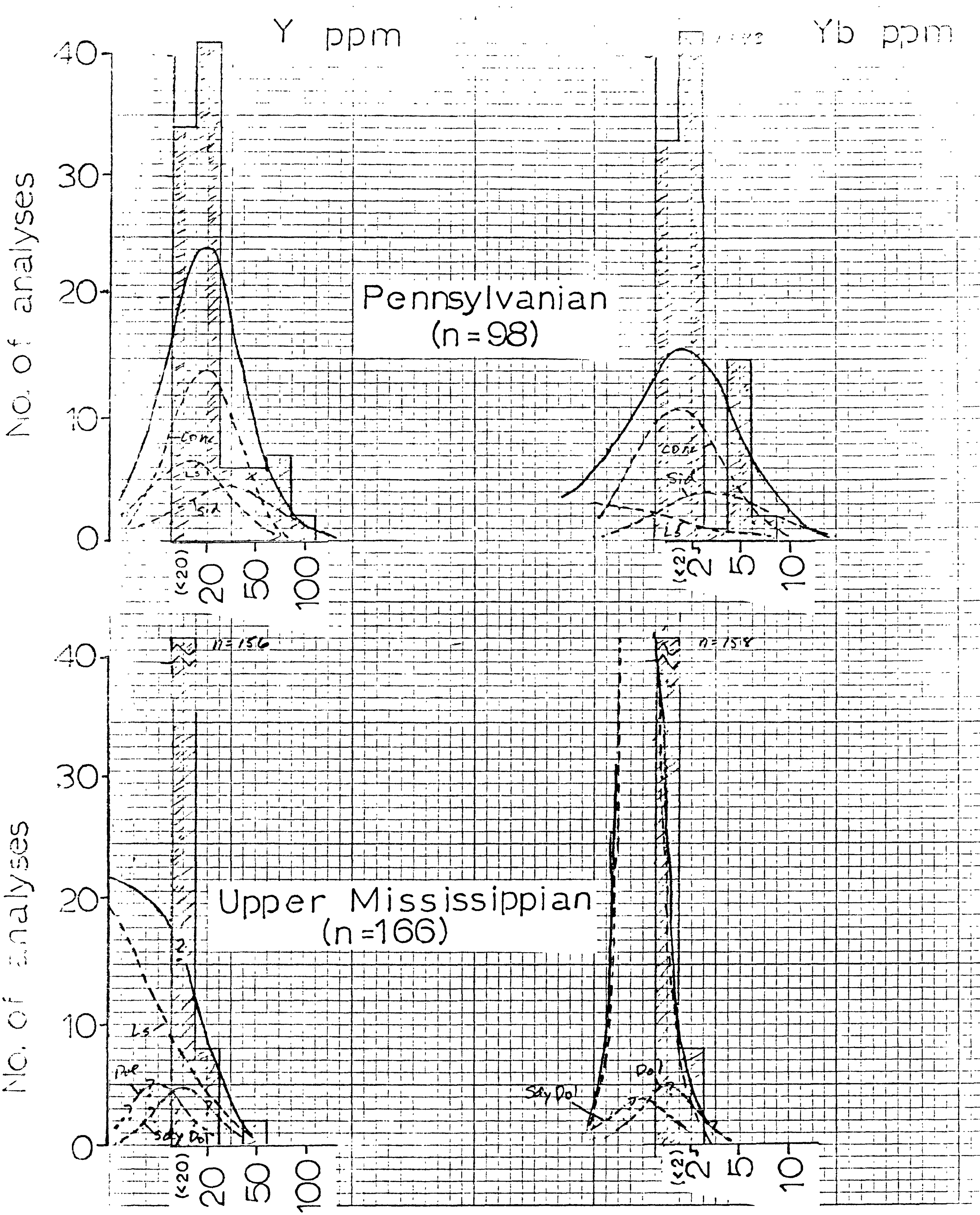

Ti ppm
Mn ppm
No. of analyses
Pennsylvanian
(n=98)
Upper Mississippian
(n=166)
0
10
20
30
40
(<20)
20
50
100
200
500
1000
2000
5000
10,000
Conc
Dol
Ls
Sid
n=50
n=42
Sdy Dol

