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SUMMARY GEOCHEMICAL MAPS OF THE HARRISON 1° x 2° QUADRANGLE, ARKANSAS AND MISSOURI

By

R. L. Erickson, Barbara Chazin, and M. S. Erickson

INTRODUCTION

This map is the first in a folio of maps of the Harrison 1° x 2° quadrangle, Arkansas and Missouri, prepared under the Conterminous United States Mineral Assessment Program. Additional maps showing various other geologic aspects of the Harrison quadrangle will be published as U.S. Geological Survey Miscellaneous Field Studies Maps bearing the same serial number with different letter suffixes (MF-1994-B, -C, and so on).

Geochemical studies of the Harrison 1° x 2° quadrangle, Arkansas and Missouri, are part of a joint multidisciplinary study by the U.S. Geological Survey; the Division of Geology and Land Survey, Missouri Department of Natural Resources; and the Arkansas Geological Commission. The objective of the joint study is to assess the mineral-resource potential of the area by integrated geologic, geochemical, and geophysical investigations.

MINING ACTIVITY

There are no major mining districts in the Harrison quadrangle. The largest district is the northern Arkansas zinc district centered in Marion County in the south-central part of the quadrangle. It contains numerous small mines and prospects, chiefly in Ordovician carbonate rocks, that had an aggregate production of less than 50,000 tons of metal, chiefly during World War I. McKnight (1935) lists 252 different mines and prospects in the district. Other smaller districts include the Caulfield (chiefly zinc carbonate) in Ozark and Howell Counties, Missouri; the Melva mines in Taney County, Missouri; the Elk Valley, Mary Arnold, Swan Creek, and Turkey Creek mines in Christian County, Missouri; and small outliers of the Tri-State district in the northwestern part of the quadrangle, such as the Purdy mines in Barry County and the Aurora district in Lawrence County, Missouri. None of the mines or prospects within the quadrangle are currently active.

GEOCHEMICAL STUDY

The geochemical work in the Rolla and Springfield (Missouri) quadrangles, to the northeast and north, respectively, completed in 1980 and 1985, respectively, indicated that insoluble residues of carbonate rocks are a useful and informative geochemical sample medium (Erickson and others, 1978, 1979, 1985). Insoluble residues are prepared by treating carbonate rocks with dilute hydrochloric acid (1:5) to dissolve the carbonate in the sample. Spectrographic and chemical analyses of residues permit detection of trace amounts of elements whose presence in the barren whole rocks is unsuspected and commonly not detected by conventional analytical methods. The resulting map patterns of distributions and abundances of trace elements permit distinction between intrinsic and epigenetic suites of elements, recognition of rock units through which metal-bearing fluids have passed, and delineation of regional mineral trends. The geochemical maps of the Rolla and Springfield quadrangles, which were based on analyses of insoluble residue samples from widely spaced drill holes, were an important part of the total geoscience input that was used to assess the metallic mineral-resource potential of those quadrangles (Pratt, 1981, and Martin and Pratt, 1985). Therefore the same type of geochemical study was done in the Harrison quadrangle. However, this regional subsurface approach, by design, commonly does not reflect the known small surface or near-surface mineral districts in the quadrangle.

Insoluble residue samples from 65 drill holes were selected for this study (about 7,600 samples). Twenty-five holes, chiefly in the west half of the quadrangle, penetrate Mississippian rocks; all holes penetrate at least some Ordovician rocks; 31 holes penetrate at least 100 feet into Cambrian rocks; and only 16 holes penetrate to Precambrian basement or a basal Cambrian sandstone. Thus, the paucity of subsurface geochemical data for Cambrian strata, particularly in the southeast quadrant, severely constrains our ability to evaluate the resource potential of Cambrian rocks in the Harrison quadrangle. Cambrian strata are not exposed anywhere in the quadrangle.

A list of the analyzed drill holes showing log number (where available), county, location, and stratigraphically highest and lowest formation analyzed (appendix, table 1) allows correlation with the stratigraphic logs on file at the Missouri Geological Survey and the Arkansas Geological Commission.

The samples analyzed are splits of insoluble residue samples derived from drill core and cuttings archived in the sample libraries of the Missouri Geological Survey and the Arkansas Geological Commission. None of the holes are company confidential and none intersect economically significant mineralized ground. Most samples are a composite of a 10-foot interval, and samples from each drill hole are contiguous. However, only limited amounts of sample material were available from several drill holes in Arkansas. In these drill holes, samples were composited over thicknesses ranging to as much as 100 feet. Each sample was analyzed for 31 elements by a semiquantitative six-step D.C.-arc optical emission spectrographic method (Grimes and Marranzino, 1968).

Bar graphs showing the stratigraphic distribution and abundance of metals in insoluble residue samples in parts per million within each drill hole, and a table showing metal content in insoluble residue samples from each drill hole, are included in the appendix of this pamphlet. The formation boundaries used on the bar graphs were determined by the Missouri Geological Survey and the Arkansas Geological Commission.

The analytical results for selected elements (Pb, Zn, Cu, Mo, As, Ag, Ni+Co) in insoluble residue samples are plotted on the maps in anomalous metal feet (AMF) as defined in the Rolla quadrangle (Erickson and others, 1978). AMF is a reporting unit derived by normalizing the ratio of a reported anomalous metal content to the minimum anomalous metal content, multiplied by the length of the sample interval in feet. The minimum anomalous metal contents of insoluble residues were established by inspection of the data and, in parts per million, are: As, 200; Zn, 200; Pb, 100; Cu 100; Ni, 70; Co, 30; Mo, 10; and Ag, 1. Thus, reported values of 500 ppm Pb and 3 ppm Ag for a 10-foot interval normalize to 50 AMF of Pb and 30 AMF of Ag. The AMF can be summed for an entire drill hole, or for each formation, or for individual metals.

The geochemical patterns shown on the maps result from simple form lines drawn to call attention to clusters of similar AMF values. The shapes of the patterns are not significant and are not meant to imply a continuum of AMF values between the widely spaced drill holes. Undoubtedly, new drilling and more closely spaced holes would reveal many barren areas within postulated trends or would change the inferred orientation of trends. Nevertheless, the geochemical patterns generated by form lines are useful and informative because they permit comparison, integration, and interpretation of geochemical patterns with lithologic, structural, and geophysical trends.

Map A is a summary geochemical map of the quadrangle showing total AMF content of insoluble residue samples from all strata penetrated in the drill holes selected for this study. The map also shows generalized geology and aeromagnetic contours. Three principal areas of high metal concentrations (10,000 AMF) are indicated in the northeast, south-central, and west-central parts of the quadrangle. All three areas are portrayed as "hot spots" in a continuous, crudely T-shaped pattern of less intense but still highly anomalous metal contents (5,000-10,000 AMF). Each "hot spot" is described later in this report.

Maps B-R show a series of paired geochemical maps, compiled on a generalized aeromagnetic and structure base, that contrast the abundance and distribution (in AMF) of total metals and individual metals in insoluble residue samples of Cambrian and Ordovician carbonate rocks. Structure and aeromagnetic contours are shown on these maps because the geochemical patterns appear to be related to tectonic zones and to possible buried Precambrian ridges or "knobs." The presence of ridges, knobs, and major tectonic zones can be postulated (but not "proved") from the aeromagnetic data. Their importance as guides to mineral exploration in the Ozark region has been well documented over the years by many investigators. Surface geologic contacts are not shown because they show no apparent relation to subsurface geochemical patterns.

The paired geochemical maps (maps B-R) are compiled only for Cambrian and Ordovician strata because most of the metal values in our study occur in those strata. As noted above, geochemical data for Cambrian strata are not available for large areas of the quadrangle, and drill holes with less than 50 feet of penetration into Cambrian strata are not shown on the Cambrian maps. Nevertheless, the map pairs clearly show that total metal, Pb, Ag, Cu, As, and Ni are most abundant in Cambrian rocks and that Zn is most abundant in Ordovician rocks--a consistent pattern that we have found throughout the Ozark region (Erickson and others, 1988). Molybdenum also is more abundant in Cambrian rocks but highly anomalous amounts also occur in Ordovician rocks (maps J and K) chiefly in the same stratigraphic units that host the zinc deposits. We reported (Erickson and others, 1988) that our subsurface geochemical data from four contiguous 1° x 2° quadrangles in parts of Missouri, Arkansas, and Kansas, and along a north-south transect of drill holes in western Illinois, revealed surprisingly consistent regional patterns of distribution and abundance of metals. Insoluble residues of Cambrian strata tend to be lead-rich and contain an extensive suite of other metals (Zn, Cu, Ni, Co, Mo, As, Ag). Residues from carbonates in each successively younger geologic system tend to be increasingly zinc-rich and significant amounts of other metals are less common. We suggested that Cambrian strata were the principal aquifers for metal transport in the Ozark region. The geochemical maps of the Harrison quadrangle presented here clearly show that all metals, other than zinc, are much less common in Ordovician residues than in Cambrian residues. The paucity of lead and silver in Ordovician residues as compared to Cambrian residues is particularly dramatic. The median AMF values for total metal, and for each individual metal (table 1), also emphasize the higher concentration of all metals except zinc in Cambrian samples as compared to Ordovician samples. Although the contrast of zinc medians (45 AMF versus 70 AMF) does not appear large, zinc in Ordovician rocks ranges to as much as 4,145 AMF, and 17 drill holes contain more than 500 AMF Zn in the Ordovician section. Zinc in Cambrian samples ranges to as much as only 1,845 AMF and only four drill holes contain more than 500 AMF Zn in the Cambrian section.

Table 1.--Median metal contents of insoluble residue samples in anomalous metal feet (AMF) in Cambrian and Ordovician rocks

	Cambrian rocks	Ordovician rocks
Total AMF	3,145	1,450
Ag	310	0
As	210	0
Cu	325	90
Mo	1,145	735
Ni	155	25
Pb	345	20
Zn	45	70

The distribution and abundance of metals in insoluble residue samples of Mississippian carbonate rocks are summarized on map R. Individual metal maps for Mississippian rocks are not shown because the samples rarely contain significantly anomalous amounts of metals. Shaded areas surround drill holes that contain 150 or more AMF total metal, and the principal metal(s) is identified. Commonly, nickel and zinc are the most abundant metals but no highly anomalous areas are indicated. A low-level zinc anomalous area flanks the western side of the Cambrian south-central anomalous area. Drill-hole H-24 near the west-central border of the quadrangle contained 1,960 AMF Ni, probably as millerite.

The small zinc mines and prospects and millerite occurrences in outcrops of Mississippian rocks in the southern and northwestern parts of the quadrangle are not well reflected in the regional subsurface geochemical study.

Recent carbonate petrologic studies of cores from southwestern Missouri and northern Arkansas (Palmer, 1983a,b, and Palmer and Hayes, unpub. data, 1988) indicate that the entire Cambrian section above the Bonneterre Formation (Davis Formation and Derby-Doerun, Potosi, and Eminence Dolomites) changes character in central and southern Missouri such that many different carbonate depositional facies occur, including shallow cratonic basin to ramp to platform lithofacies. Palmer informally refers to the Davis through Eminence as the post-Bonneterre Cambrian sequence. His terminology is used here in discussion of the distribution and abundance of metals.

NORTHEAST ANOMALOUS AREA

This area is the southeast part of a geochemical trend described by Erickson and others (1985) that extends from the southern border of Missouri northwestward across the adjacent Springfield quadrangle. We reported that anomalous amounts of an extensive suite of metals (As, Ag, Cu, Mo, Ni, Pb, Zn) occur in restricted platform-flat, lagoon, and shoal lithofacies of post-Bonneterre Cambrian dolomite as described by Palmer (1983 a, b). The Bonneterre Formation, host rock for the Southeast Missouri lead district, in this area is chiefly dense, tight "ribbon rock"--interbedded shale and limestone indicative of a deep-ramp depositional environment, which is an unfavorable host lithology for mineral deposits.

The post-Bonneterre Cambrian geochemical trend appears to follow a northwest structural grain bounded on the northeast by the projection of the Bolivar-Mansfield tectonic zone. This relationship was first noted in the subsurface geochemical study of the Springfield quadrangle to the north where the northwest-trending geochemical form lines were drawn without foreknowledge of the location of the Bolivar-Mansfield tectonic zone (Erickson and others, 1985). The "hottest" (most highly anomalous) drill hole in this study (appendix, table 2, drill-hole S-35) is believed to be in this zone. Samples from drill-holes H-45, on the southwest side of the trend, and H-68, in the Poplar Bluff quadrangle to the east (not shown), are oxidized to total depth and are possibly leached of much of their original metal content. We believe that the deep oxidation indicates the presence of a fault and that these two holes penetrated a northwest-striking fault(s) that may mark the southwest boundary of this trend.

The highest AMF values for Mo, Ag, As, Cu, and Ni in the quadrangle (maps H, J, L, M, P) occur in the post-Bonneterre Cambrian rocks in this trend. Lead AMF values also are high (map D) but the highest lead values occur in the south-central anomalous area. The highest metal contents in each drill hole in this trend occur in dark-gray, earthy, fine-grained mixtures of iron sulfide and thermally degraded organic(?) material in expanded stylolites, vugs, and breccia zones in coarse-grained, recrystallized dolomite. Marcasite appears to be a more favorable metal host than pyrite. Ore minerals such as sphalerite, galena, and chalcopyrite were not detected by binocular examination of the insoluble residue samples. Most of the metals probably occur as discrete, small inclusions in iron sulfides. Molybdenum, unusually abundant in this trend and not hosted in iron sulfides, most likely occurs as amorphous MoS_2 or as a metallo-organic complex. We previously reported (Erickson and others, 1985) that molybdenum was the most abundant metal in whole-rock samples from many of the drill holes in southern Missouri and that the total molybdenum endowment in southern Missouri must be enormous--probably on the order of tens of millions of tons of molybdenum metal. We postulated that a broad molybdenum-rich province, chiefly in post-Bonneterre Cambrian strata, was present in southern Missouri and that it probably extended southward into Arkansas and westward into Oklahoma. The molybdenum maps (maps J and K) clearly show that anomalous amounts of molybdenum are present in both Cambrian and Ordovician rocks in northern Arkansas. Drill-hole S-35 in this trend is the most molybdenum-rich drill hole that we have encountered in all of our work in the Ozark region. Whole-rock samples over a 110-foot thickness in post-Bonneterre Cambrian strata in this hole contained from 115 to 925 ppm molybdenum and averaged 315 ppm as determined by atomic absorption following a pyrosulfate fusion digestion. Whether or not the molybdenum was transported by the same fluids that brought other metals (Pb, Cu, Zn, As, Ag, Ni, Co) into the trend is unresolved.

Insoluble residue samples of Ordovician rocks in this trend contain very low AMF values (map C). This is because the Everton Formation, Cotter Dolomite, and Jefferson City Formation, known favorable host rocks elsewhere in the Ozark region, have been mostly removed by erosion and only the lower part of the Ordovician section (Roubidoux Formation and Gasconade Dolomite) is preserved in this area. The Roubidoux and Gasconade nowhere are known to host significant mineral deposits.

SOUTH-CENTRAL ANOMALOUS AREA

The presence of a narrow, north-south geochemical trend in the south-central part of the quadrangle, chiefly in Arkansas (map A), is suggested on the basis of (1) highly anomalous amounts of several different metals in both Cambrian and Ordovician rocks in three deep core holes that penetrate to basement (H-13, H-44, and A-7); (2) probable presence of a north-south-trending Precambrian topographic ridge that marks the western boundary of the trend; (3) presence of porous, permeable, recrystallized dolomite in the Bonneterre, post-Bonneterre Cambrian, and Ordovician Canadian Series rocks; and (4) probable southward projection of the Chesapeake tectonic zone adjacent to or in the trend. Samples from drill-hole H-58 are oxidized to total depth, and the hole probably is in a southward projection of the Chesapeake tectonic zone.

The three core holes noted above are on the east flank of the probable Precambrian ridge, are aligned north-south, and each penetrates more than 1,000 feet of Cambrian rocks. Pinchout of the Cambrian rocks to the west against the ridge must occur because Cambrian rocks were not found in drill-hole H-67, a core hole to basement about 8 miles west of drill-hole H-13. In drill-hole H-67, the Gunter Sandstone Member of the Gasconade Dolomite of Early Ordovician age lies directly on Precambrian igneous rocks. Thus, the trend of the postulated pinch out and trends of depositional facies changes in Cambrian rocks should be approximately north-south. Pinch outs and abrupt facies changes are important mineral exploration guides in the Southeast Missouri lead district.

This geochemical trend is best portrayed by the distribution and abundance patterns for total metal, lead, molybdenum, copper, arsenic, nickel, and cobalt in Cambrian rocks, and by total metal, zinc, and molybdenum in Ordovician rocks (maps B through O). The highest concentrations of lead found in this study occur in this trend in insoluble residue samples of post-Bonneterre Cambrian carbonate. Drill-hole H-61 (appendix, table 2), a rotary-drilled water well at the north end of the trend, contains the highest Pb AMF value (4,400) along with anomalous amounts of Ag, As, Cu, Mo, Ni, and Zn. Unfortunately, this hole penetrated only about 300 feet of Cambrian rocks, all of which were logged as Eminence Dolomite. The three core holes to the south (A-7, H-44, and H-13; appendix, table 2) each penetrated about 1000 feet of Cambrian carbonate. Insoluble residue samples from these holes contain anomalous amounts of the same extensive suite as in drill-hole H-61. However, it is intriguing that most of the high metal values in these holes occur below the Eminence Dolomite and deeper in the post-Bonneterre Cambrian section than was penetrated in drill-hole H-61. The three core holes also indicate that the Davis Formation and at least part of the underlying Bonneterre Formation are shallow-water dolomite--vuggy, recrystallized, shallow-ramp or higher facies--favorable host lithologies for mineral deposits. Anomalous amounts of Pb, As, Mo, Cu, and Ag are present in these units in all three holes.

Insoluble residue samples of Mississippian (where present) and Ordovician carbonate rocks in this trend also contain anomalous amounts of metal, particularly zinc. Most of the metal values occur in the Boone Formation (Mississippian) and the Everton Formation, Cotter Dolomite, and Jefferson City

Formation (Ordovician).

Unfortunately, no drill holes that penetrate to basement between this postulated trend and the northeast area described above are known to us. It is possible that anomalous concentrations of metals in Cambrian carbonate rocks could be present in this gap area, but on the basis of our present knowledge, each area appears to have its own unique set of geologic conditions which suggests that they are separate anomalous areas. The south-central area is on the east flank of a Precambrian high and along the projection of the Chesapeake tectonic zone; the northeastern area is on the southwest flank of a Precambrian high and along the projection of the Bolivar-Mansfield tectonic zone. We note, however, that the aeromagnetic map indicates a possible Precambrian knob midway between the two anomalous areas.

WEST-CENTRAL ANOMALOUS AREA

This anomalous area is portrayed by form lines as an east-west geochemical trend that intersects the north-south geochemical trend described above (map A). Much of the total AMF value is contributed by small amounts of Mo in both Cambrian and Ordovician rocks. This anomalous area is not considered to be as significant as the northeast and south-central anomalous areas. The "hottest" drill hole in this area (H-52) contains 11,215 total AMF of which Mo contributes 7,770 AMF (map A and table 2 in appendix). Zinc occurs in the Cotter through Jefferson City section and Pb, Cu, Mo, As, Ni, and Ag occur in post-Bonneterre Cambrian carbonate. This drill hole penetrated only 340 feet of Cambrian section, all logged as Eminence Dolomite.

OTHER ANOMALOUS AREAS

The small, less intense anomalous area east of the north-south trend (map A) is centered in the Northern Arkansas Zinc District. None of the geochemical maps reflect this district very well. We believe that this is because most deposits in the district are small and structurally controlled. Sphalerite occurs in fractures, faults, and breccias, indicating that the principal ore-fluid movement was upward along structure--not laterally through porous and permeable rocks. Thus, broad areas of low-grade or anomalous concentrations of zinc between deposits are not likely to occur--there is little or no halo effect.

The small anomalous area in the southwest part of the quadrangle is considered insignificant because most of the AMF value is contributed by small amounts of Mo, and many of the sample intervals are 50 feet thick.

REFERENCES CITED

Erickson, R.L., Chazin, Barbara, Erickson, M.S., Mosier, E.L., and Whitney, Helen, 1988, Tectonic and stratigraphic control of regional subsurface geochemical patterns, midcontinent U.S.A.: in North American Conference on Tectonic Control of Ore Deposits, University of Missouri-Rolla, Proceedings volume, p. 435-446.

Erickson, R.L., Erickson, M.S., Mosier, E.L., and Chazin, Barbara, 1985, Summary geochemical and generalized geologic maps of the Springfield 1° x 2° quadrangle and adjacent area, Missouri: U.S. Geological Survey Miscellaneous Field Studies Map MF-1830-A, scale 1:500,000.

Erickson, R.L., Mosier, E.L., and Viets, J.G., 1978, Generalized geologic and summary geochemical maps of the Rolla 1° x 2° quadrangle, Missouri: U.S.

Geological Survey Miscellaneous Field Studies Map MF-1004-A, scale 1:250,000.

Erickson, R.L., Mosier, E.L., Viets, J.G., and King, S.C., 1979, Generalized geologic and geochemical maps of the Cambrian Bonneterre Formation, Rolla 1° x 2° quadrangle, Missouri: U.S. Geological Survey Miscellaneous Field Studies Map MF-1004-B, scale 1:500,000.

Grimes, D.J., and Marranzino, A.P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Kisvarsanyi, E.B., 1984, Geology and structure of the Precambrian surface in Missouri: Missouri Department of Natural Resources, Division of Geology and Land Survey Open-File Map 84-207-61.

Martin, J.A., and Pratt, W.P., eds., 1985, Geology and mineral-resource potential of the Springfield 1° x 2° quadrangle, Missouri, as appraised in September 1985: Missouri Department of Natural Resources, Division of Geology and Land Survey Open-File Report 85-42-MR, 82 p.

McKnight, E.T., 1935, Zinc and lead deposits of northern Arkansas: U.S. Geological Survey Bulletin 853, 311 p.

Palmer, J.R., 1983a, Cambrian lithofacies cross section from southern Bates County, Missouri, to southeastern Pulaski County, Missouri: Missouri Department of Natural Resources, Division of Geology and Land Survey [Open-file map] OFM-83-145-GI.

_______1983b, Cambrian lithofacies cross section from western Christian County, Missouri, to eastern Howell County, Missouri: Missouri Department of Natural Resources, Division of Geology and Land Survey [Open-file map] OFM-83-146-GI.

Pratt, W.P., ed., 1981, Metallic mineral resource potential of the Rolla 1° x 2° quadrangle, Missouri, as appraised in September 1980: U.S. Geological Survey Open-File Report 81-518, 77 p.

APPENDIX--TABULAR AND GRAPHICAL DRILL-HOLE DATA

The stratigraphic distributions of anomalous contents of selected metals, in parts per million, in insoluble residue samples of carbonate rocks from each drill hole analyzed in this study are shown in the following bar graphs. These bar graphs enable the user to refer to a specific drill hole shown on the geochemical maps to determine stratigraphic position, metal suite and relative abundance of each metal, and intensity, continuity, thickness, and depth from the surface of geochemically anomalous zones. Metal contents less than the minimum anomalous contents are not graphed.

The stratigraphic boundaries on the bar graphs are those shown on the stratigraphic log of each drill hole on file either with the Division of Geology and Land Survey, Missouri Department of Natural Resources, or the Arkansas Geological Commission. Stratigraphic abbreviations are explained at the bottom of table 1.

The vertical axis is depth from surface (in feet), and missing intervals are shown with the symbol ⁄\.

Table 1.--List of drill holes from which samples have been analyzed in the Harrison quadrangle, Arkansas and Missouri

[Arkansas Geological Commission log numbers are listed by county; thus, drill hole H-1 would be found under Baxter 536. Core holes in the northern Arkansas Zinc District (H-13, 15, 18, 19, 26, 27, 28, 31, 32, 34, 38, 43, 44) are identified at the Arkansas Geological Commission as the 1976 V-A2 Arkansas Zinc drilling program. Recent water wells, H-46 and H-24, and recent core hole, H-67, are identified by well name. Missouri Geological Survey log numbers are preceded by an "M"; note that this includes logs of several Arkansas holes.]