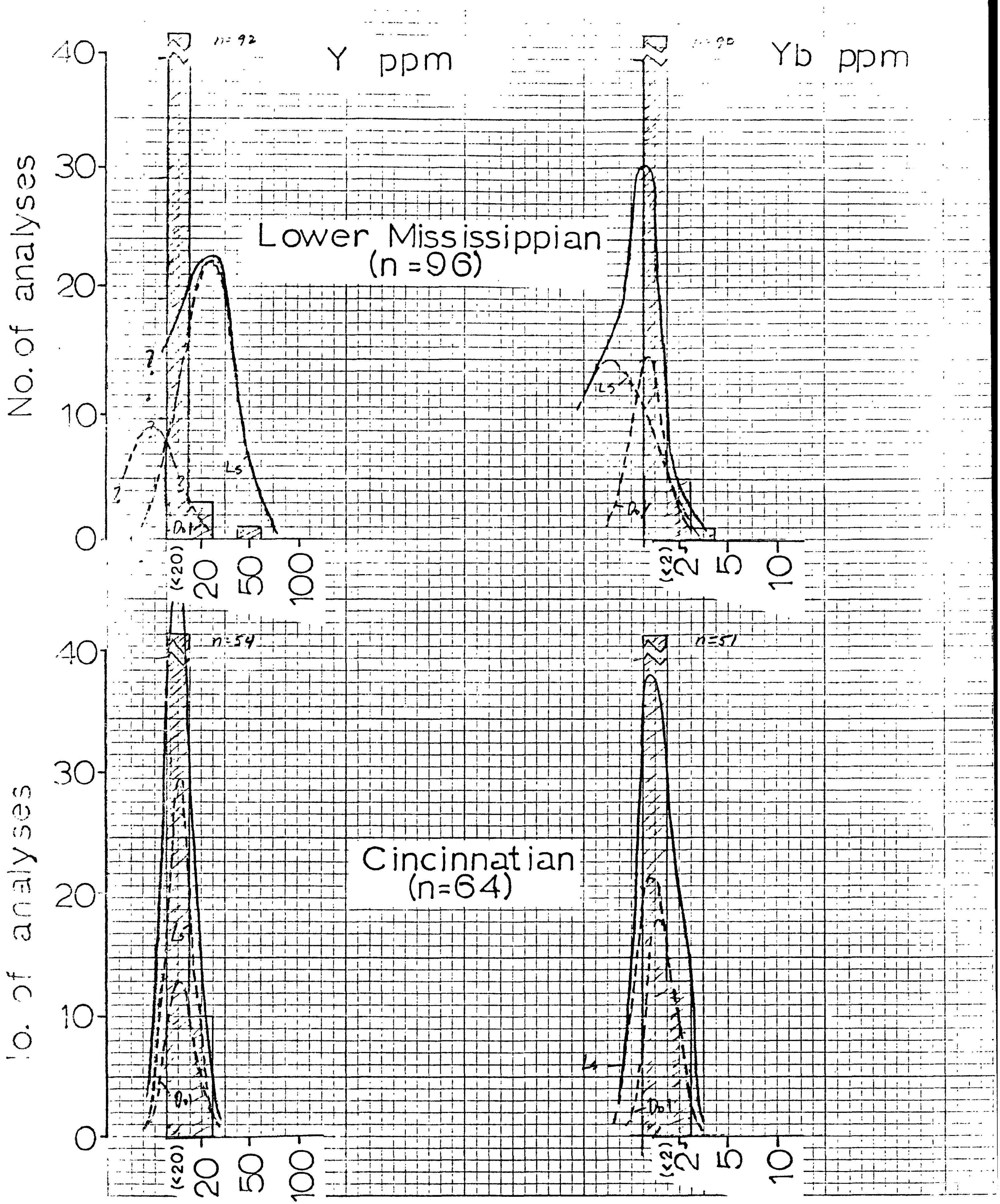

Ti ppm
Mn ppm
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
No. of analyses
No. of analyses
0
10
20
30
40
(<20)
20
50
100
200
500
1000
2000
5000
10,000
Ls
Dol

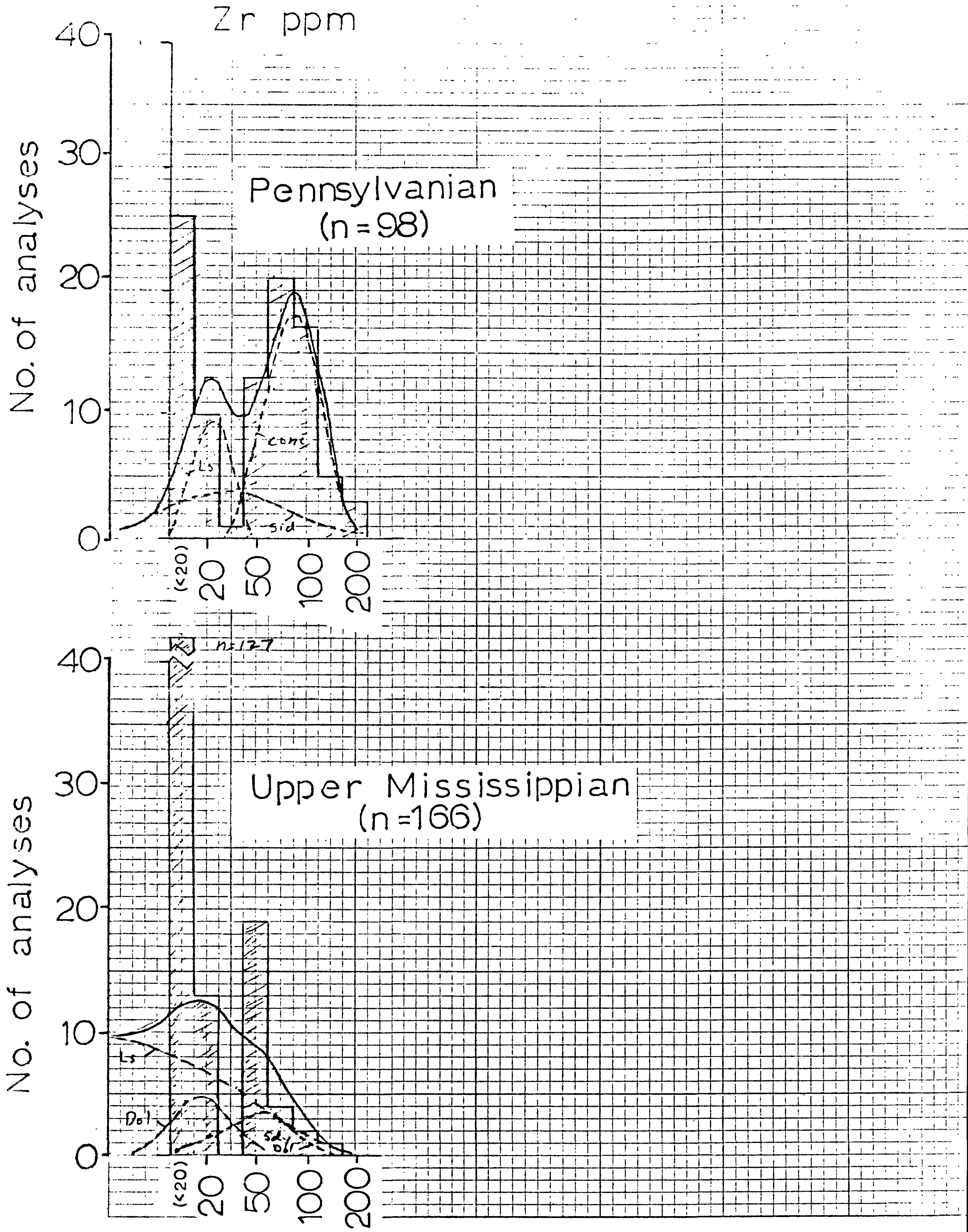

Sc ppm
V ppm
No. of analyses
Pennsylvanian
(n=98)
Upper Mississippian
(n=166)
0
10
20
30
40
(<10)
10
20
(<15)
15
30
70
150
300