Drill-hole number	Arkansas/ Missouri log number	County, State	Location: section, township, and range	Youngest to oldest stratigraphic units sampled
H-13	V-A2 AR ZN-13	Searcy, AR	2, 16N, 18W	Oe - Ꞓb
H-44	V-A2 AR ZN-44	Boone, AR	20, 19N, 18W	Opo - Ꞓb
A-7	V-A2 AR ZN-A7	Boone, AR	14, 20N, 19W	Oj - Ꞓl
H-1	536	Baxter, AR	28, 19N, 14W	Oc - Ogg
H-3	651	Baxter, AR	33, 20N, 13W	Oc - Ꞓe
H-4	2373	Newton, AR	27, 16N, 22W	Pu - Or
H-5	1789	Newton, AR	20, 17N, 20W	Mu - Ogg
H-6	Crooked Creek water well	Boone, AR	4, 17N, 20W	Mu - Ꞓe
H-7	2289	Madison, AR	3, 16N, 26W	Pu - Ꞓl
H-9	2295	Carroll, AR	4, 19N, 23W	Pu - Ou
H-10	2270	Carroll, AR	30, 20N, 24W	Mu - Ꞓe
H-11	1994	Carroll, AR	14, 20N, 26W	Mu - Ꞓe
H-12	1933	Madison, AR	35, 18N, 26W	Mu - Ou
H-14	315	Madison, AR	6, 16N, 27W	Mu - pꞒ
H-15	V-A2 AR ZN-15	Searcy, AR	22, 16N, 18W	Oe - Opo
H-16	1822	Benton, AR	13, 20N, 28W	Mu - Ogg
H-17	2291	Newton, AR	26, 17N, 22W	Pu - Ogg
H-18	V-A2 AR ZN-18	Searcy, AR	17, 16N, 17W	Mu - Opo
H-19	V-A2 AR ZN-19	Searcy, AR	1, 16N, 17W	Oe - Oc
H-20	2242	Boone, AR	33, 18N, 19W	Mu - Ꞓe
H-21	1507	Baxter, AR	21, 18N, 12W	Oc - Og
H-23	2348	Madison, AR	12, 18N, 27W	Mu - Or
H-24	Gateway water well	Benton, AR	14, 21N, 28W	Mu - Ꞓe
H-26	V-A2 AR ZN-26	Searcy, AR	14, 16N, 16W	Oe - Opo
H-27	V-A2 AR ZN-27	Marion, AR	32, 18N, 14W	Opo - Oj
H-28	V-A2 AR ZN-28	Marion, AR	30, 18N, 15W	Opo - Oj
H-31	V-A2 AR ZN-31	Marion, AR	13, 18N, 16W	Oe - Oc
H-32	V-A2 AR ZN-32	Marion, AR	10, 17N, 15W	Oe - Oc
H-34	V-A2 AR ZN-34	Marion, AR	6, 17N, 14W	Oe - Oj
H-38	V-A2 AR ZN-38	Boone, AR	36, 20N, 19W	Oe - Oc
H-43	V-A2 AR ZN-43	Marion, AR	17, 20N, 17W	Mu - Or

Table 1.--List of drill holes from which samples have been analyzed in the Harrison quadrangle, Arkansas and Missouri--Continued

Drill-hole number	Arkansas/ Missouri log number	County, State	Location: section, township, and range	Youngest to oldest stratigraphic units sampled
H-45	M23560	Ozark, MO	7, 22N, 13W	Oc - €pb
H-46	M23644	Barry, MO	6, 25N, 27W	Mu - €e
H-47	M28101	Taney, MO	28, 23N, 21W	Oc - €d
H-48	M26094	Stone, MO	33, 26N, 24W	Mu - €e
H-49	M28587	Stone, MO	15, 22N, 23W	Oc - €d
H-50	M21791	Baxter, AR	16, 19N, 13W	Oc - €e
H-51	M23766	Boone,AR	18, 18N, 21W	Osp - €e
H-52	M27211	Carroll, AR	27, 21N, 26W	Mu - €p
H-53	M28263	Barry, MO	23, 21N, 28W	Mu - €e
H-54	M13928	Barry, MO	9, 22N, 25W	Oc - €e
H-55	M23831	Barry, MO	27, 22N, 27W	Oc - €e
H-56	M20816	Stone, MO	12, 24N, 24W	Mu - €e
H-57	M24724	Taney, MO	13, 21N, 22W	Mu - €e
H-58	M28115	Stone, MO	29, 23N, 22W	Mu - €e
H-59	M27324	Stone, MO	26, 21N, 23W	Mu - €e
H-60	M28026	Taney, MO	22, 22N, 22W	Oc - €e
H-61	M28594	Taney, MO	20, 23N, 20W	Oc - €e
H-63	M17029	Barry, MO	29, 23N, 27W	Mu - €e
H-64	M25852	Marion, AR	6, 21N, 15W	Oc - Or
H-65	M26505	Marion, AR	33, 19N, 16W	Opo - Og
H-66	M26928	Boone, AR	8, 19N, 19W	Mu - Og
H-67	Hasty core hole	Newton, AR	33, 17N, 19W	Mu - p€
S-20	M26469	Douglas, MO	33, 27N, 13W	Or - €l
S-26	M26468 M28484	Douglas, MO	21, 26N, 14W	Or - €l
S-27	M26468 M28475	Douglas, MO	27, 27N, 12W	Or - €b
S-28	M26445	Douglas, MO	20, 25N, 13W	€e - €l
S-35	M28497	Douglas, MO	35, 25N, 11W	Og - €l
S-37	M28500	Stone, MO	4, 26N, 22W	Oc - €r
DH-85	M27496	Ozark, MO	32, 23N, 12W	€e - €l
DH-95	M25825	Douglas, MO	24, 26N, 17W	€e - €l
DH-99	M25823	Carroll, AR	30, 21N, 25W	Ogg - p€
DH-100	M25827	Taney, MO	15, 24N, 20W	Ogg - €l
DH-101	M25826	Christian, MO	33, 25N, 18W	Ogg - €l
DH-103	M17452	Ozark, MO	19, 23W, 11W	Ogg - €dd

Stratigraphic abbreviations are listed below:

Table 1.--**List of drill holes from which samples have been analyzed in the Harrison quadrangle, Arkansas and Missouri--Continued**

Pennsylvanian:	Pu, undifferentiated
Mississippian:	Mu, undifferentiated
Mississippian and Devonian	MDc, Chattanooga Shale
Ordovician:	Ou, Ordovician undifferentiated
	Osp, St. Peter Sandstone
	Oe, Everton Formation
	Opo, Powell Dolomite
	Oc, Cotter Dolomite
	Oj, Jefferson City Formation
	Or, Roubidoux Formation
	Og, Gasconade Dolomite
	Ogg, Gunter Sandstone Member of Gasconade Dolomite
Cambrian:	Ꞓu, undifferentiated
	Ꞓe, Eminence Dolomite
	Ꞓp, Potosi Dolomite
	Ꞓdd, Derby-Doerun Dolomite
	Ꞓd, Davis Formation
	Ꞓpb, post-Bonneterre Cambrian, undifferentiated
	Ꞓb, Bonneterre Formation
	Ꞓr, Reagan Sandstone
	Ꞓl, Lamotte Sandstone
Precambrian:	pꞒ, undifferentiated

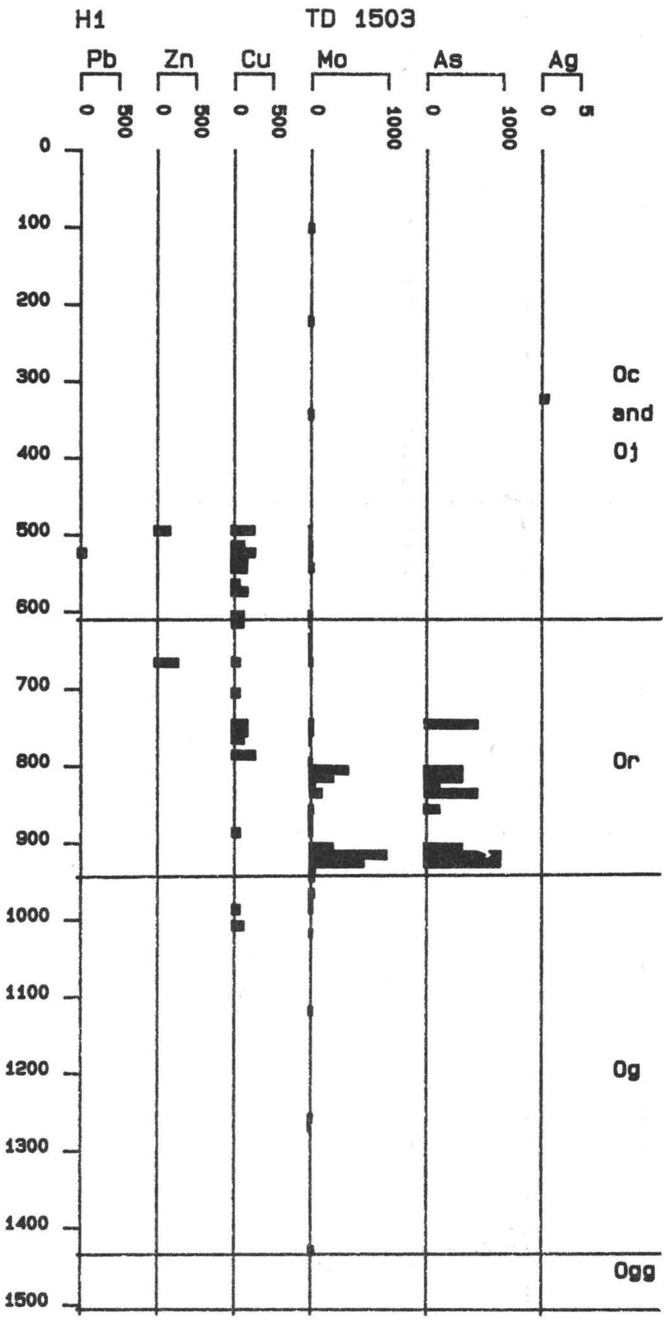
Table 2.--Metal contents (in anomalous metal feet, AMF) of insoluble residue samples from drill holes in the Harrison 1° x 2° quadrangle

Drill-hole number	Ag	As	Co	Cu	Mo	Ni	Pb	Zn	Total	Principal[1] host
H-1	10	315	0	315	3,910	0	10	25	4,585	Or
H-3	0	155	0	20	1,735	25	30	115	2,080	Ou
H-4	165	640	25	210	3,360	585	105	165	5,255	Ou
H-5	0	0	0	300	1,350	100	150	350	2,250	Ou
H-6	50	30	10	365	9,270	305	85	4,275	14,390	Ou
H-7	50	0	75	200	3,470	840	400	225	5,260	Ou
H-9	0	0	0	75	475	0	0	0	550	--
H-10	0	0	0	150	225	0	0	0	375	--
H-11	200	100	0	575	1,120	150	100	0	2,245	Ꞓpb
H-12	0	0	0	240	300	0	0	0	540	--
H-13	255	1,115	20	2,935	2,900	195	1,495	4,080	12,985	Oc, Ꞓpb
H-14	0	0	0	230	1,080	220	500	85	2,115	Ou
H-15	0	10	10	800	380	65	40	2,060	3,365	Oe
H-16	0	0	45	60	1,110	120	0	75	1,410	Oc, Oj
H-17	200	100	30	225	675	380	0	0	1,610	IPu
H-18	50	125	160	760	185	905	75	860	3,120	Mu
H-19	0	290	10	85	970	85	10	0	1,450	Oe, Oc, Oj
H-20	0	0	0	100	4,930	100	0	0	5,130	Ou
H-21	0	0	0	500	320	0	0	0	820	--
H-23	0	0	0	75	215	200	0	0	490	--
H-24	10	35	500	225	1,180	1,980	45	335	4,310	Mu
H-26	0	0	0	160	270	115	0	1,515	2,060	Oe
H-27	290	450	0	1,365	2,750	700	70	230	5,855	Oc, Oj
H-28	0	10	0	45	610	0	10	0	675	--
H-31	30	75	45	330	725	125	85	10	1,425	Oe
H-32	0	0	0	450	365	0	0	1,435	2,250	Oe, Opo
H-34	0	0	0	0	30	70	0	0	100	--
H-38	20	55	30	290	1,220	225	360	2,025	4,225	Oc, Oj
H-43	35	0	0	45	1,020	10	805	780	2,695	Oc, Oj
H-44	10	2,425	90	795	13,155	525	1,540	995	19,535	Ꞓpb
H-45	80	85	0	0	250	0	60	620	1,095	Oc, Oj, Ꞓpb
H-46	0	45	15	310	1,995	305	55	80	2,795	Ꞓpb
H-47	100	130	90	295	5,215	0	250	525	6,080	Ou, Ꞓpb
H-48	80	70	0	180	1,180	0	75	120	1,705	Ꞓpb
H-49	990	290	185	1,850	1,935	735	810	10	6,805	Ꞓpb

Table 2.--Metal contents (in anomalous metal feet, AMF) of insoluble residue samples from drill holes in the Harrison 1° x 2° quadrangle--Continued

Drill-hole number	Ag	As	Co	Cu	Mo	Ni	Pb	Zn	Total	Principal[1] host
H-50	15	170	0	20	3,140	20	20	125	3,510	Ou
H-51	10	30	0	280	3,220	125	140	1,080	4,885	Oc, Oj
H-52	55	205	165	580	7,770	490	895	1,055	11,215	Oc, Ꞓe
H-53	310	1,840	50	1,030	2,235	165	125	0	5,755	Ꞓe
H-54	210	415	40	325	1,555	240	240	445	3,470	Ꞓe
H-55	0	0	0	55	2,715	10	15	25	2,820	Ou
H-56	0	0	15	190	310	45	25	40	625	--
H-57	0	45	25	70	1,940	130	395	485	3,090	Oc, Oj
H-58	260	20	0	60	40	110	135	0	625	--
H-59	30	10	120	175	990	255	145	0	1,725	Oc
H-60	615	770	125	505	1,525	330	390	825	5,085	Ꞓe
H-61	370	690	10	345	1,420	135	4,475	65	7,510	Ꞓe
H-63	0	0	15	290	305	20	40	1,000	1,670	Oc
H-64	0	0	0	0	655	0	0	810	1,465	Oj
H-65	20	240	0	180	1,835	20	115	0	2,410	Ou
H-66	0	20	0	120	2,090	165	210	1,170	3,775	Oc, Oj
H-67	150	85	0	660	2,615	390	520	435	4,855	Ou
S-20	455	1,820	105	605	2,280	395	535	975	7,215	Ꞓpb
S-26	395	645	20	440	1,905	25	550	610	4,490	Ꞓpb
S-27	420	130	45	250	620	170	670	200	2,505	Ꞓpb
S-28	535	1,920	265	915	7,160	640	2,215	370	14,020	Ꞓpb
S-35	3,710	4,485	1,635	2,475	30,500	3,235	890	150	47,080	Ꞓpb
S-37	40	50	0	1,085	230	90	65	25	1,585	Ꞓpb
A-7	365	910	65	360	7,415	320	3,190	3,575	16,200	Oj, Ꞓpb
DH-85	2,290	3,835	555	1,460	20,275	1,160	2,045	185	31,805	Ꞓpb
DH-95	975	680	40	460	930	125	1,545	65	4,820	Ꞓpb
DH-99	365	795	0	680	2,645	250	610	265	5,610	Oc, Oj, Ꞓpb
DH-100	310	260	0	905	265	105	310	0	2,155	Ꞓpb
DH-101	370	245	30	350	665	80	440	1,685	3,865	Ꞓpb
DH-103	455	2,190	85	670	5,305	390	250	135	9,480	Ꞓpb