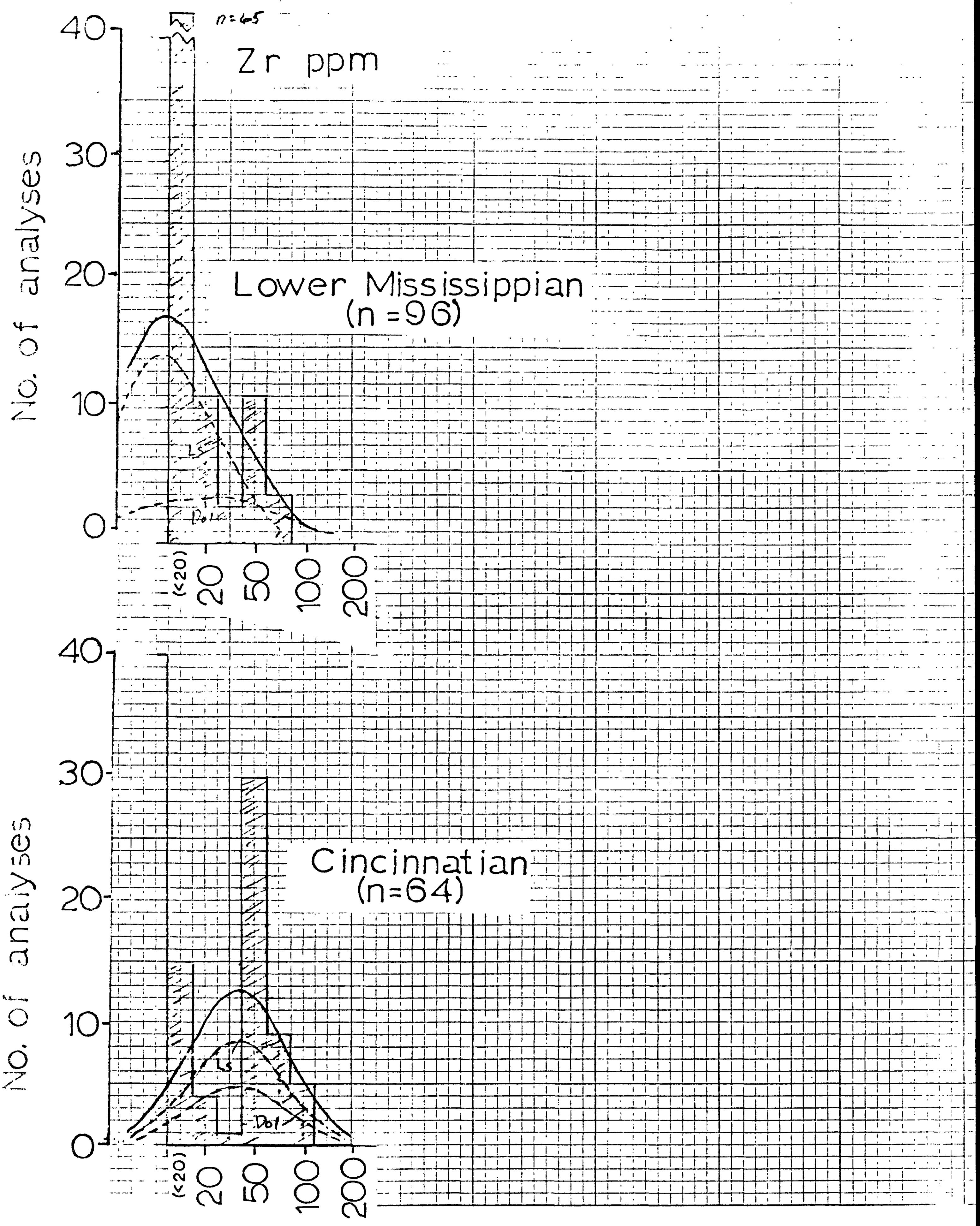


Sc ppm
V ppm
n=96
No. of analyses
40
30
20
10
0
Ls
Dol
Lower Mississippian
(n=96)
(<10)
10
20
(<15)
15
30
70
150
300
n=61
No. of analyses
Cincinnatian
(n=64)


Y ppm
Yb ppm
No. of analyses
40
30
20
10
0
Pennsylvanian
(n=98)
Conc
LS
Sid
(<20)
20
50
100
(<2)
2
5
10
n=156
n=158
No. of analyses
Upper Mississippian
(n=166)
LS
Dol
Sdy Dol


Y ppm
Yb ppm
No. of analyses
Lower Mississippian
(n =96)
Cincinnatian
(n=64)
(<20)
20
50
100
(<2)
2
5
10
0
10
20
30
40


Zr ppm
No. of analyses
40
30
20
10
0
Pennsylvanian
(n=98)
(<20)
20
50
100
200
No. of analyses
40
30
20
10
0
Upper Mississippian
(n=166)
(<20)
20
50
100
200


Zr ppm
n=65
Lower Mississippian
(n =96)
Ls
Dol
Cincinnatian
(n=64)
Ls
Dol
No. of analyses
No. of analyses
0
10
20
30
40
(<20)
20
50
100
200