[1]Principal host not listed when total AMF is less than 1,000. Stratigraphic abbreviations are those listed at bottom of table 1.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0 5
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100
200
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400
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700
800
900
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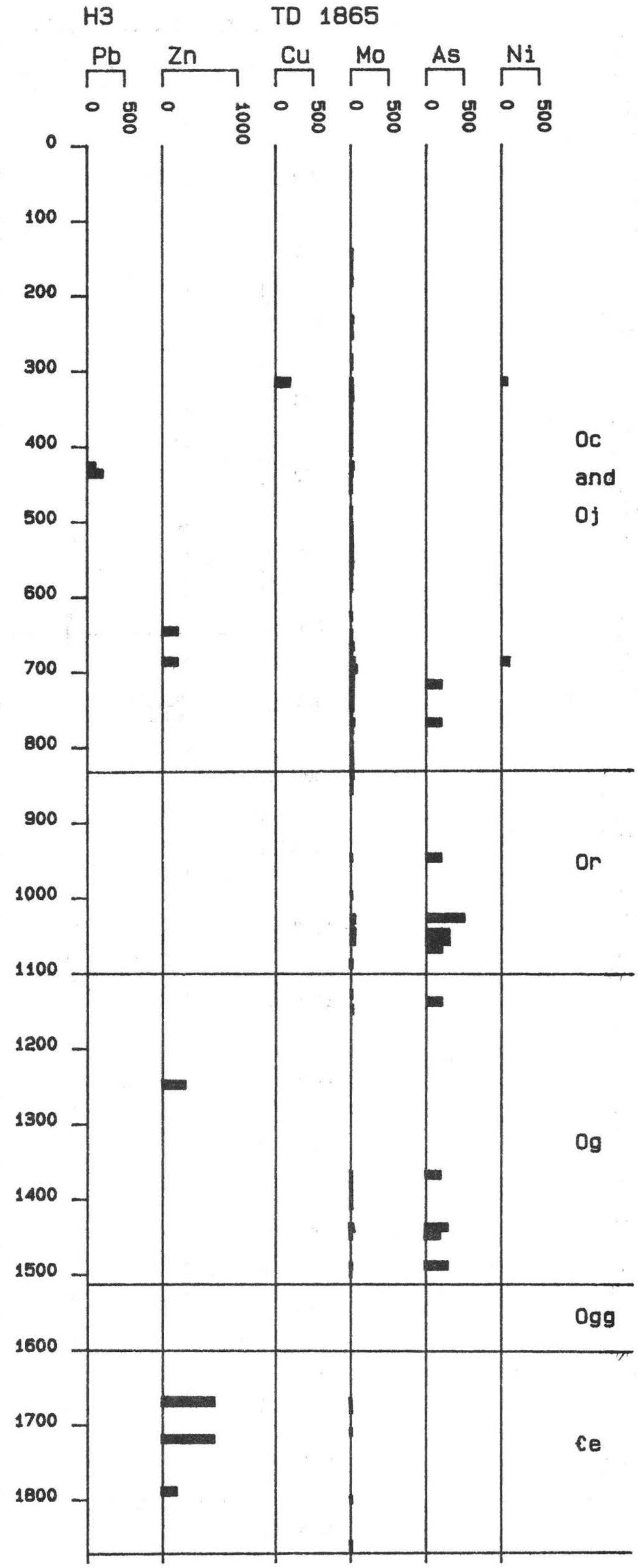
1100
1200
1300
1400
1500
Oc
and
Oj
Or
Og
Ogg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1700
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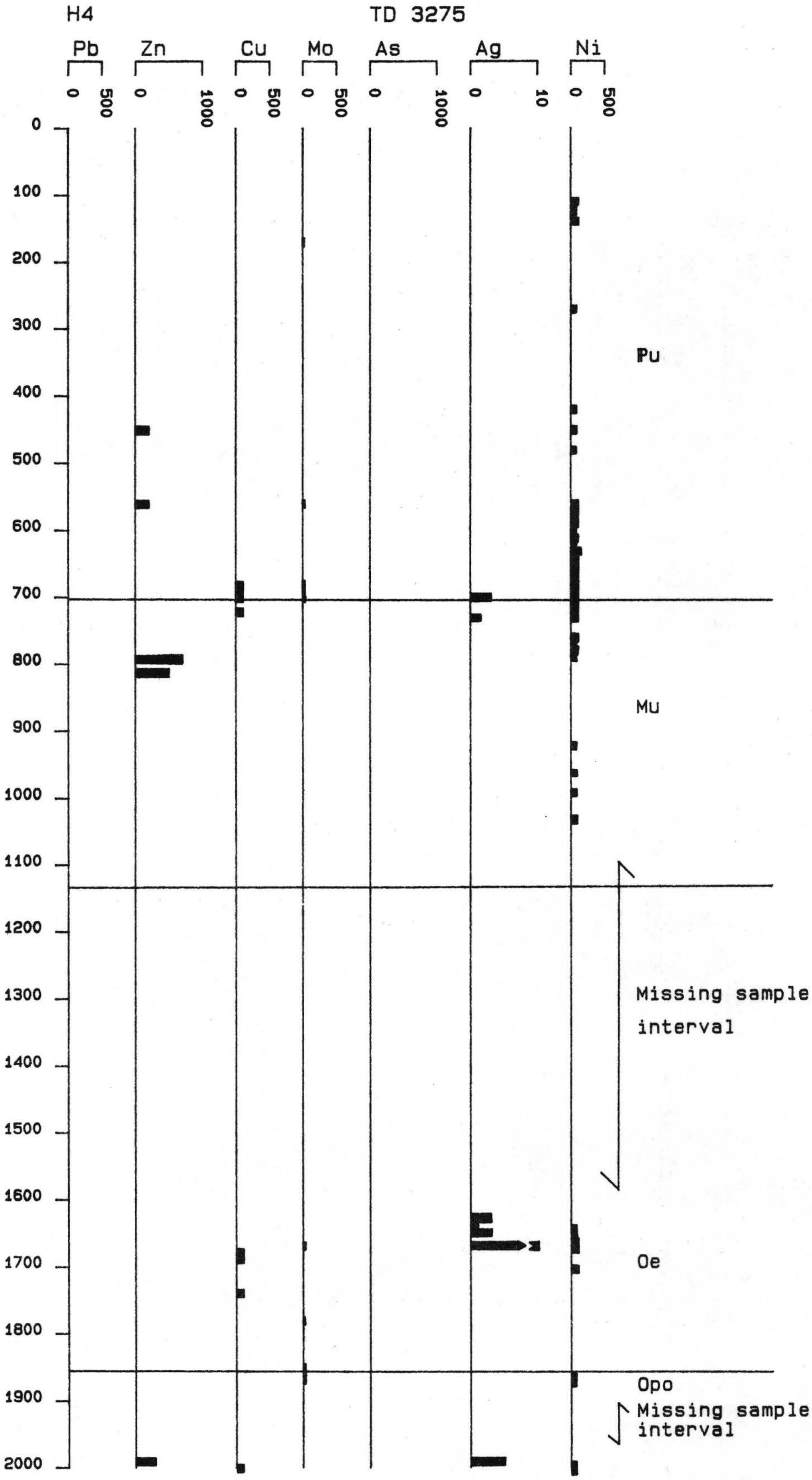
Oc
and
Oj
Or
Og
Ogg
Ce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100
200
300
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Opo
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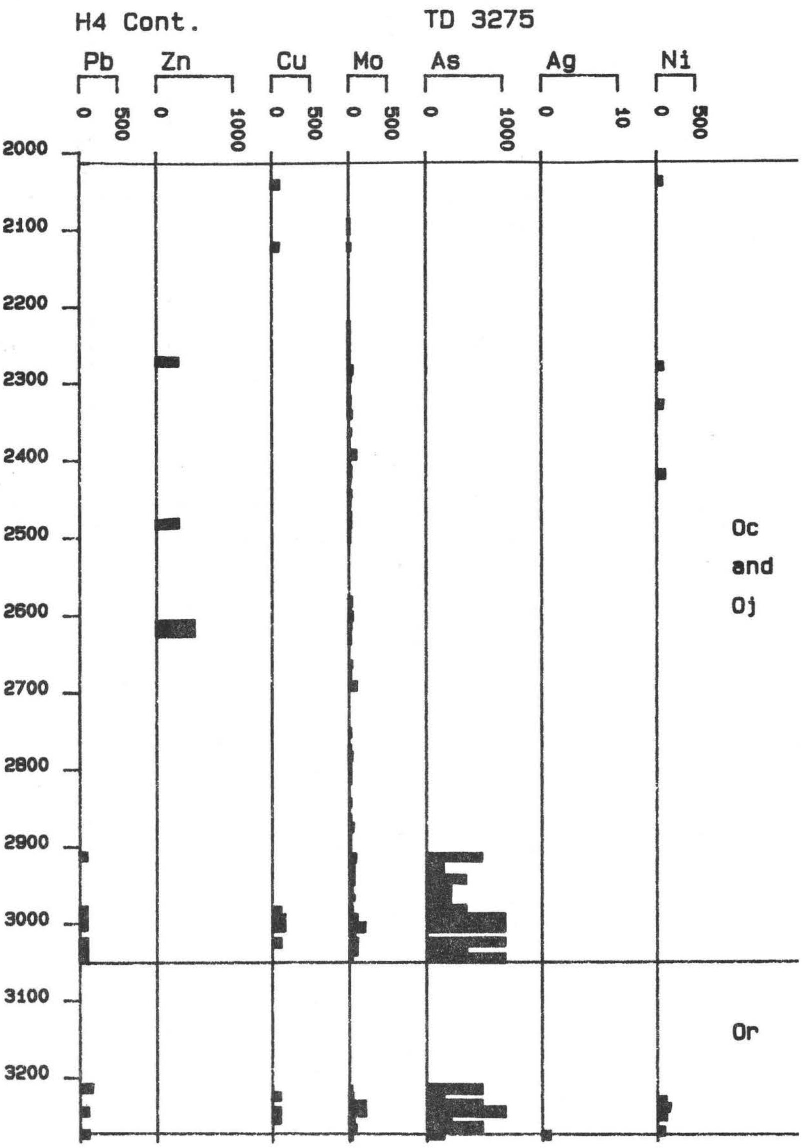
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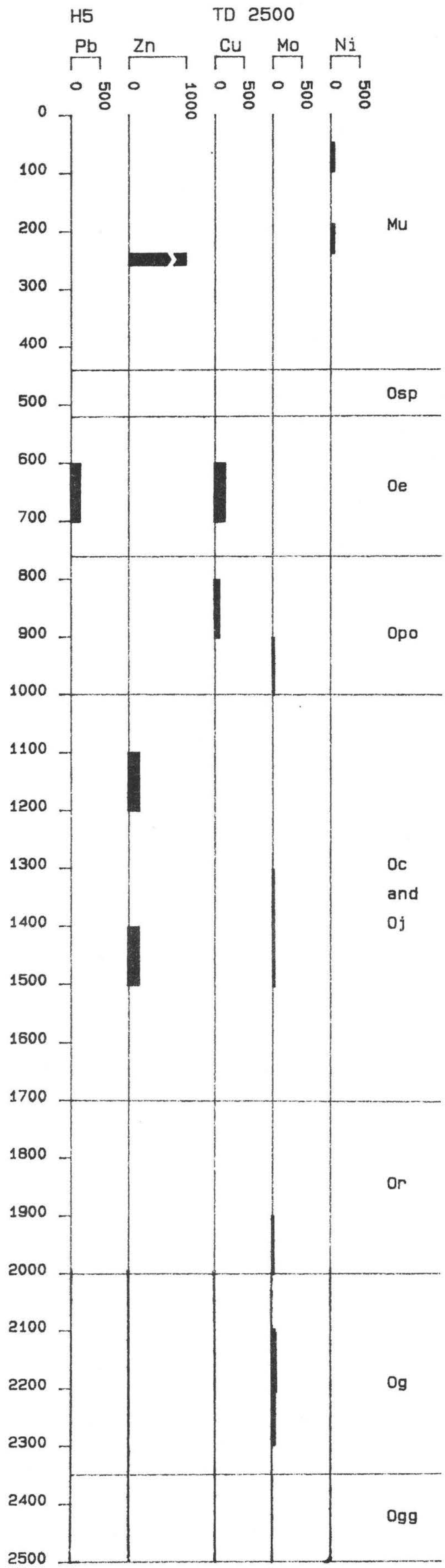
Oc
and
Oj
Or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Osp
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Oc
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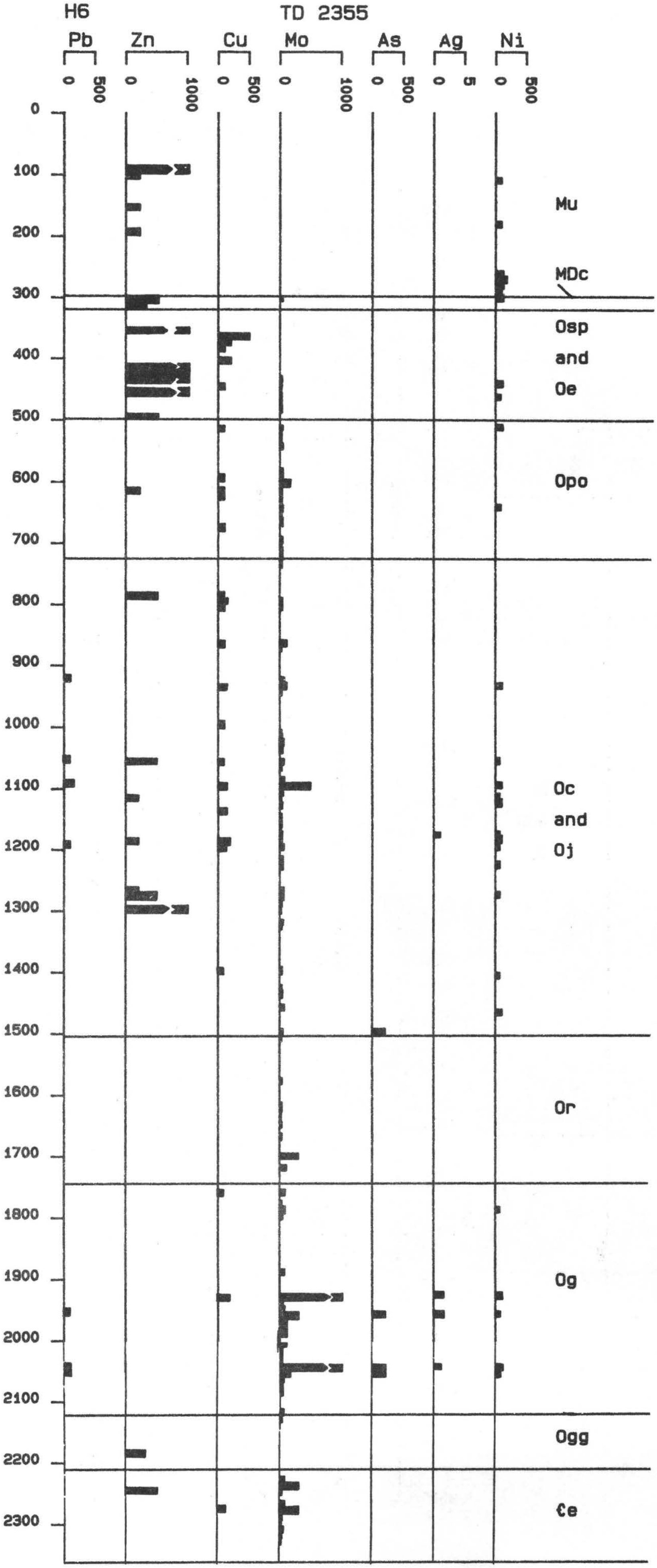
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and
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Or
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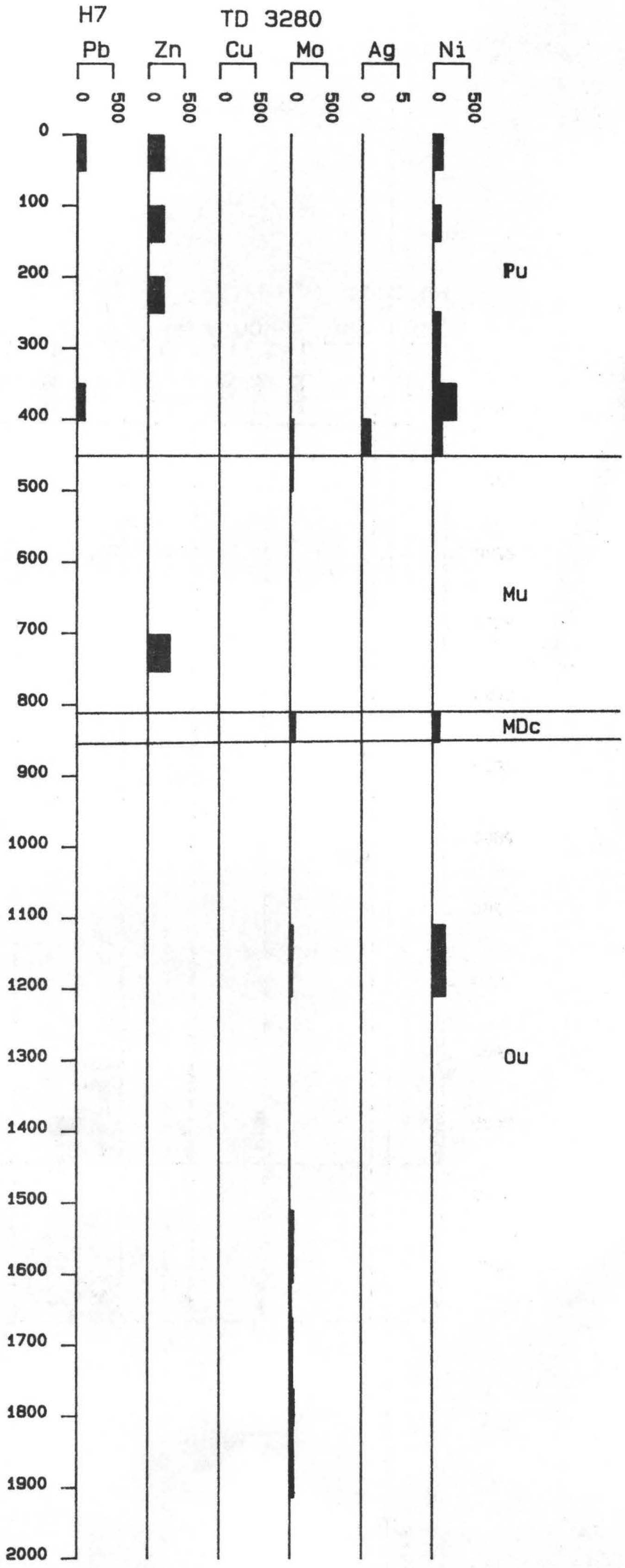
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MDc
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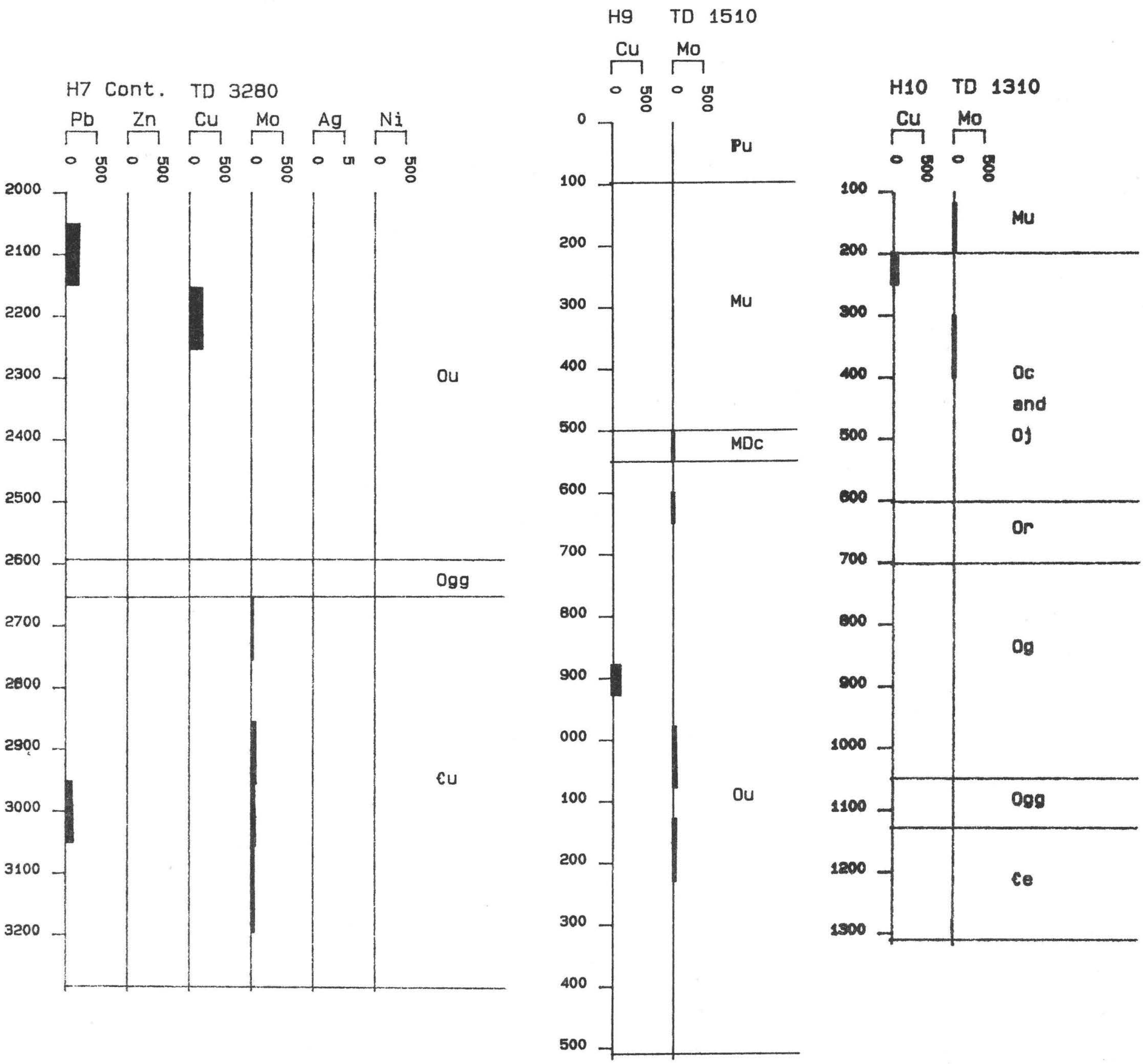
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3100
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Ogg
€u
H9 TD 1510
Cu
Mo
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500
Pu
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H10 TD 1310
Cu
Mo
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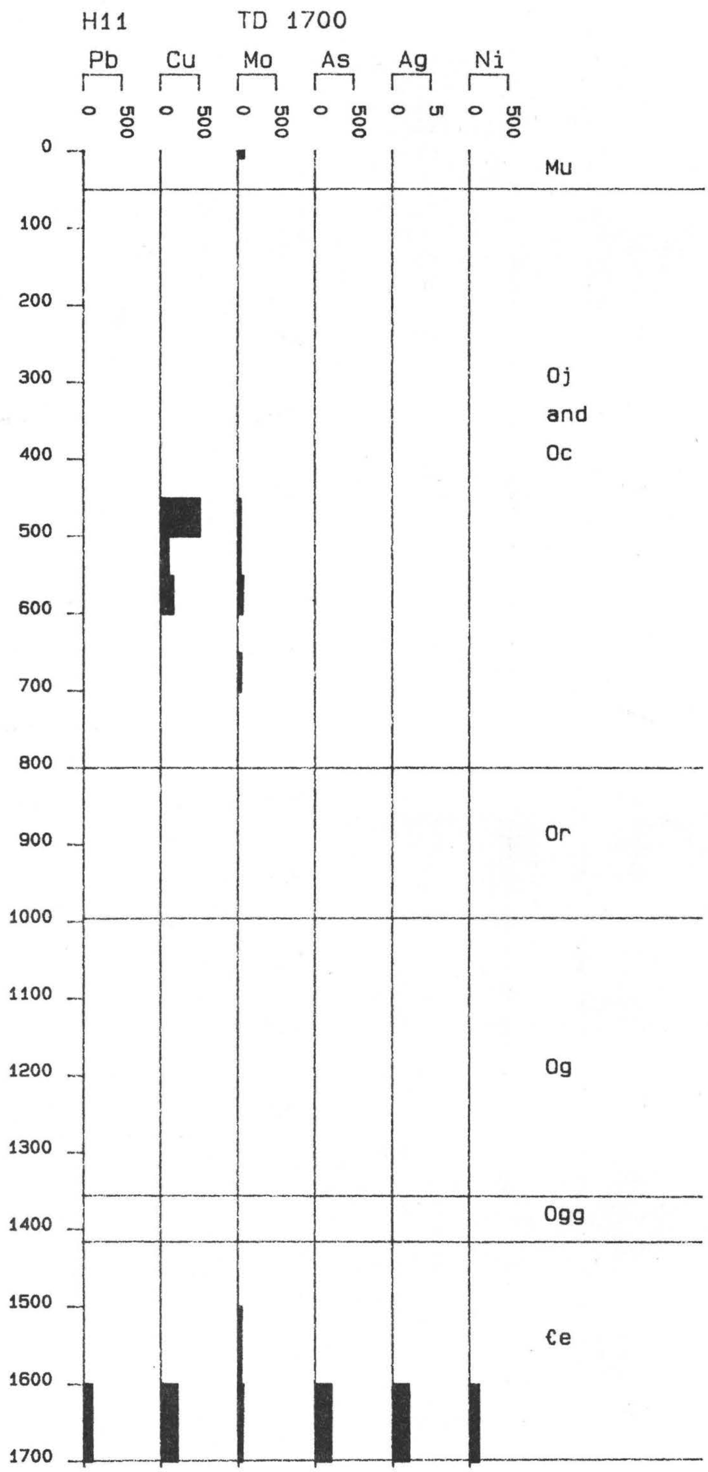
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Mo
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and
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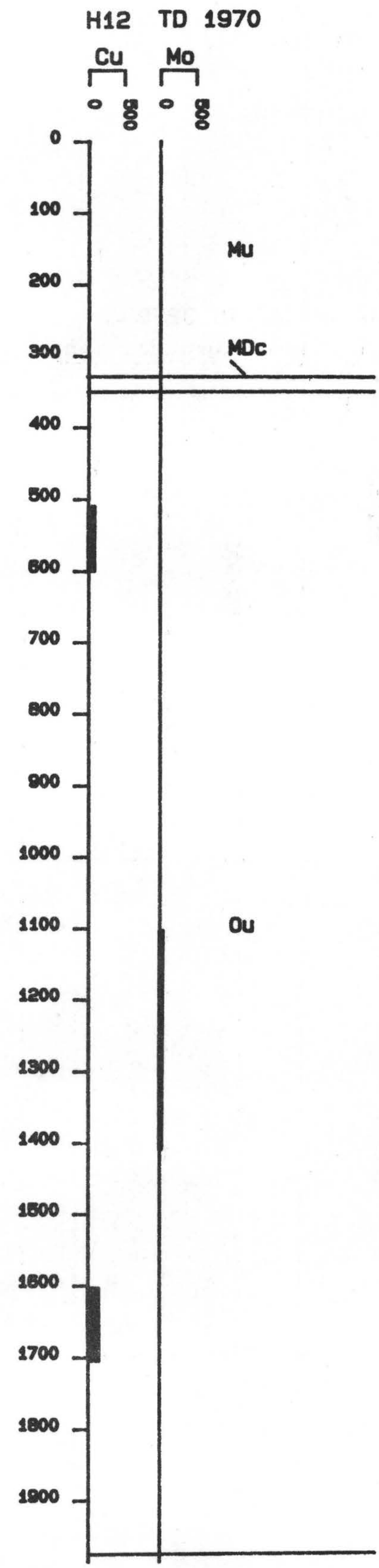
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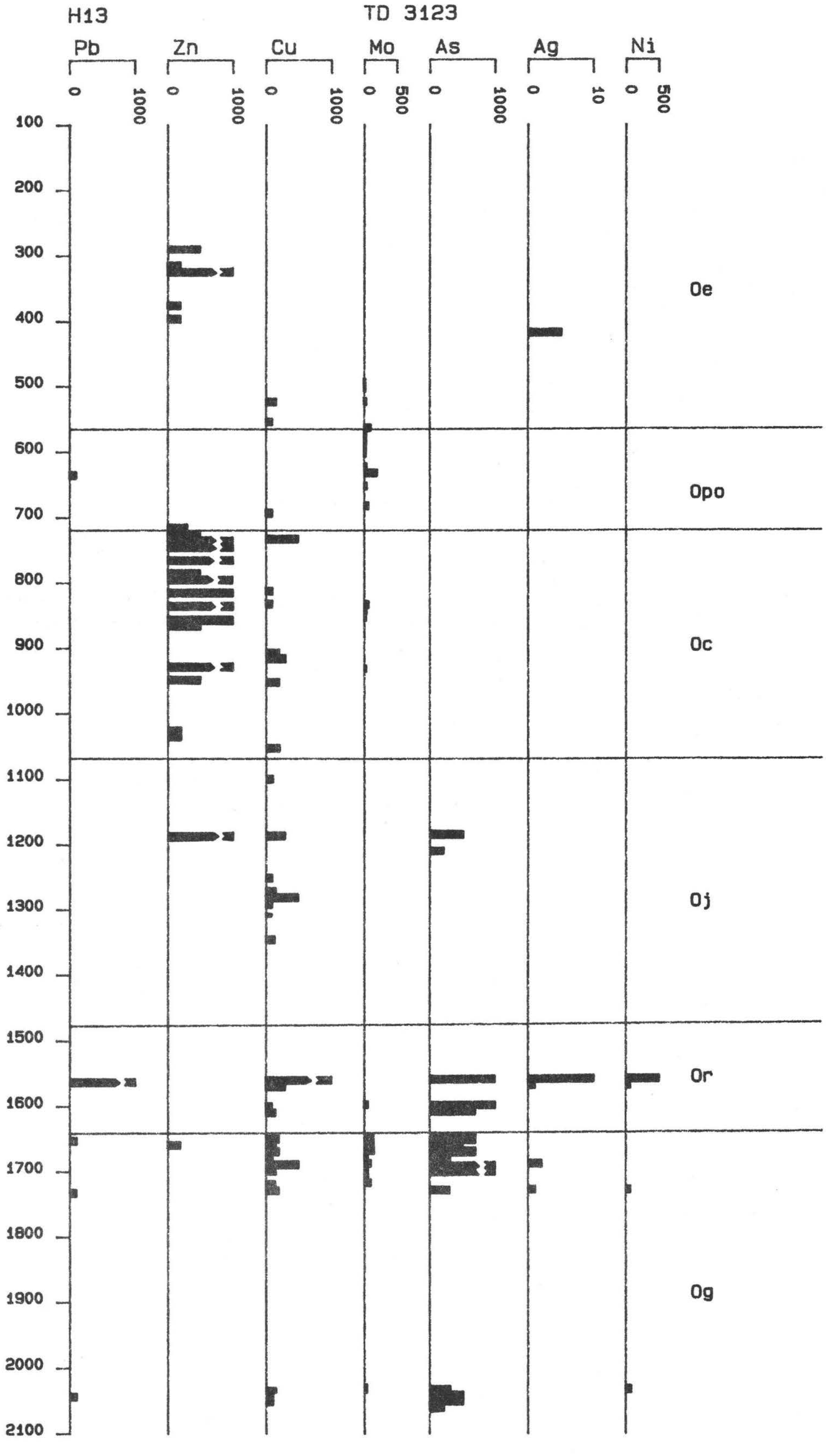
Mu
MDc
Ou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900
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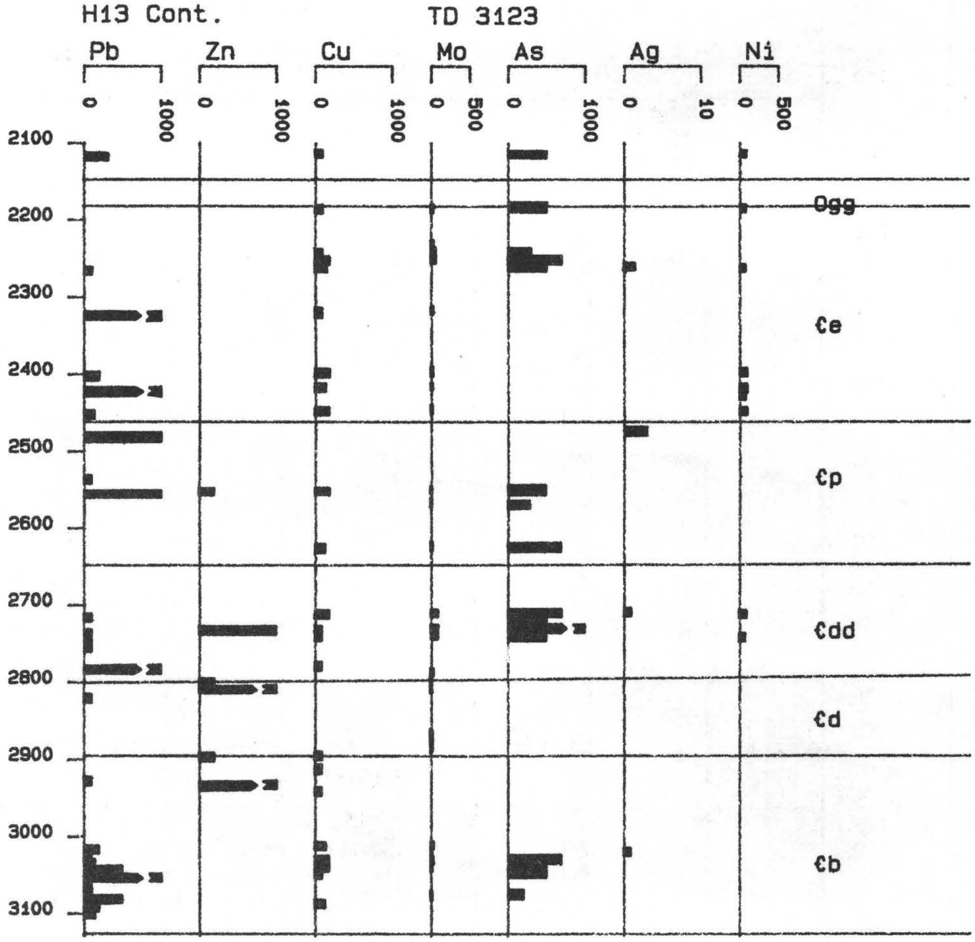
Or
Og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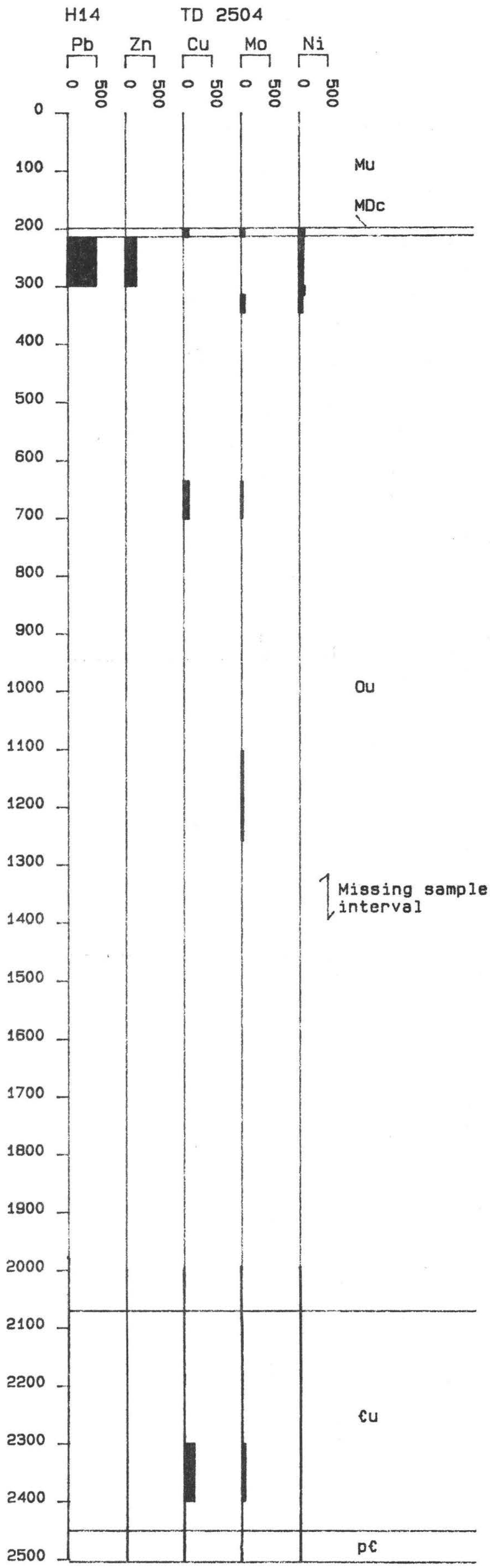
Cp
Cdd
Cd
Cb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1200
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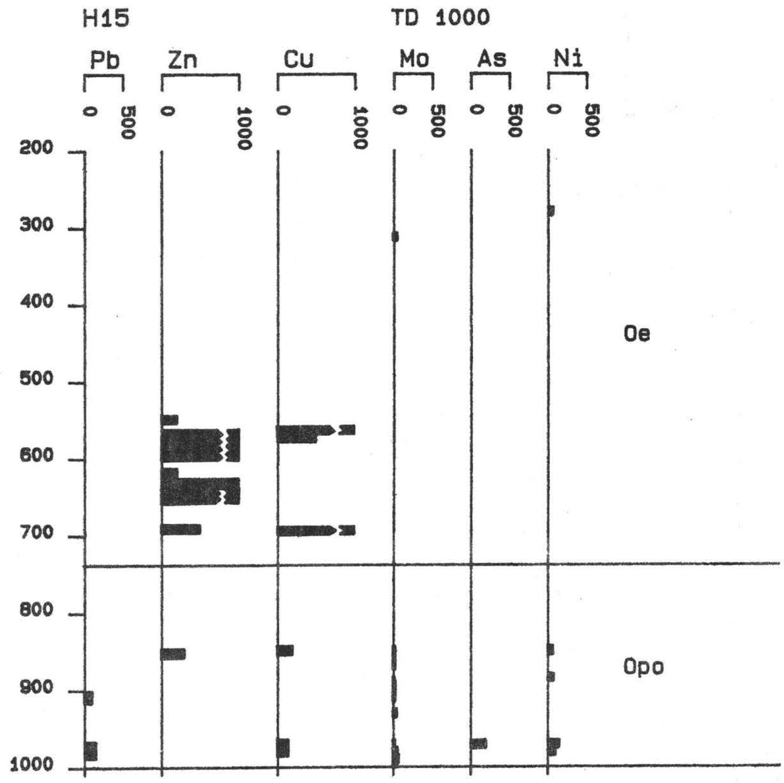
2100
2200
2300
2400
2500
Mu
MDc
Ou
Missing sample interval
€u
p€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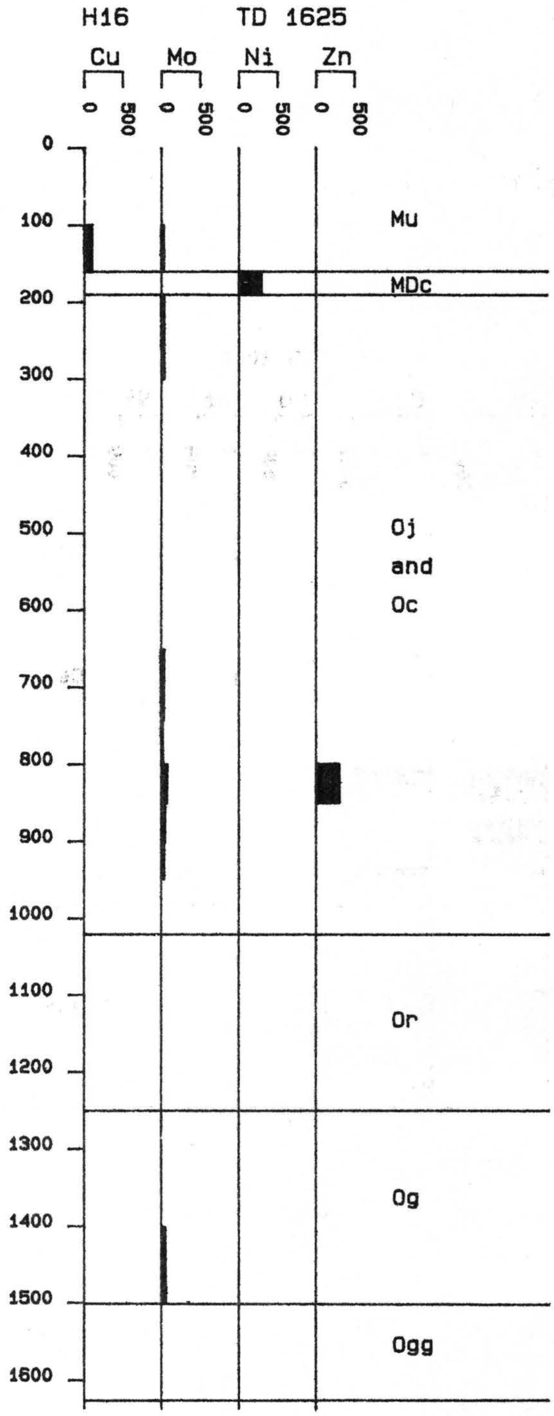
1000
Oe
Opo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Zn
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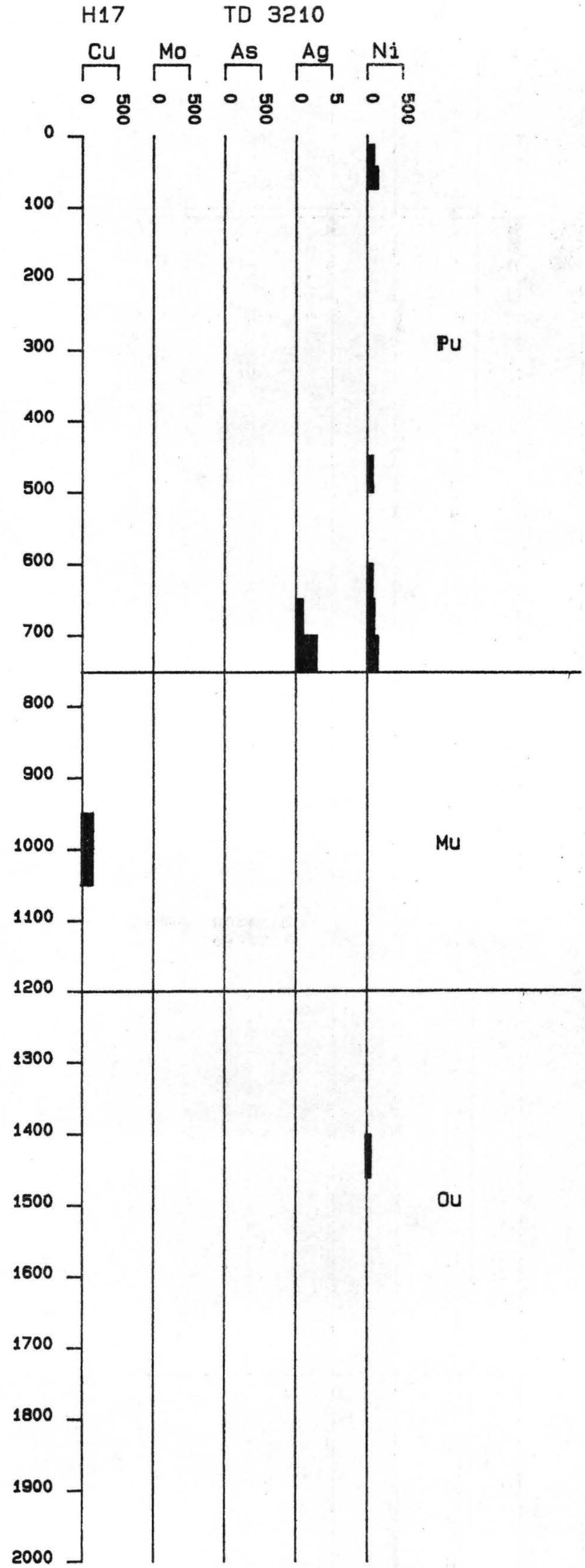
1100
1200
1300
1400
1500
1600
Mu
MDc
Oj
and
Oc
Or
Og
Ogg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Ag
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1700
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2000
Pu
Mu
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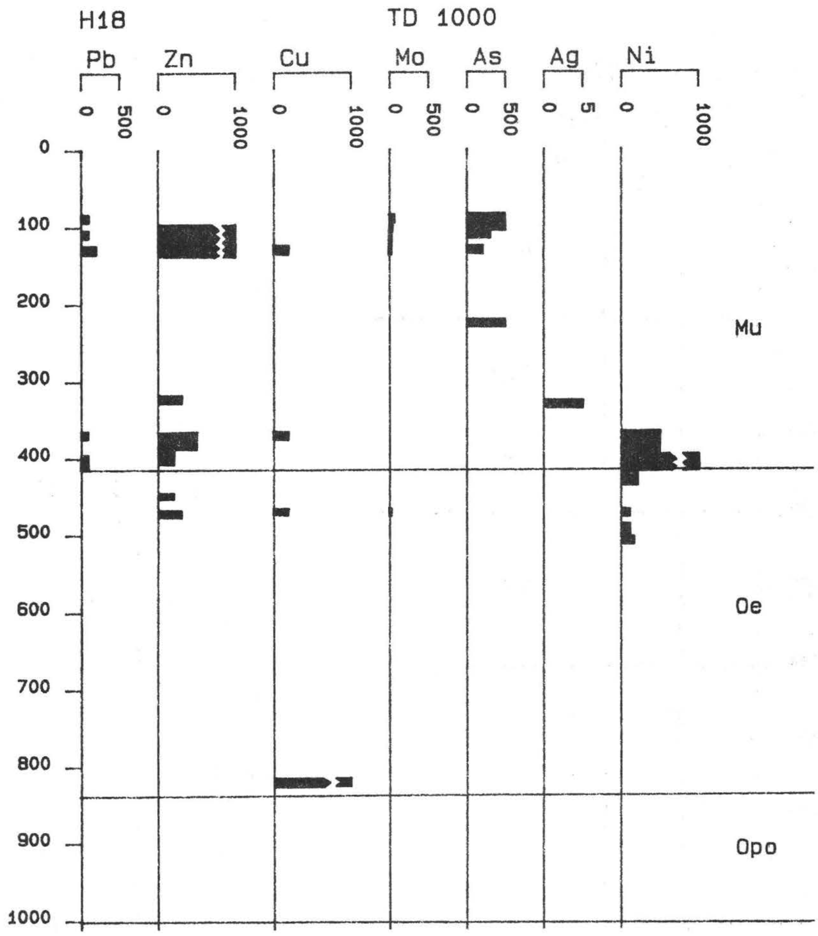
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700
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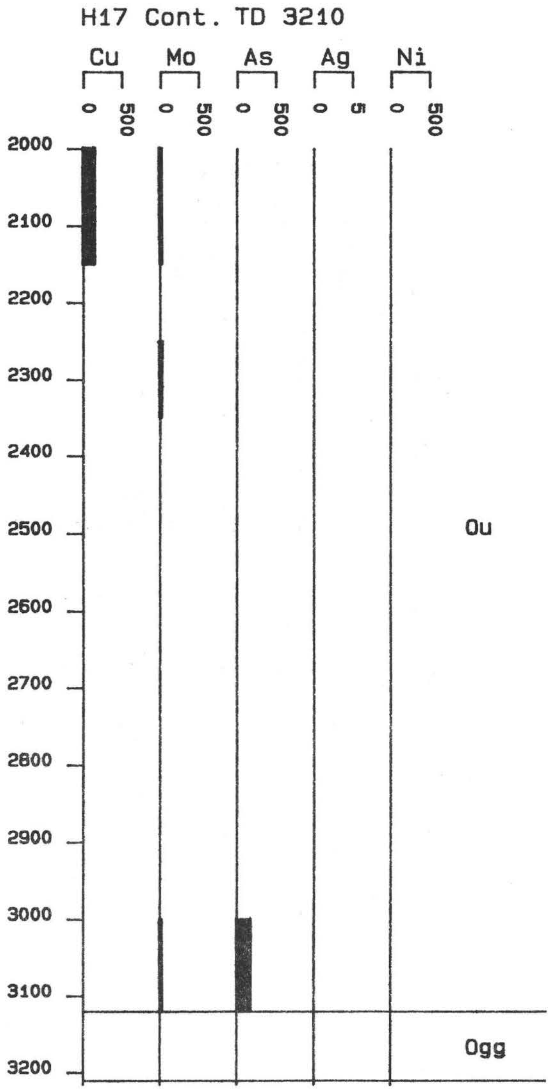
1000
Mu
Oe
Opo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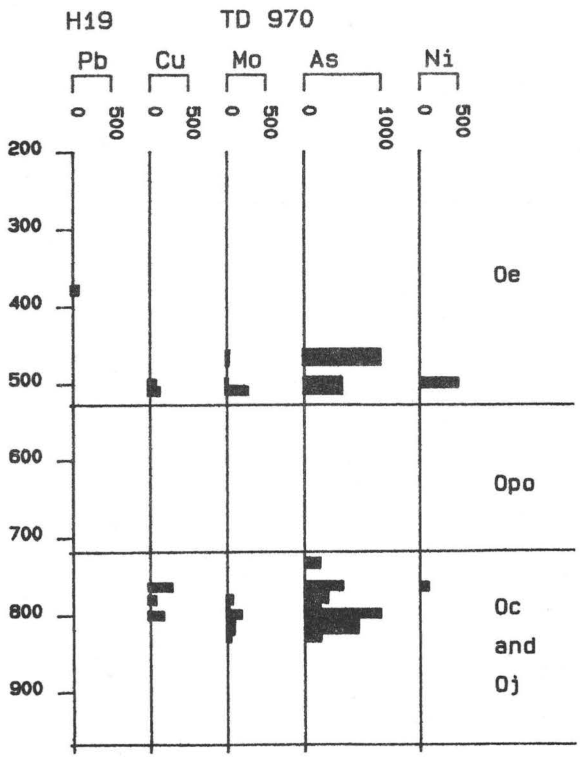
3100
3200
Ou
Ogg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As
Ni
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0 500
200
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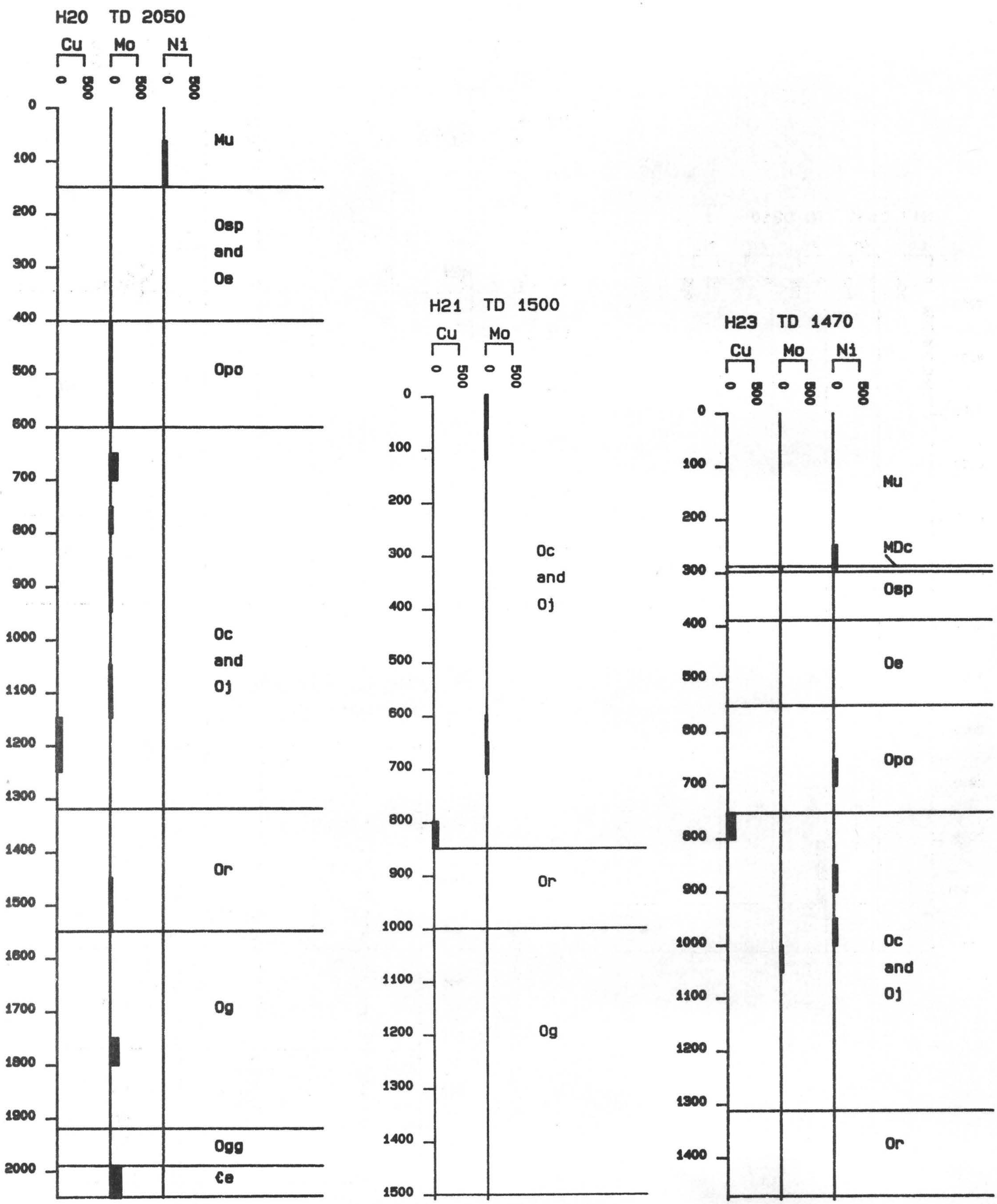
400
500
600
700
800
900
Oe
Opo
Oc
and
Oj



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Mo
Ni
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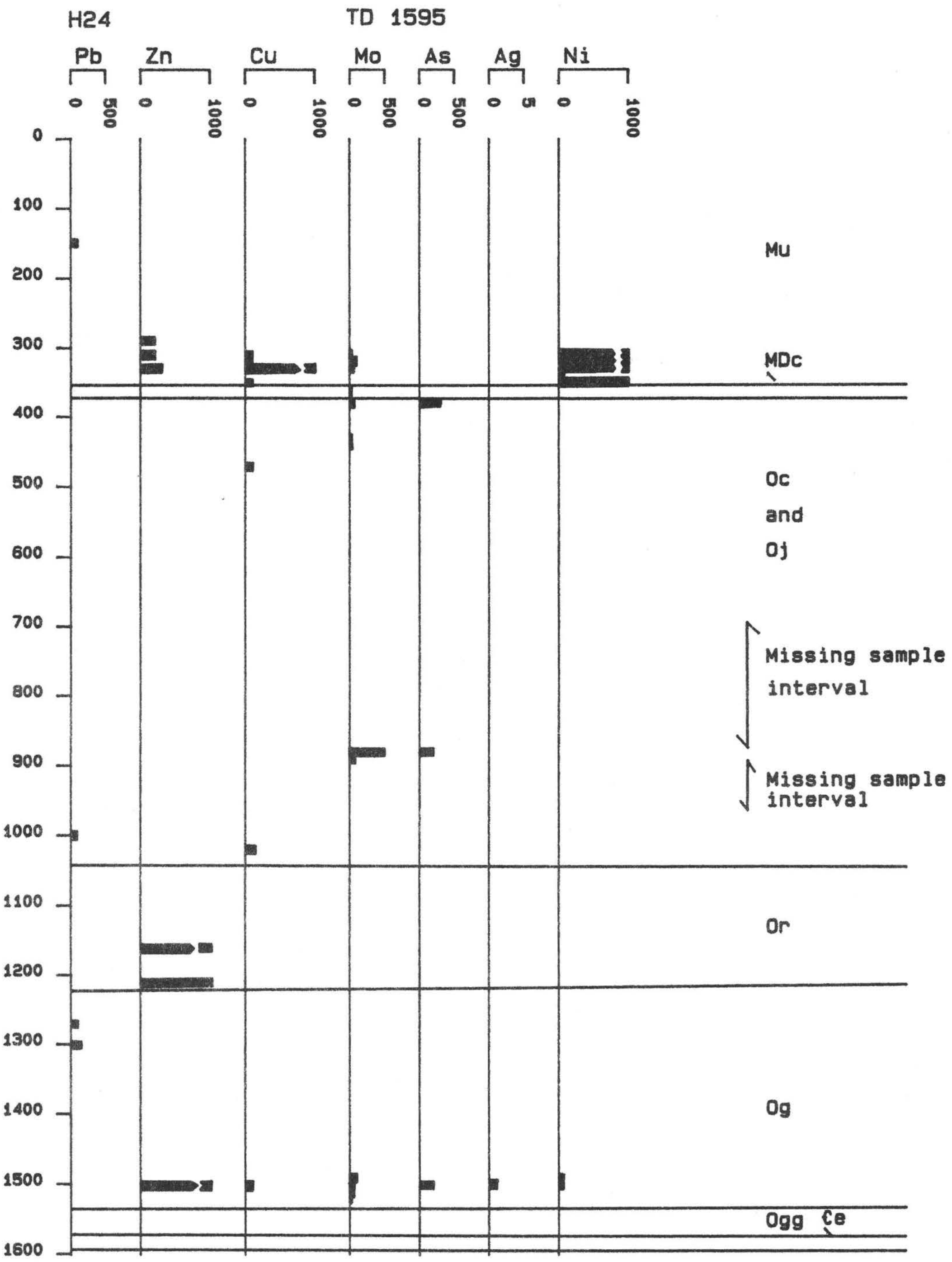
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Mu
Osp
and
Oe
Opo
Oc
and
Oj
Or
Og
Ogg
Ce
H21 TD 1500
Cu
Mo
0
500
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Oc
and
Oj
Or
Og
H23 TD 1470
Cu
Mo
Ni
0
500
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Mu
MDc
Osp
Oe
Opo
Oc
and
Oj
Or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Cu
Mo
As
Ag
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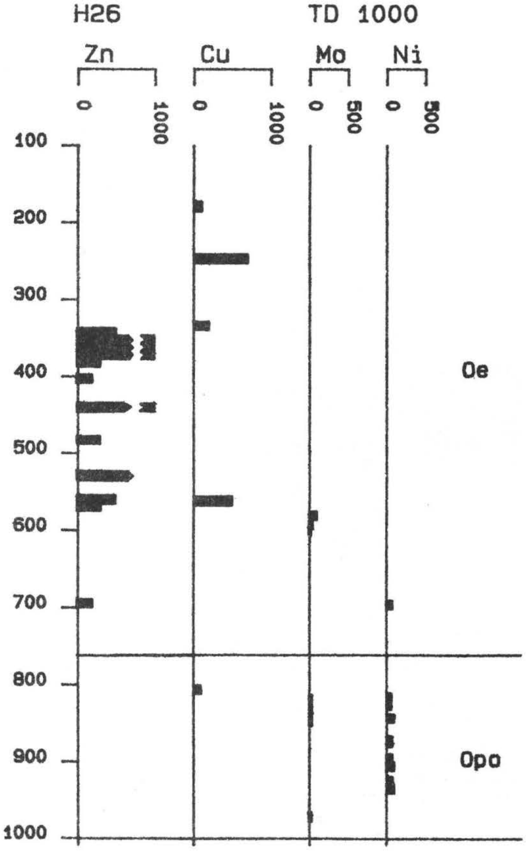
0 500
0 500
0 5
0 1000
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
Mu
MDc
Oc
and
Oj
Missing sample interval
Missing sample interval
Or
Og
Ogg
Ce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100
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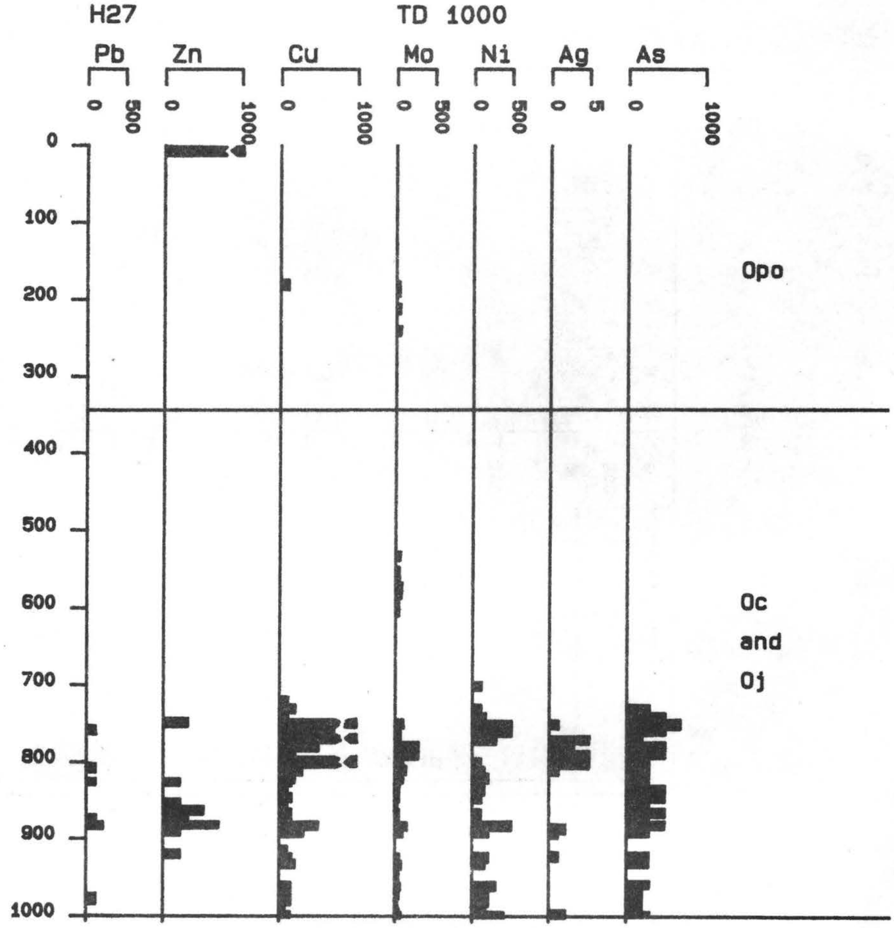
800
900
1000
Oe
Opo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Zn
Cu
Mo
Ni
Ag
As
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and
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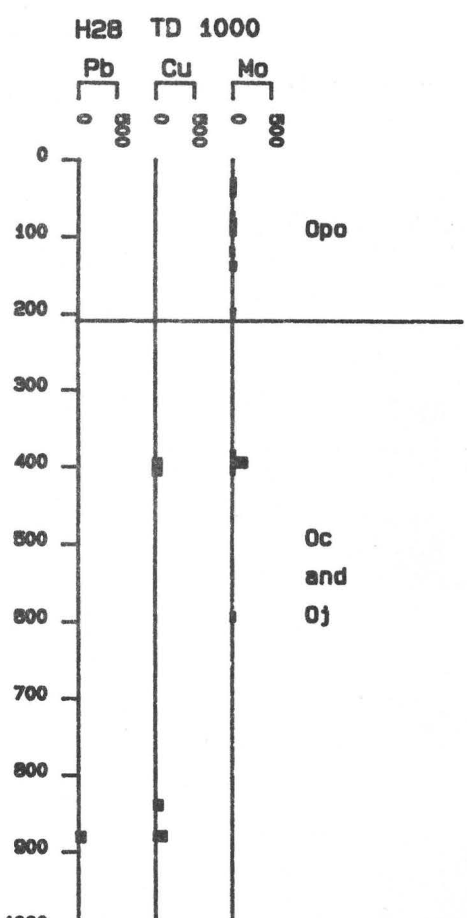
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TD 1000
Pb
Cu
Mo
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Opo
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and
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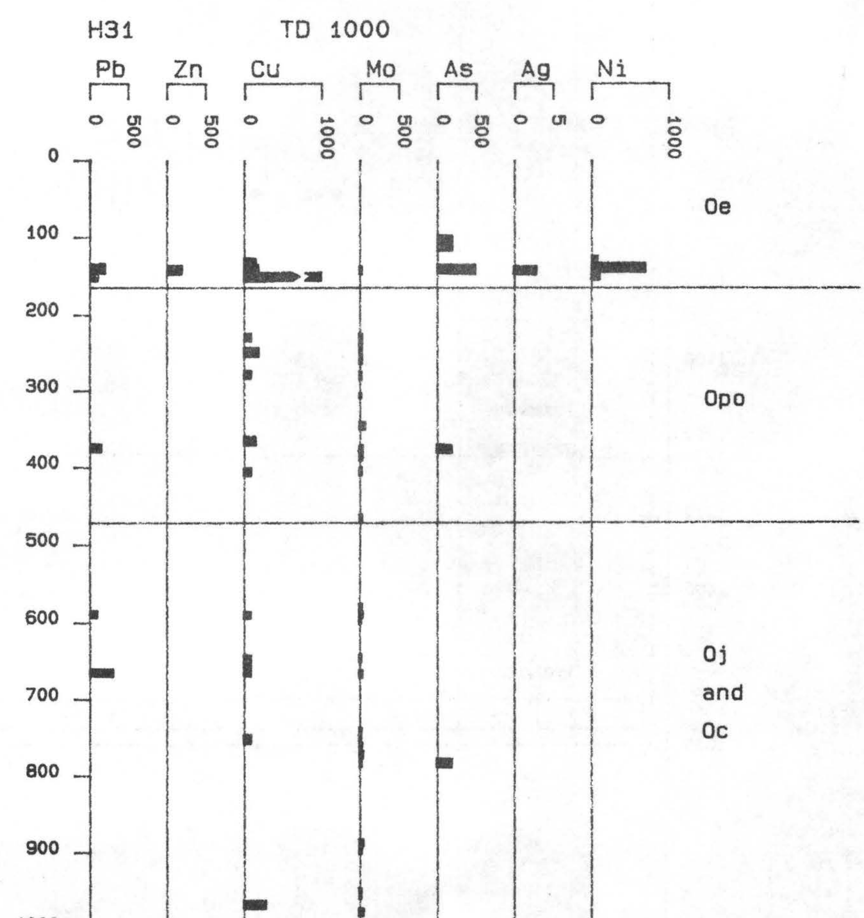
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Pb
Zn
Cu
Mo
As
Ag
Ni
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500
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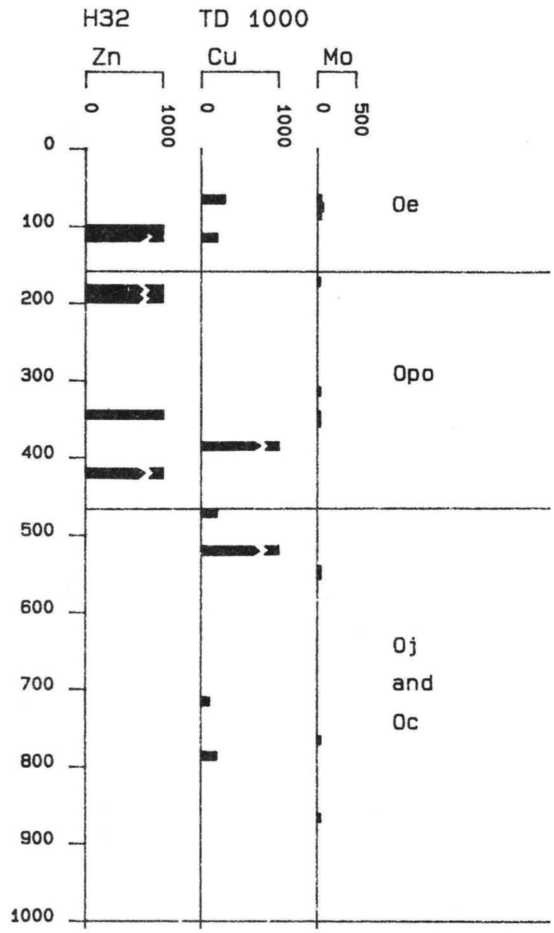
and
Oc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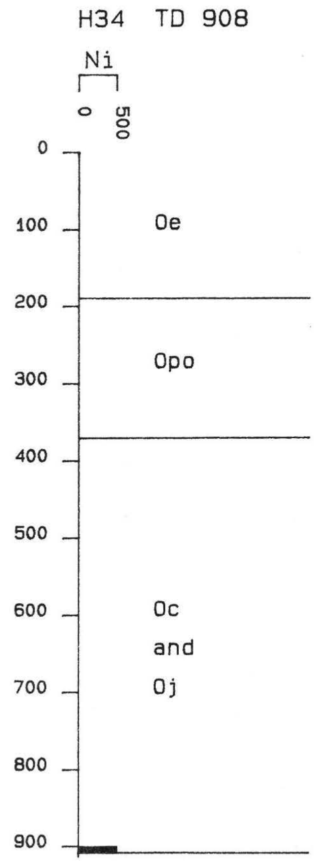
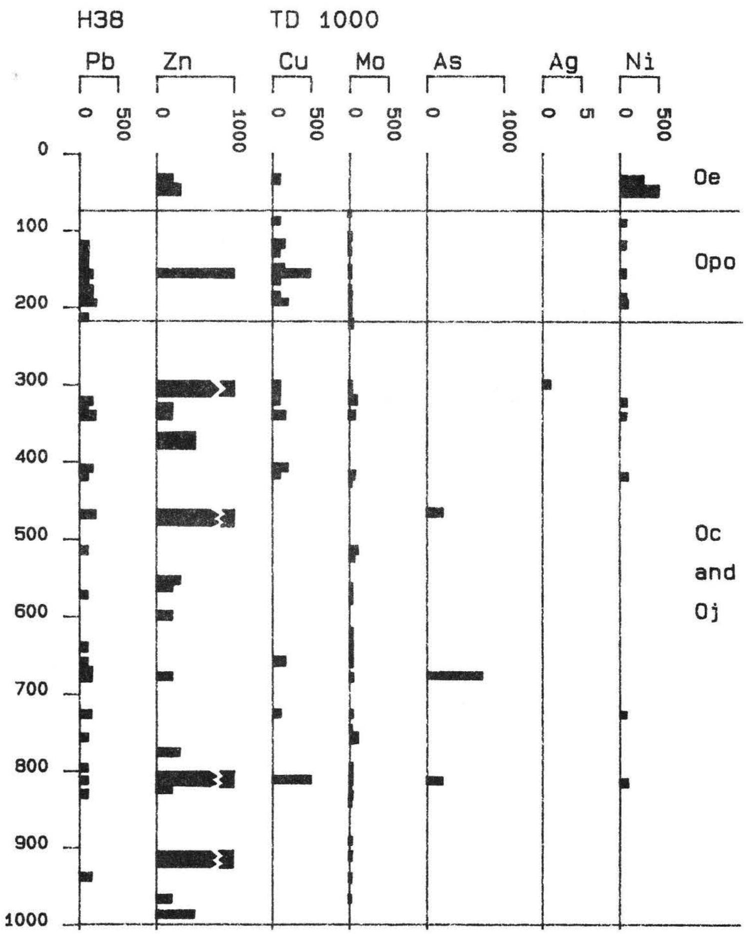
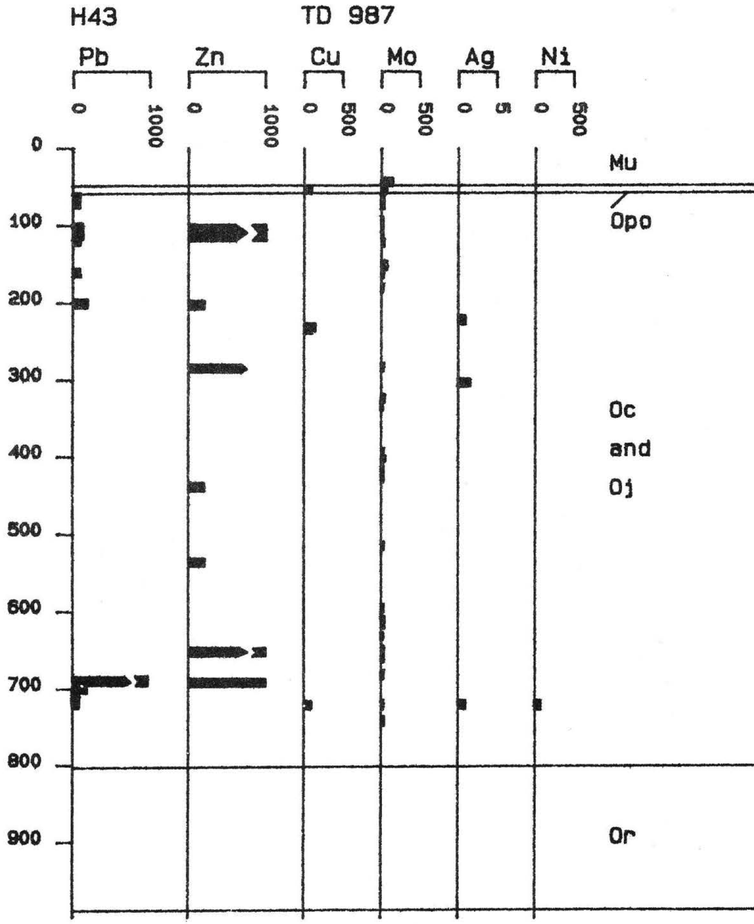
Zn
Cu
Mo
0 1000
0 1000
0 500
Oe
Opo
Oj
and
Oc


H34 TD 908
Ni
0 500
Oe
Opo
Oc
and
Oj


H38
TD 1000
Pb
Zn
Cu
Mo
As
Ag
Ni
Oe
Opo
Oc
and
Oj


H43
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Zn
Cu
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Ag
Ni
Mu
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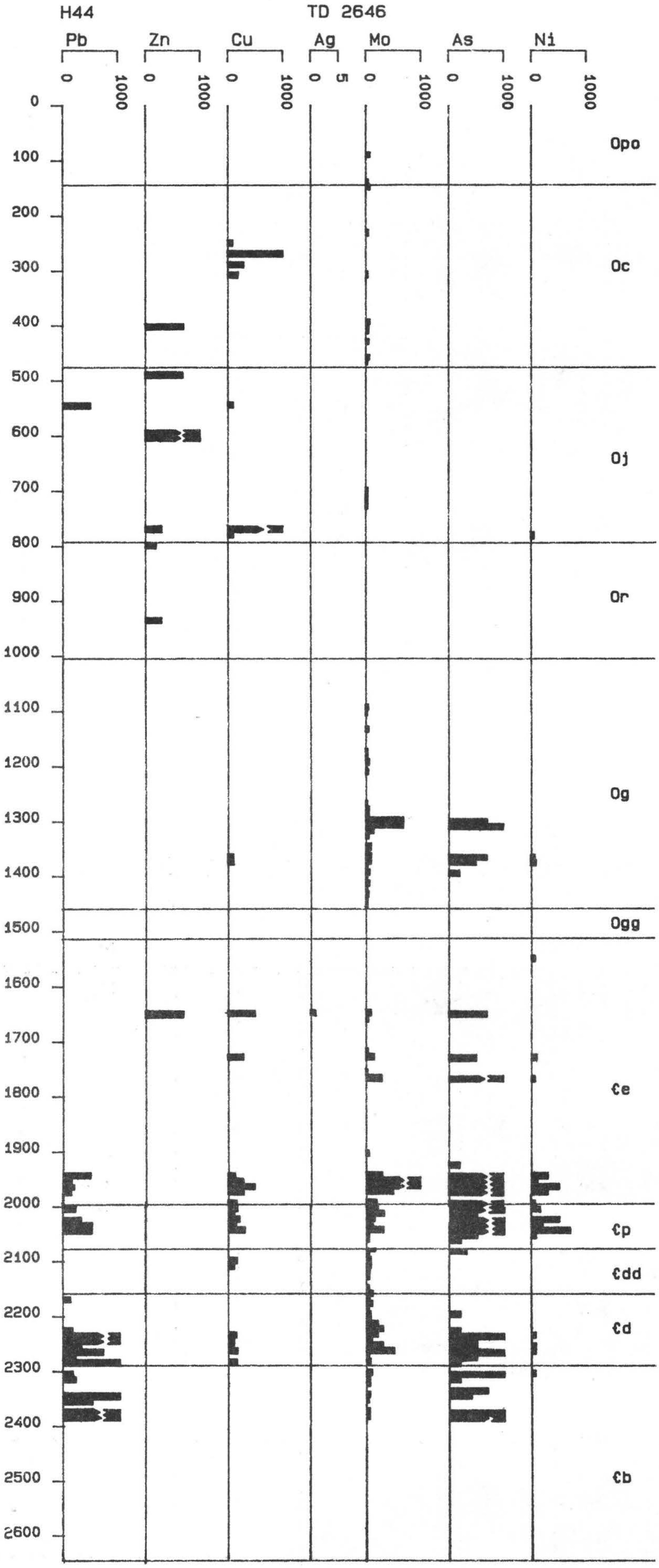
Oc
and
Oj
Or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TD 2646
Pb
Zn
Cu
Ag
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As
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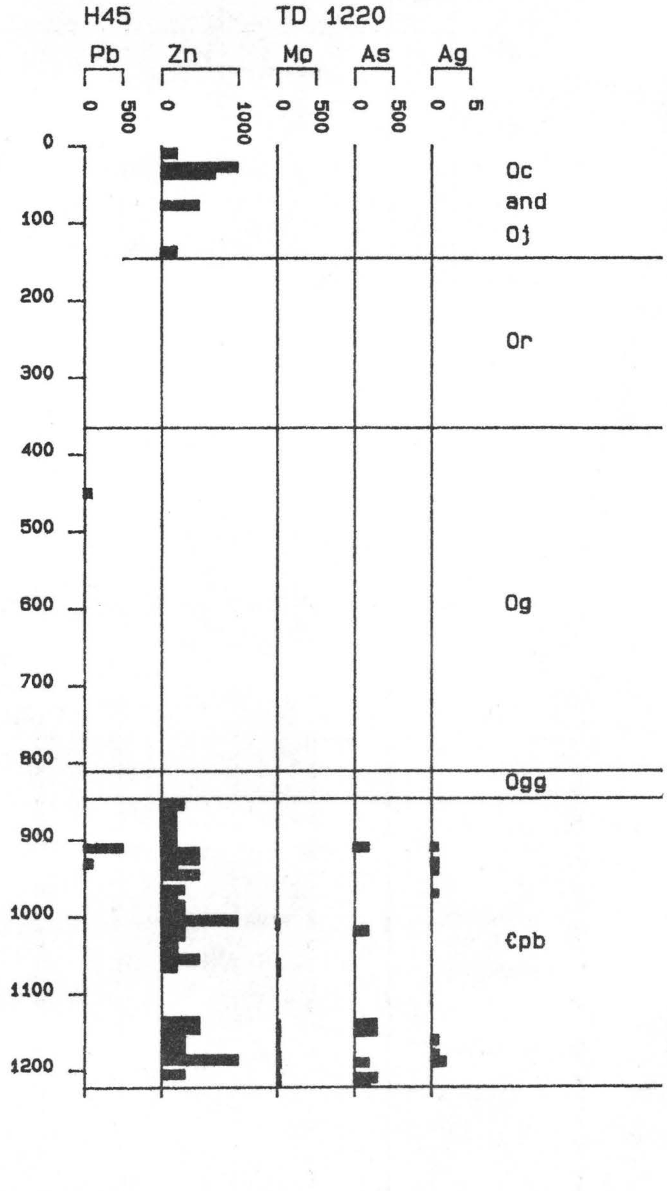
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Pb
Zn
Mo
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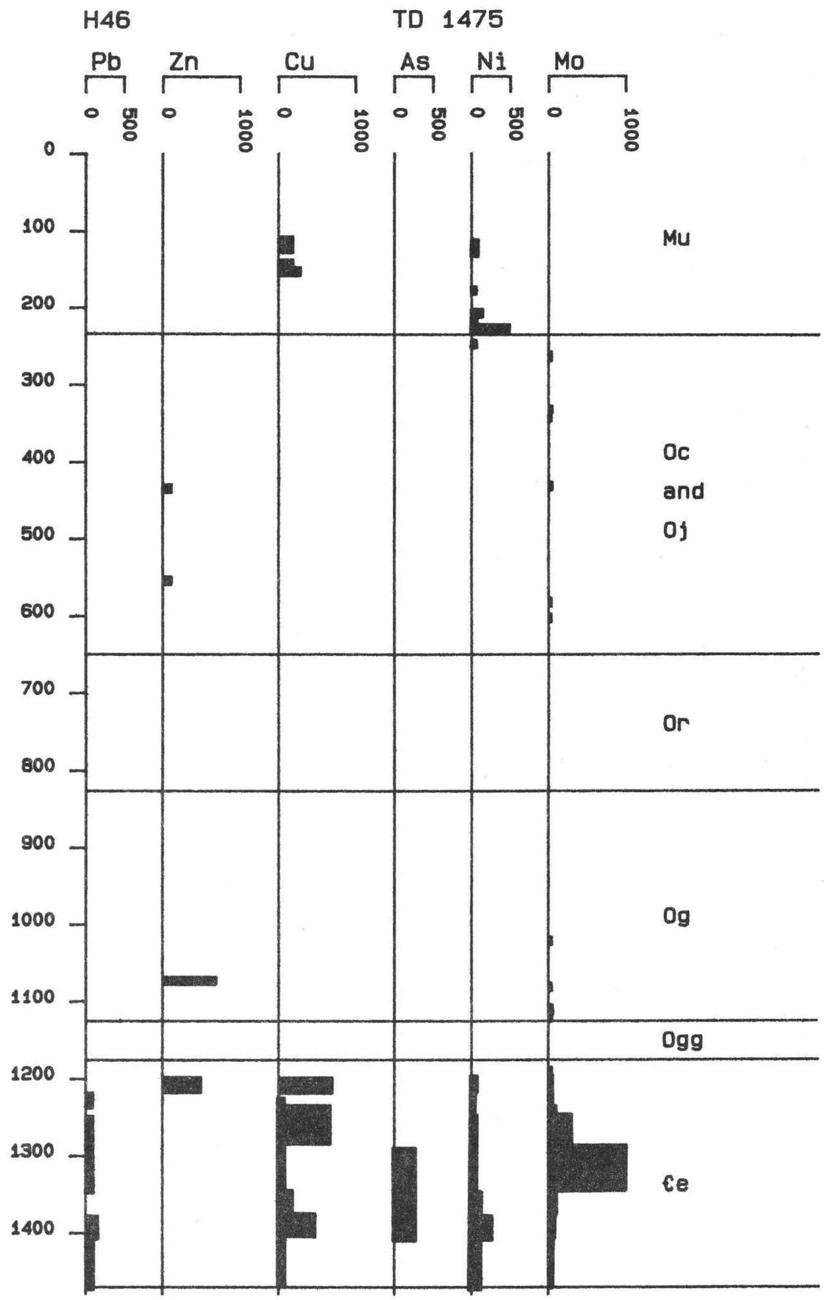
H46
TD 1475
Pb
Zn
Cu
As
Ni
Mo
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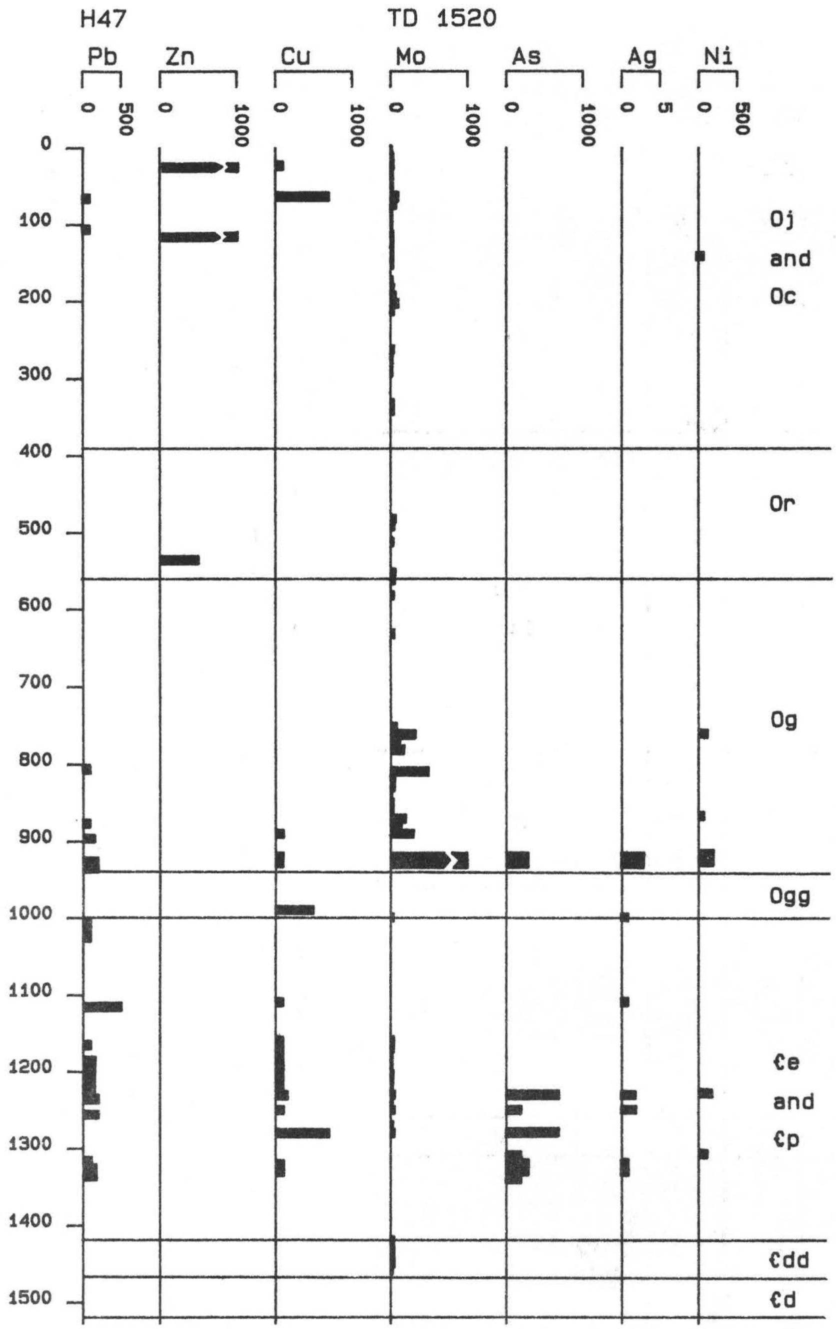
H47
TD 1520
Pb
Zn
Cu
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Ni
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and
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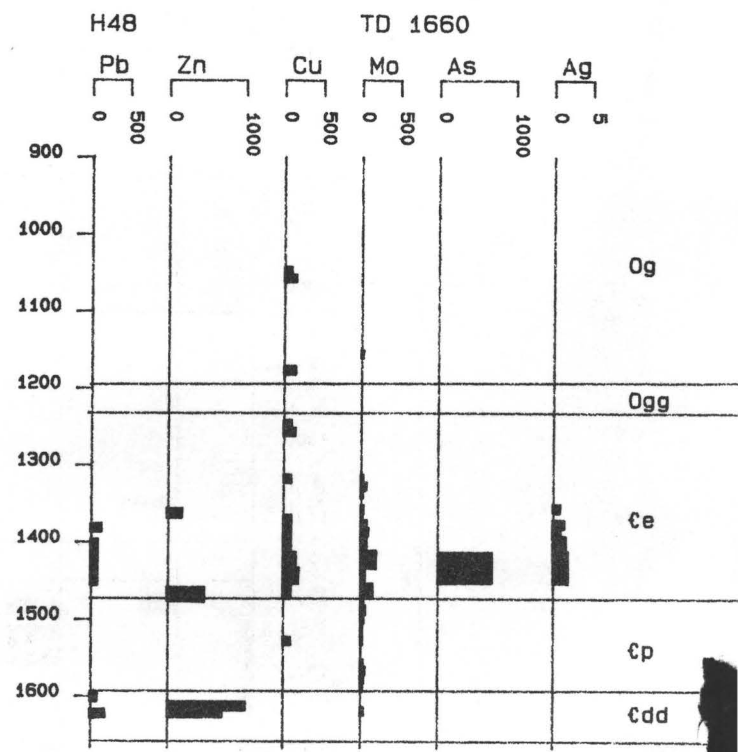
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Pb
Zn
Cu
Mo
As
Ag
0 500
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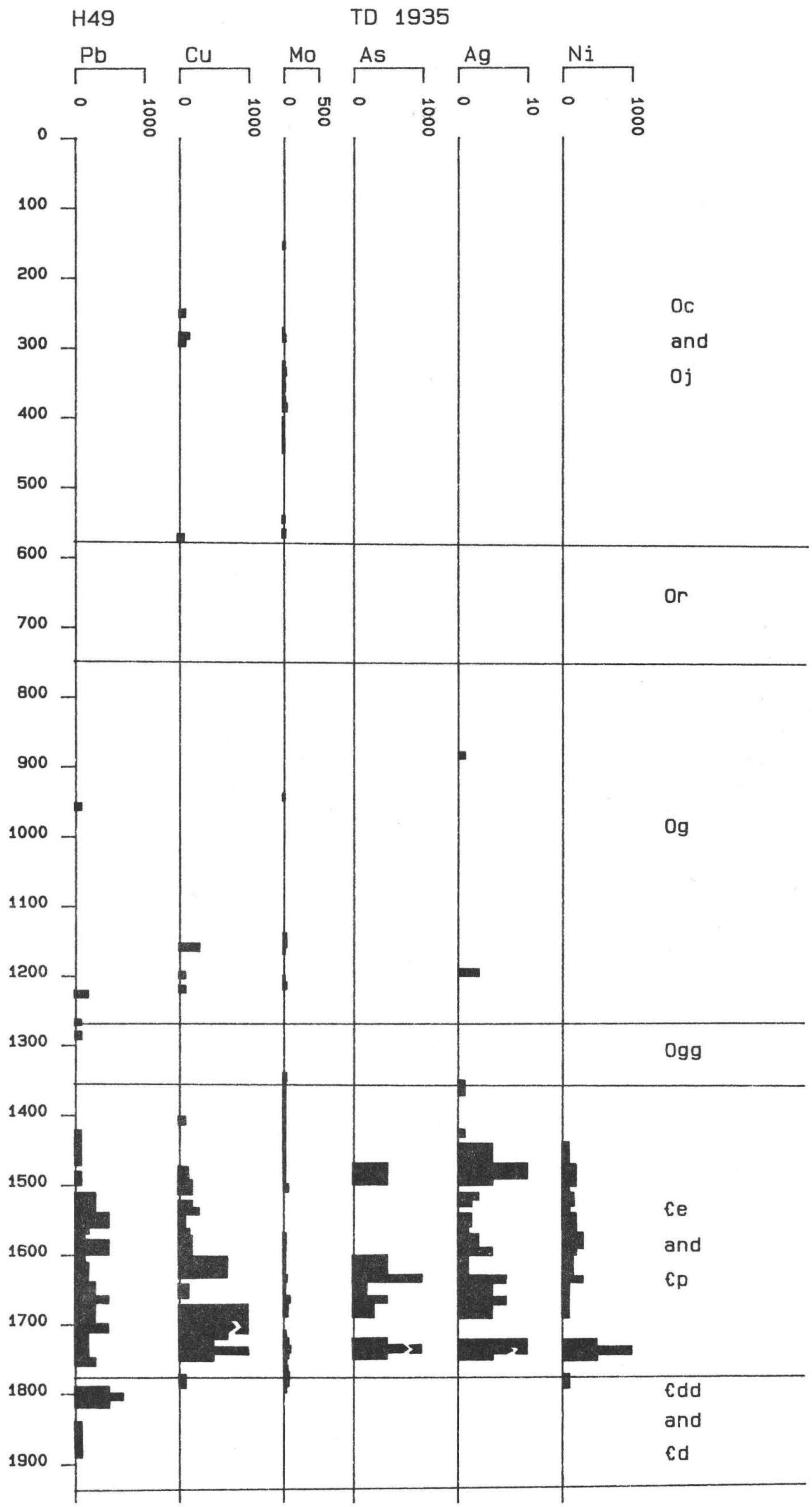
Cp
Cdd



H49
TD 1935
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Cu
Mo
As
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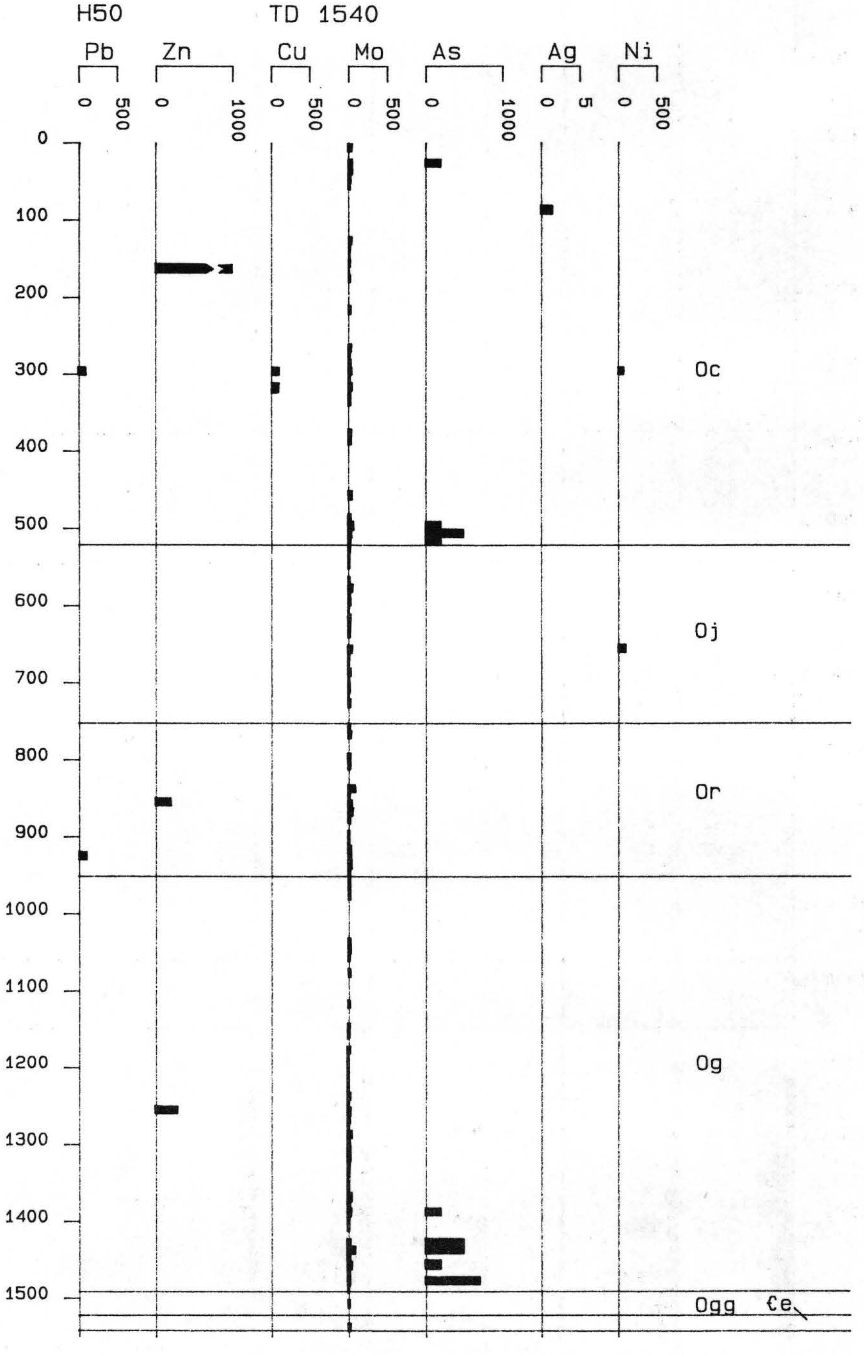

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Pb
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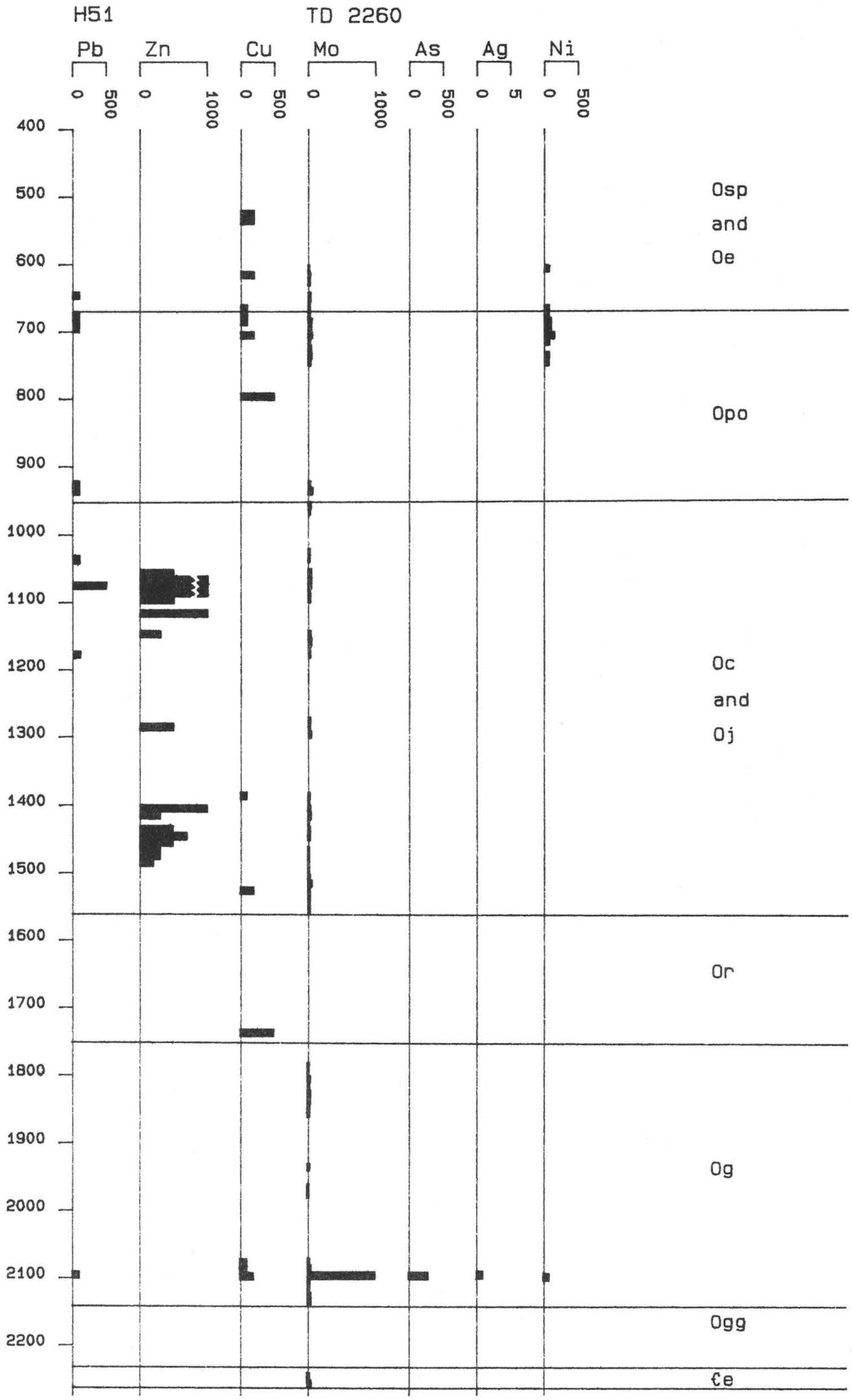
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TD 2260
Pb
Zn
Cu
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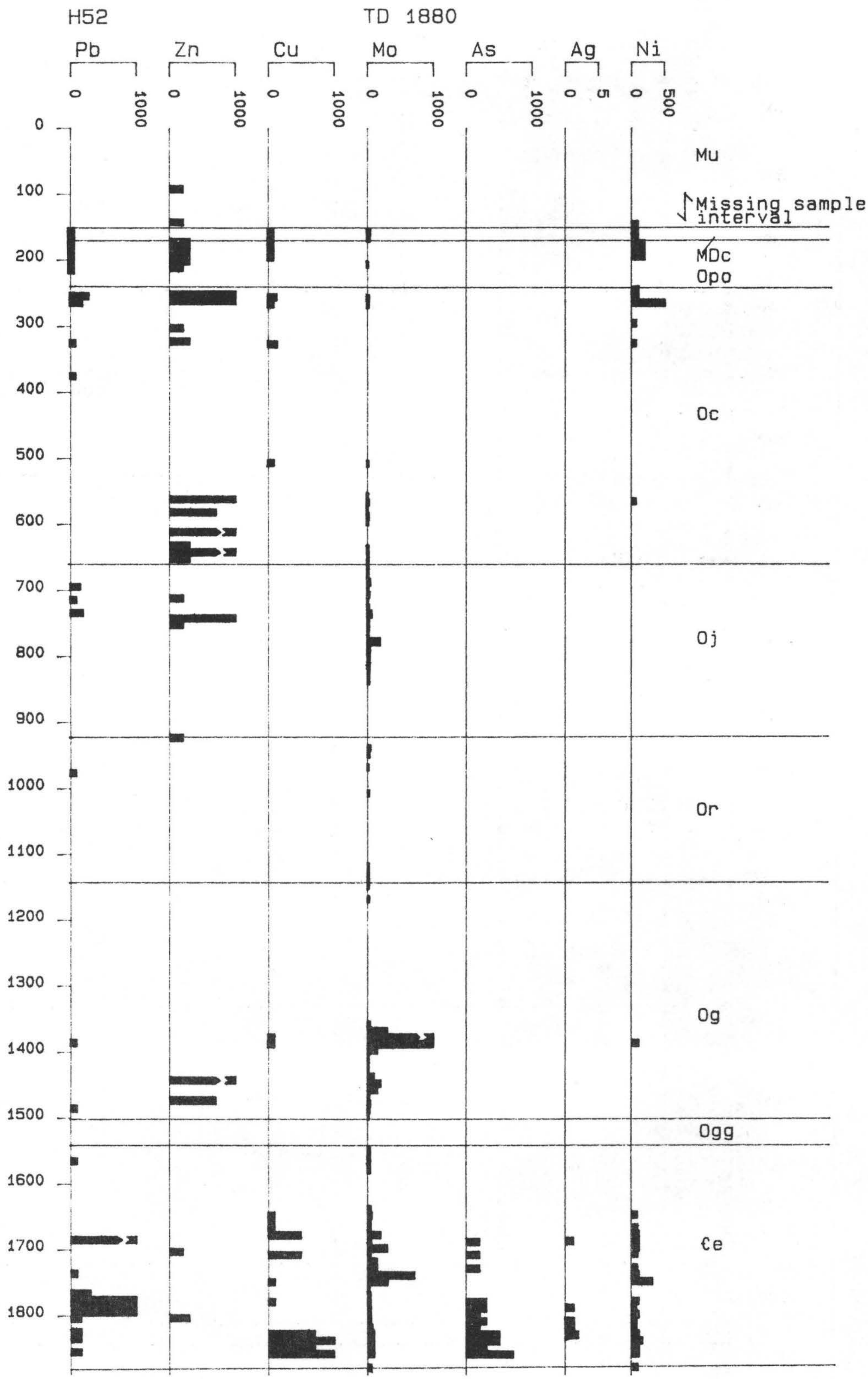

H52
TD 1880
Pb
Zn
Cu
Mo
As
Ag
Ni
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Mu
Missing sample interval
MDc
Opo
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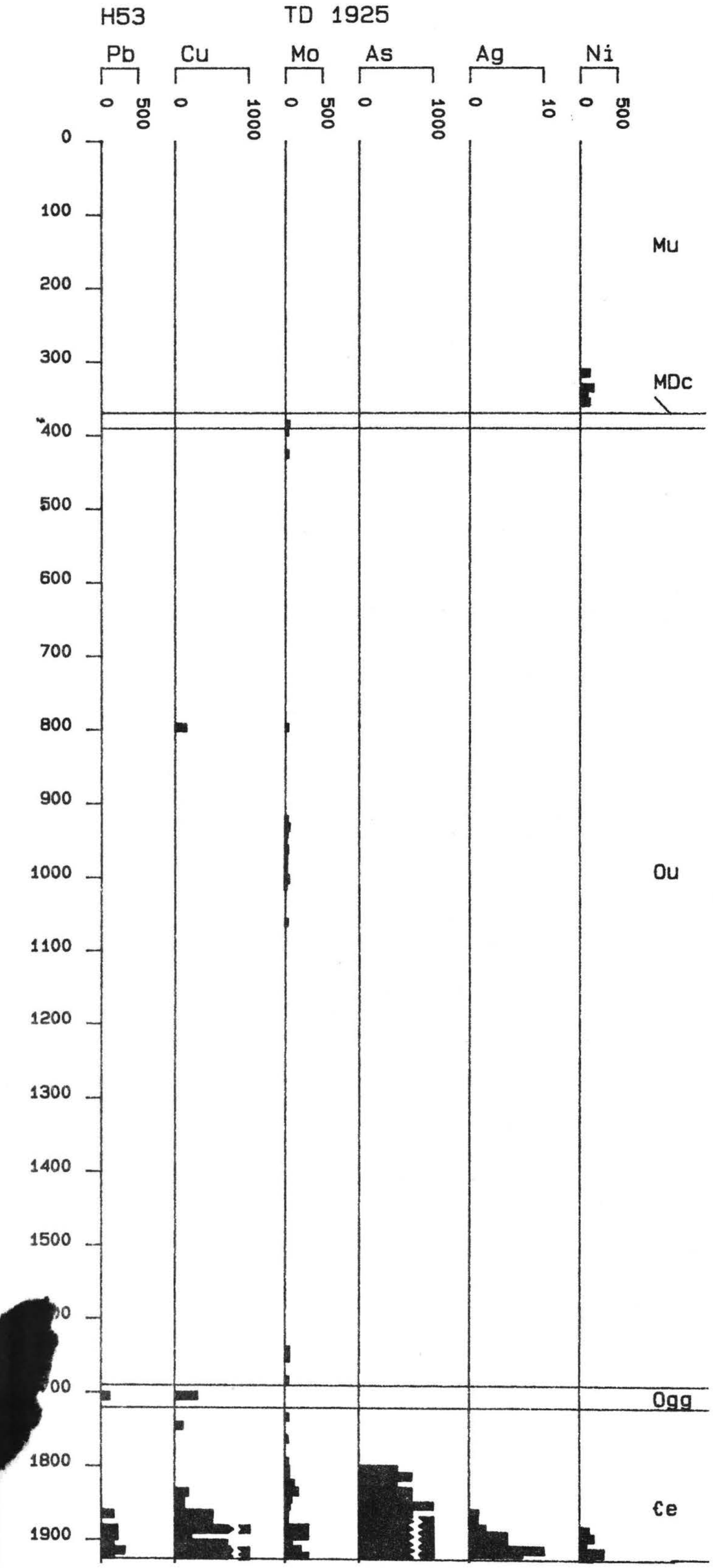
H53
TD 1925
Pb
Cu
Mo
As
Ag
Ni
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0 500
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0 10
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MDc
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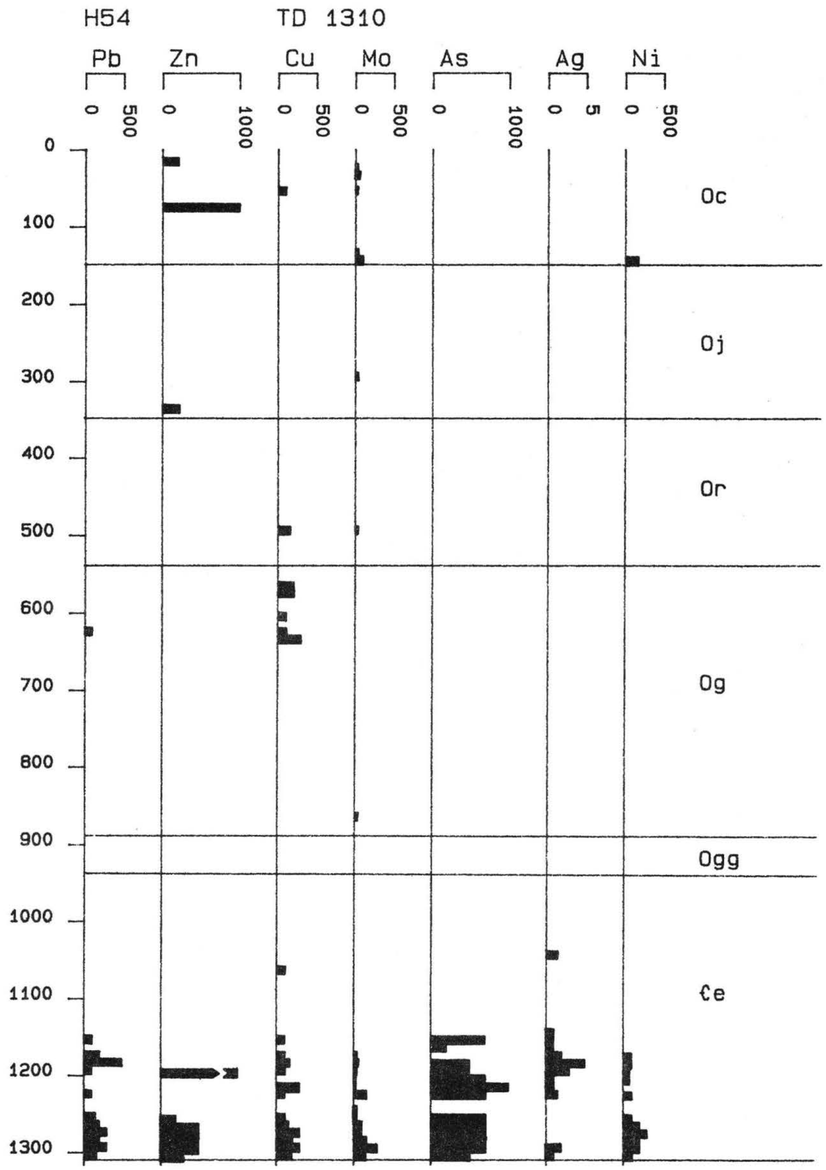
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TD 1310
Pb
Zn
Cu
Mo
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Ag
Ni
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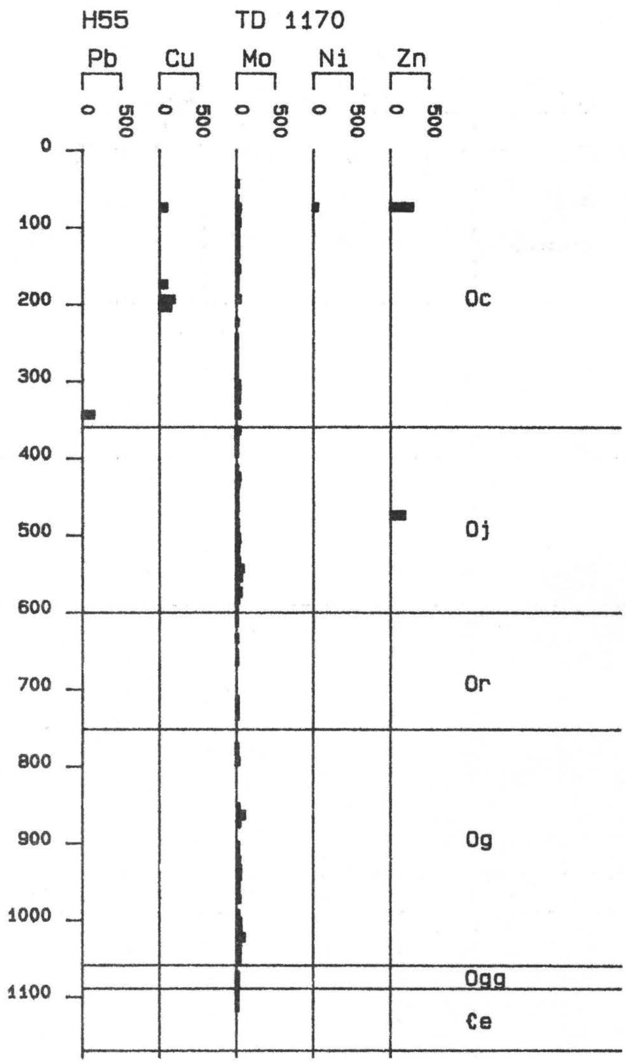
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Pb
Cu
Mo
Ni
Zn
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1100
Oc
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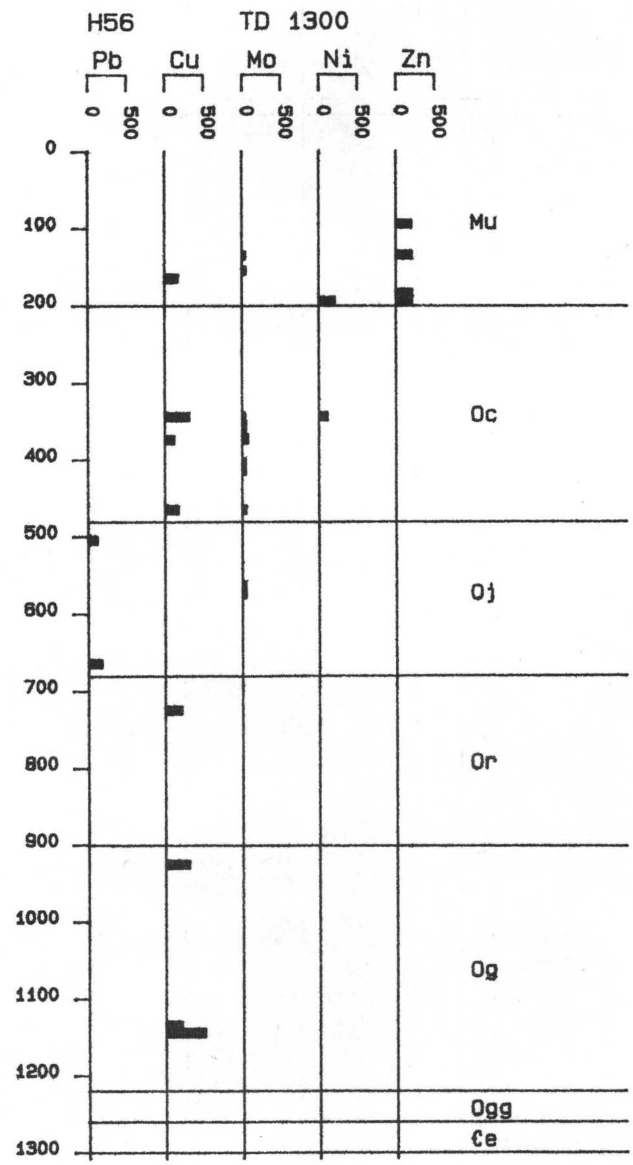
H56
TD 1300
Pb
Cu
Mo
Ni
Zn
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Mu
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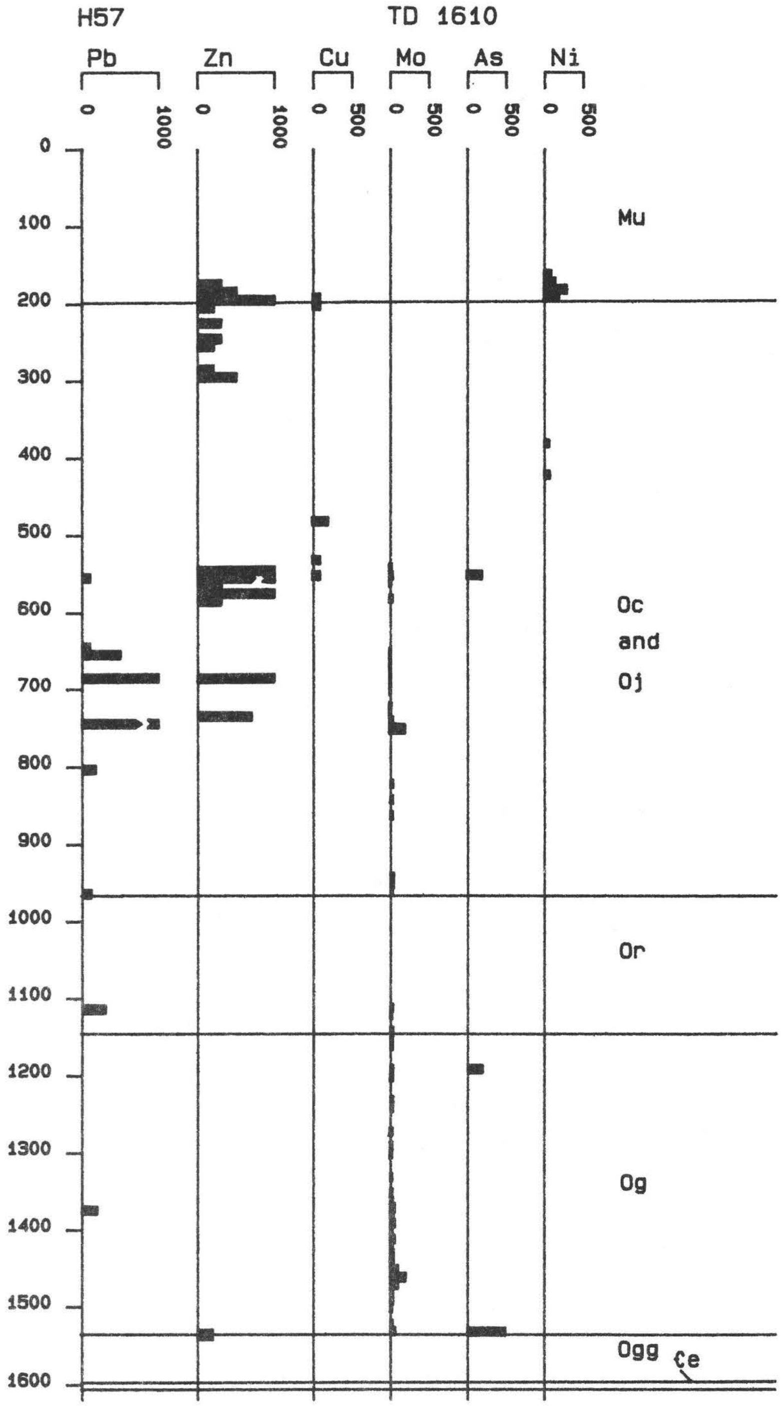
H57
TD 1610
Pb
Zn
Cu
Mo
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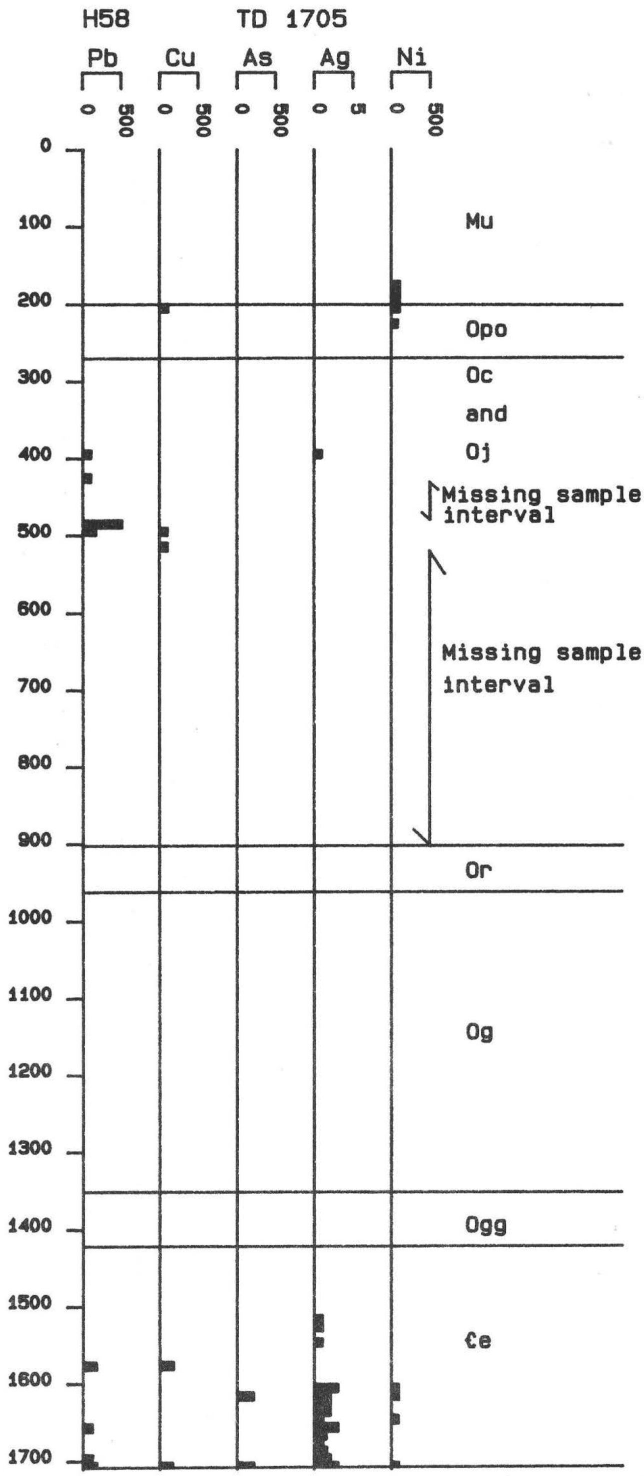
H58
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Pb
Cu
As
Ag
Ni
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and
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Missing sample interval
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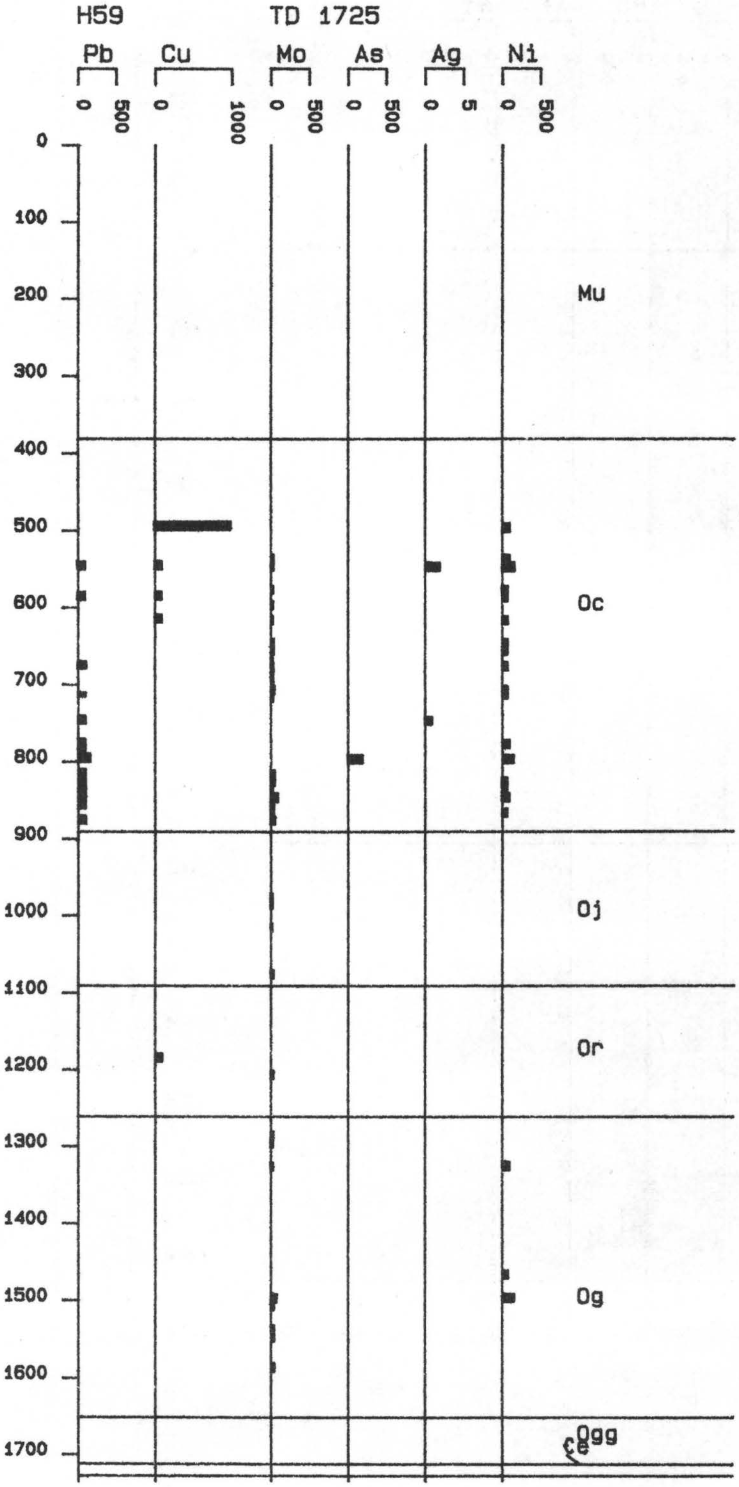
H59
TD 1725
Pb
Cu
Mo
As
Ag
Ni
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0 5
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Mu
Oc
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Or
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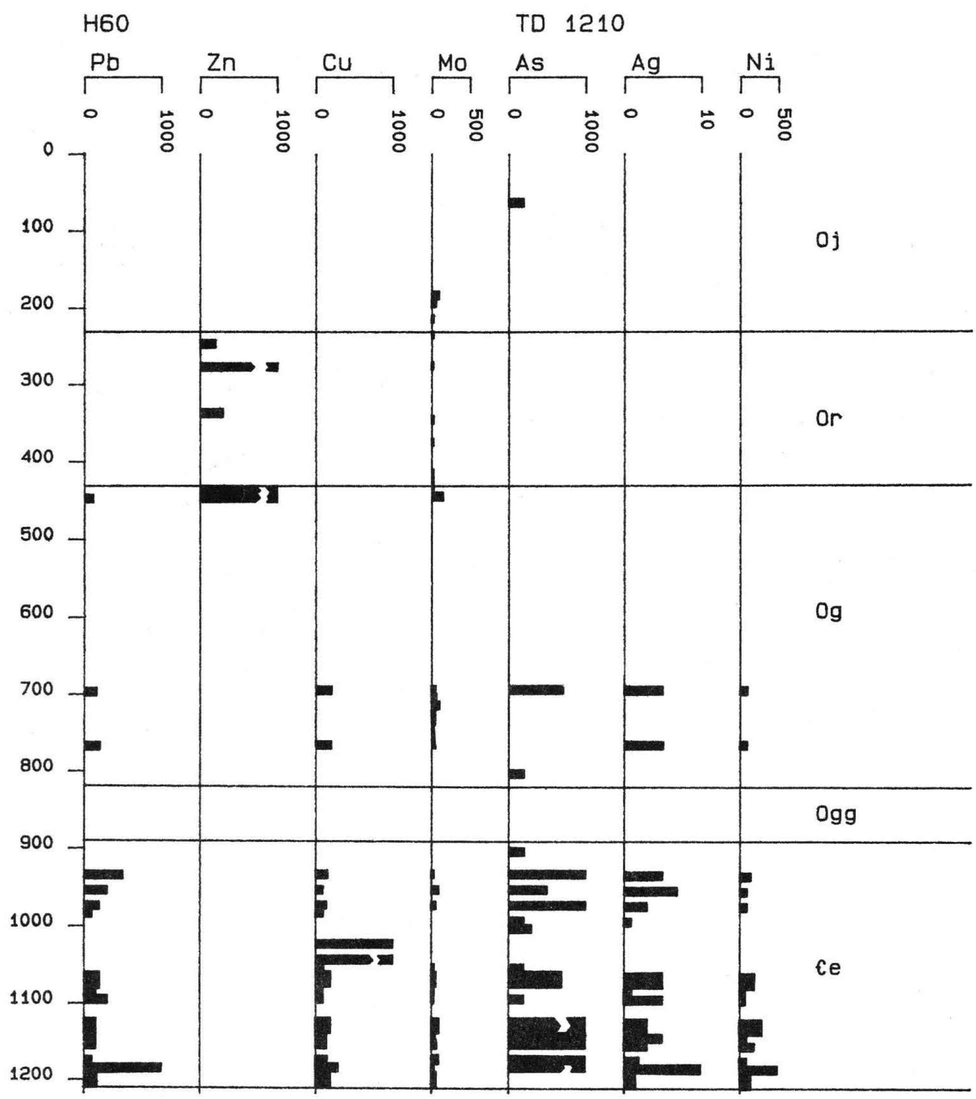
Ce



H60
TD 1210
Pb
Zn
Cu
Mo
As
Ag
Ni
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Or
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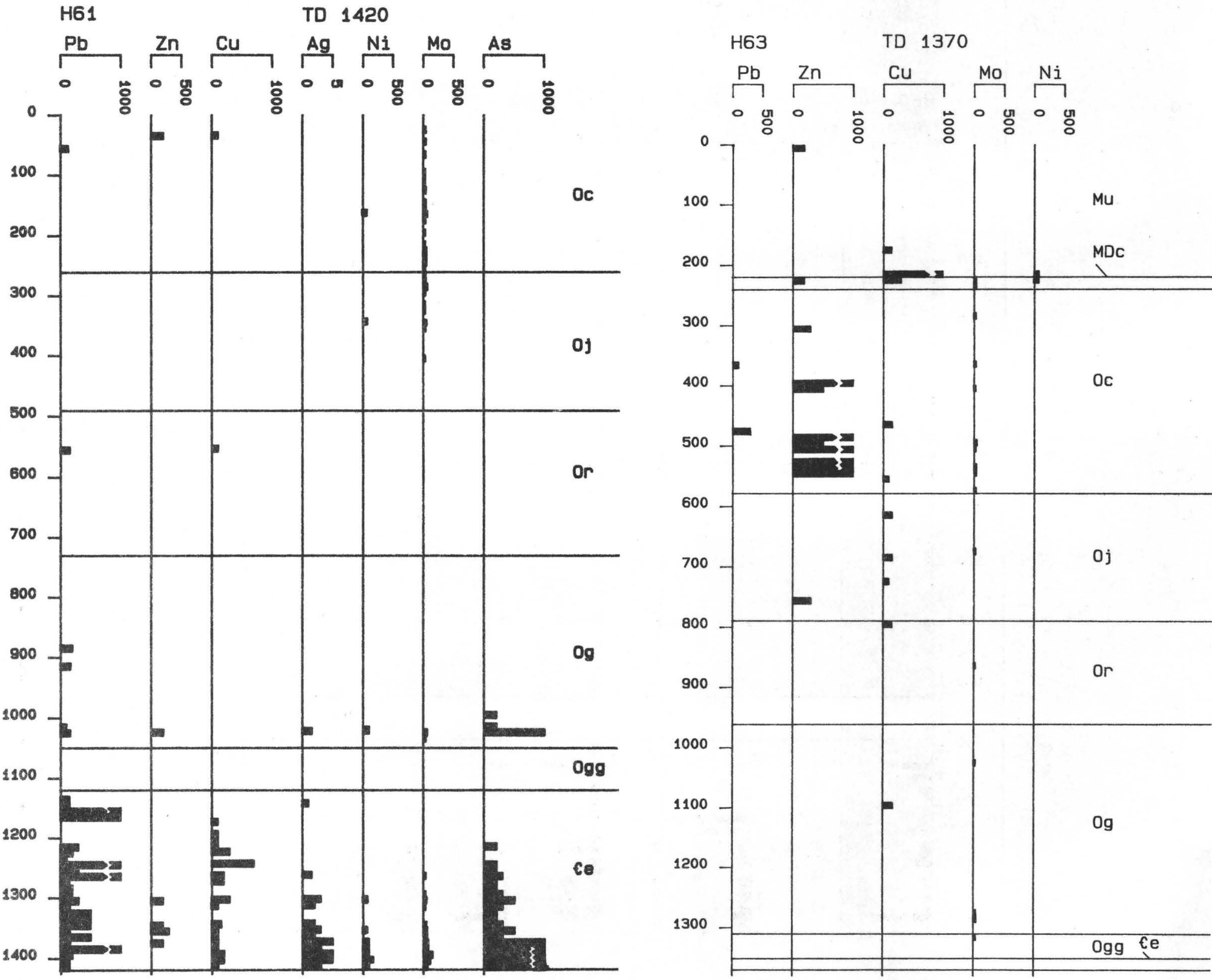
Ce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TD 1420
Pb
Zn
Cu
Ag
Ni
Mo
As
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1000
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Or
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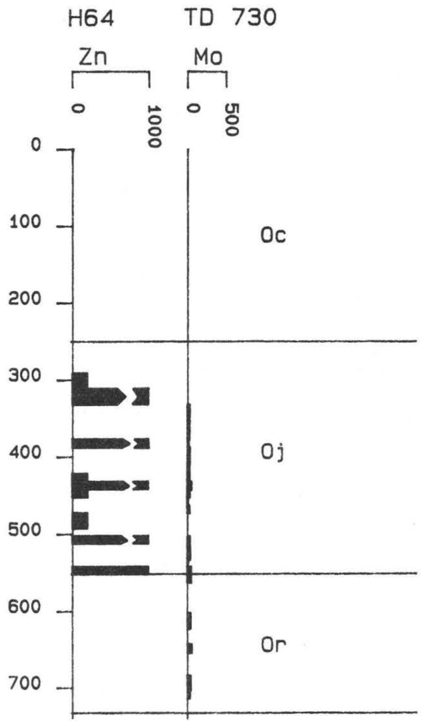
€e
H63
TD 1370
Mu
MDc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Mo
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1000
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500
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200
300
400
500
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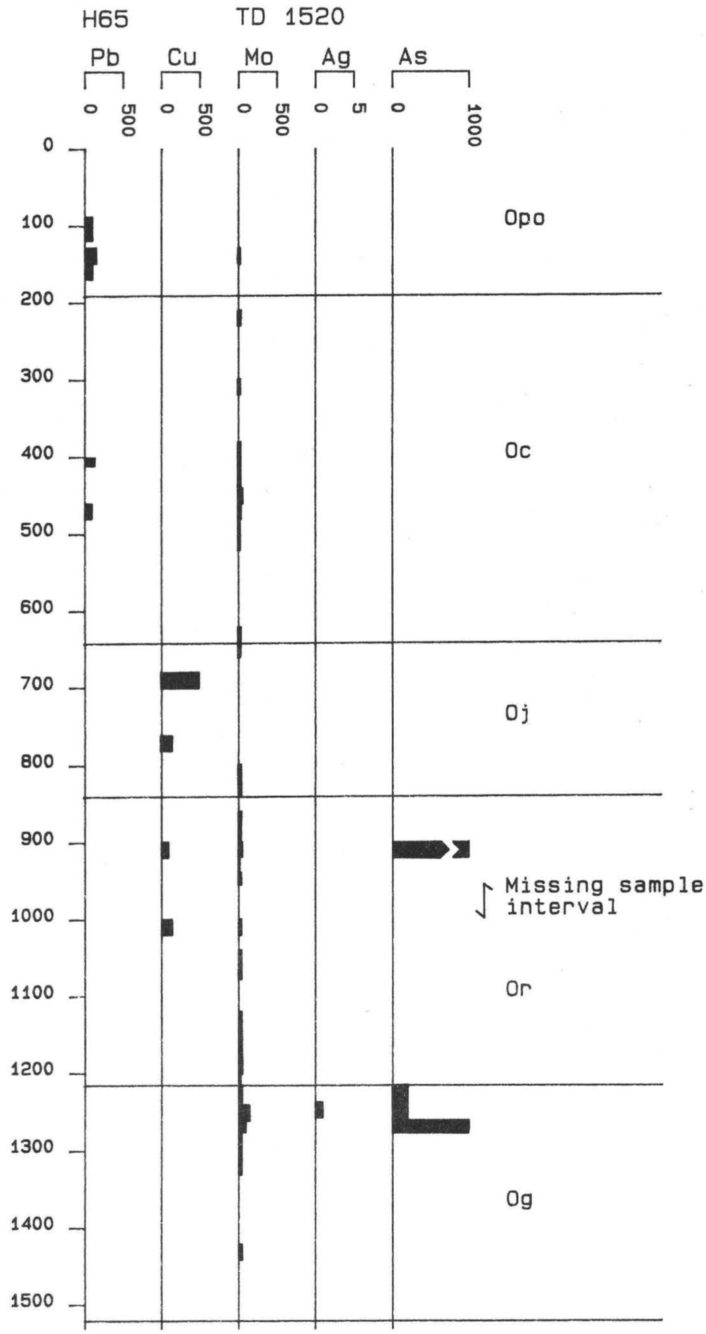
700
Oc
Oj
Or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TD 1520
Pb
Cu
Mo
Ag
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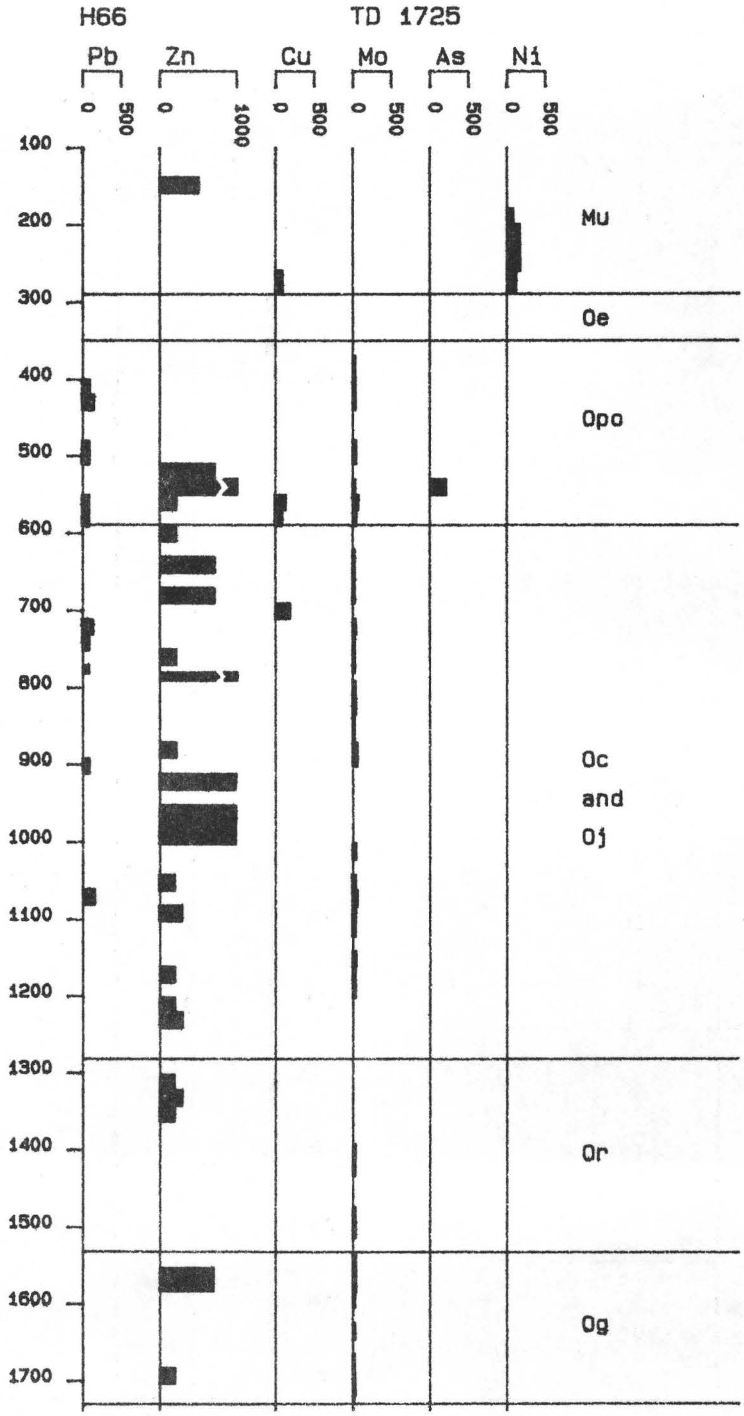
Missing sample interval
Or
Og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Pb
Zn
Cu
Mo
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Ni
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Or
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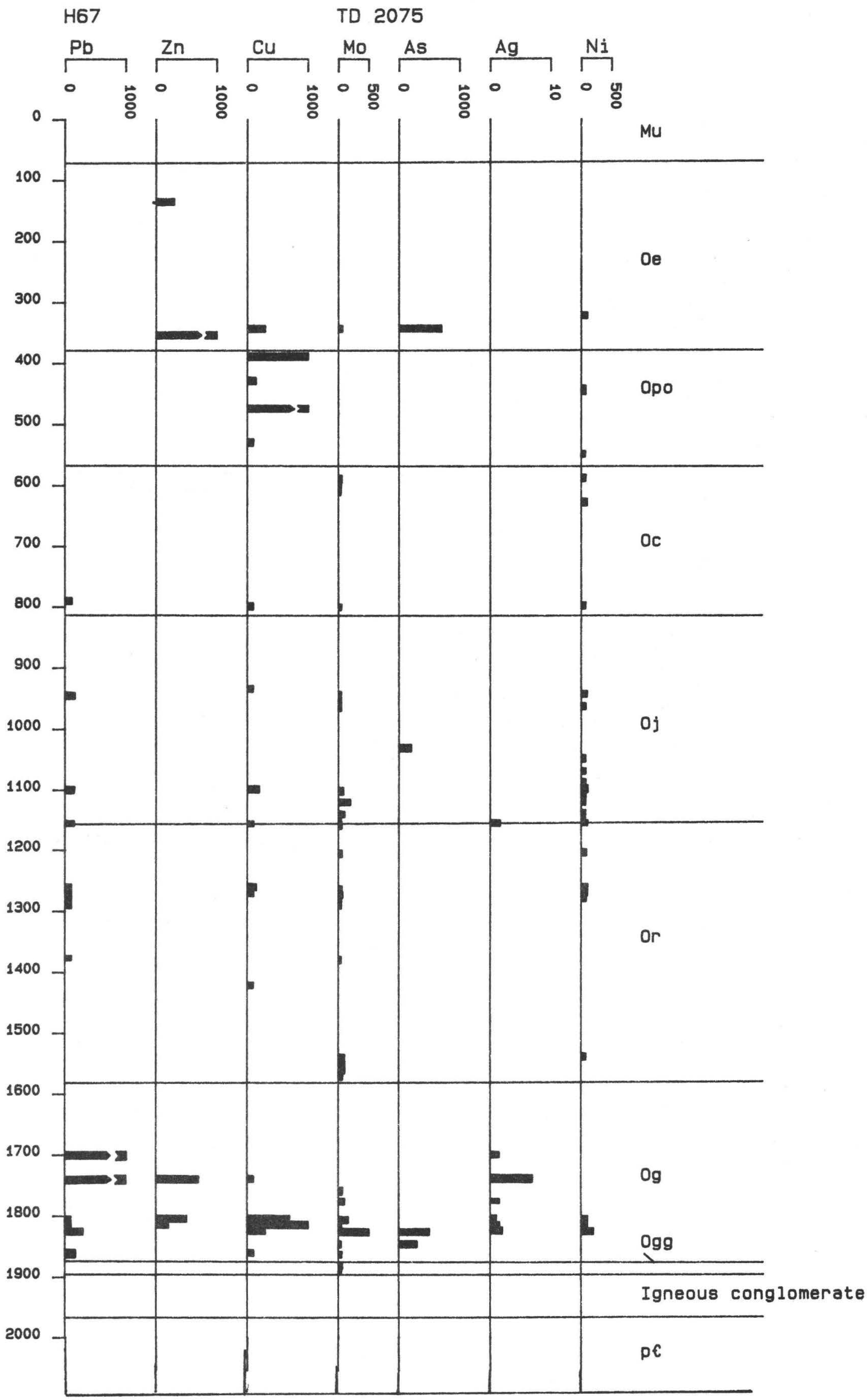
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Pb
Zn
Cu
Mo
As
Ag
Ni
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1000
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Or
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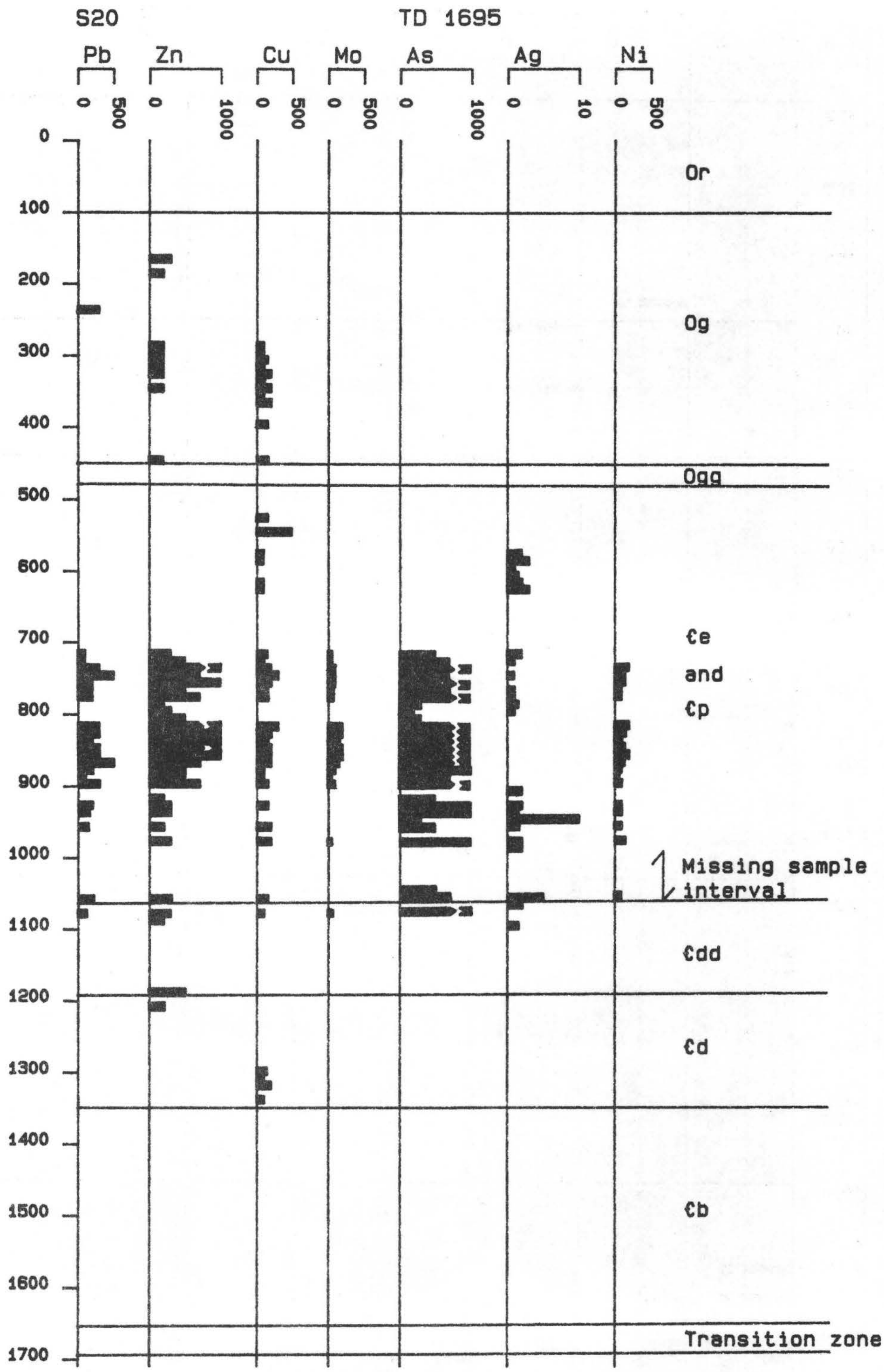
Ogg
Igneous conglomerate
p€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Pb
Zn
Cu
Mo
As
Ag
Ni
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1100
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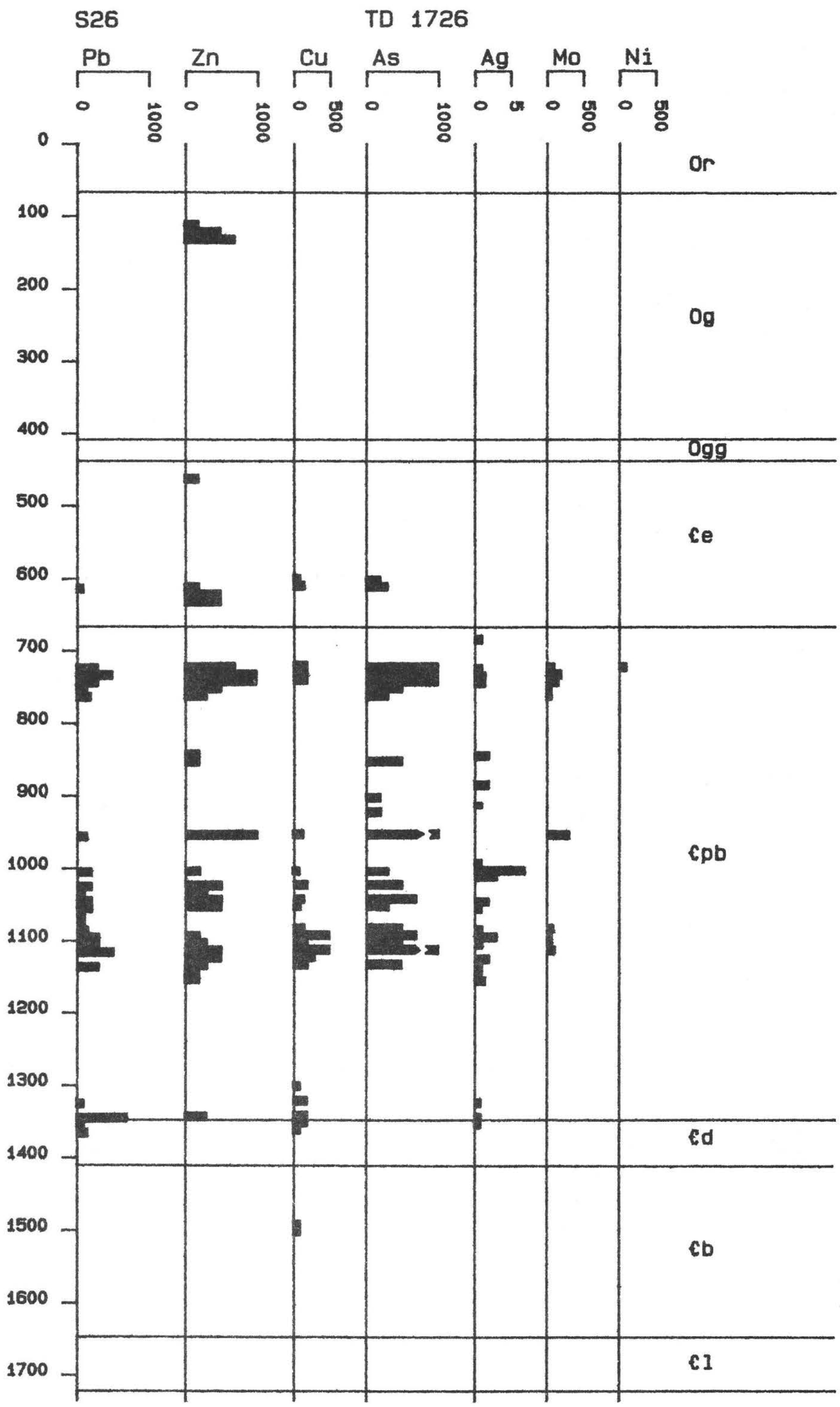
1700
Or
Og
Ogg
Ce
and
Cp
Missing sample interval
Cdd
Cd
Cb
Transition zone


S26
TD 1726
Pb
Zn
Cu
As
Ag
Mo
Ni
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1000
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Or
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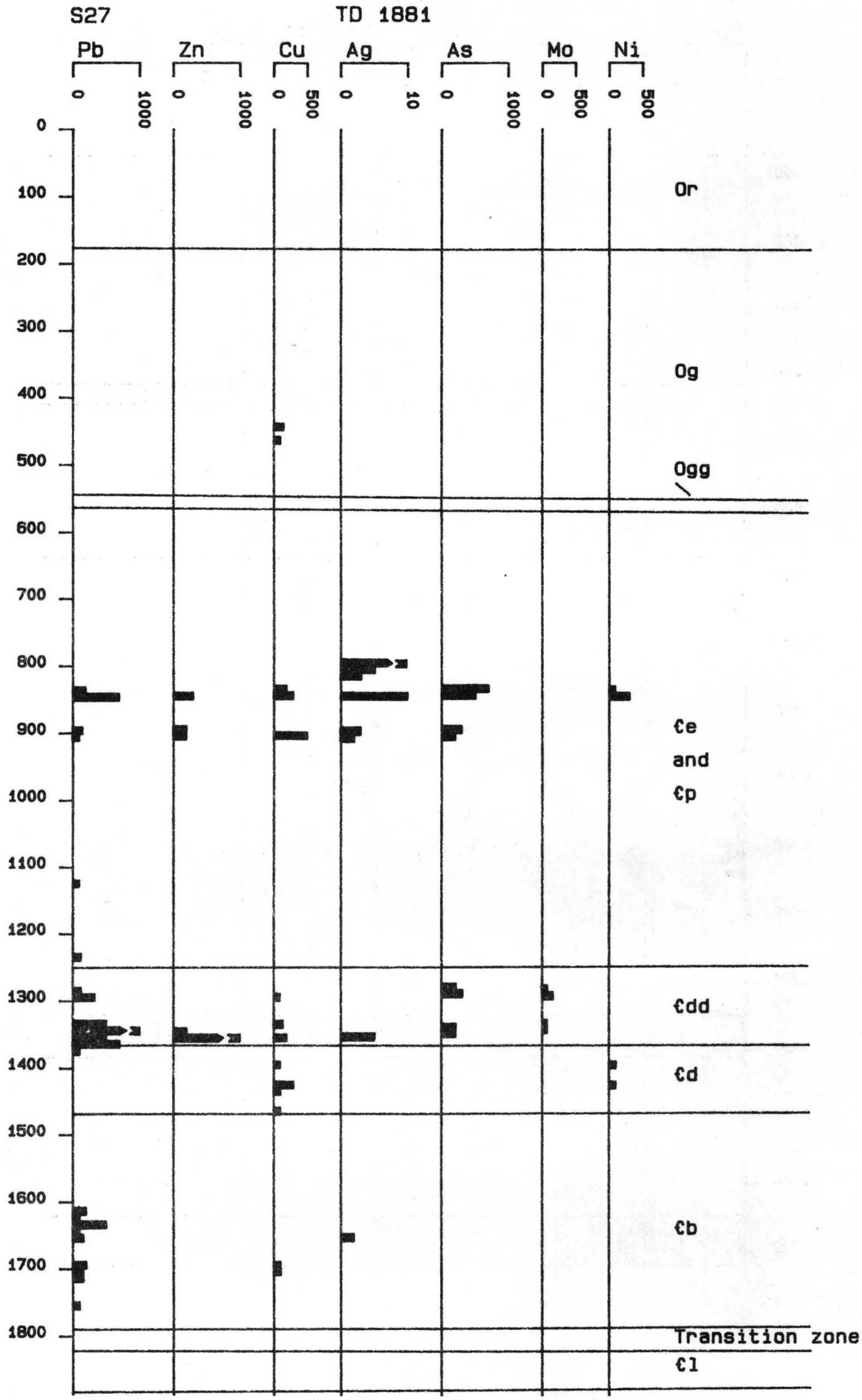
S27
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Pb
Zn
Cu
Ag
As
Mo
Ni
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Or
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and
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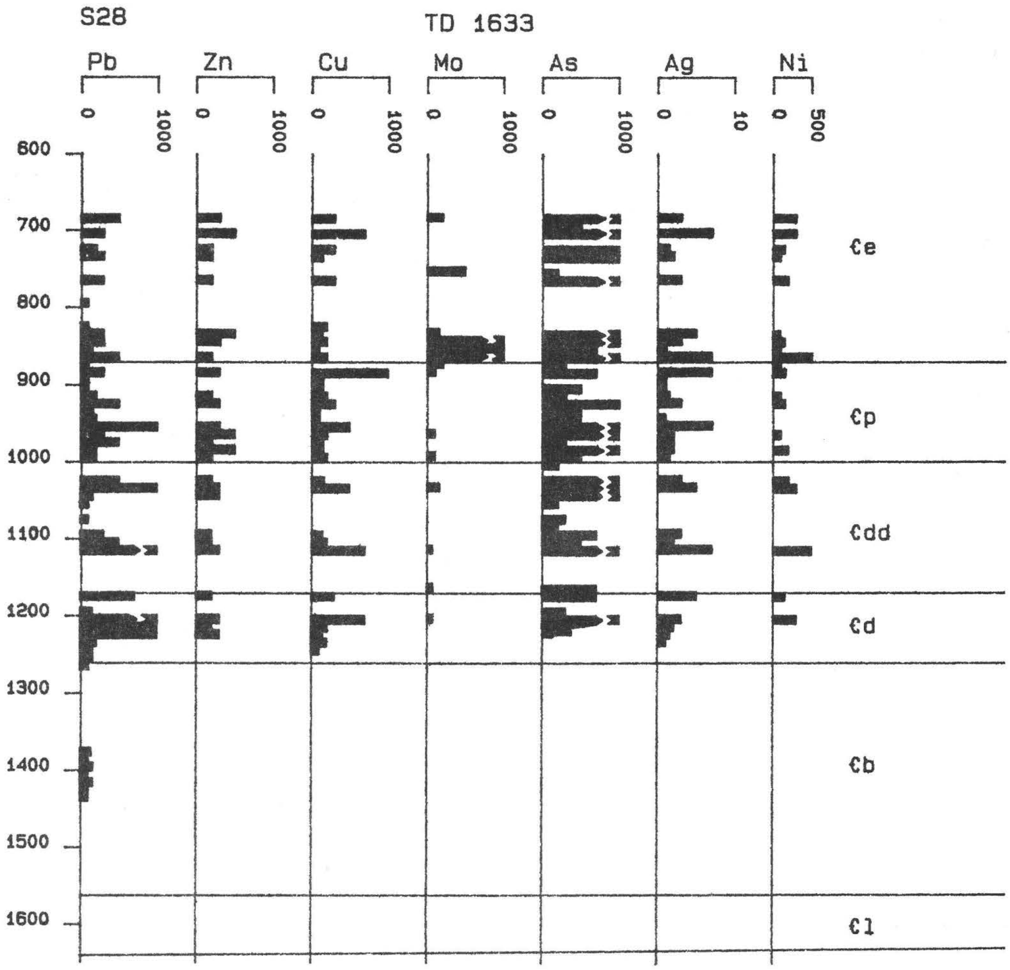
Transition zone
€l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Pb
Zn
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Mo
As
Ag
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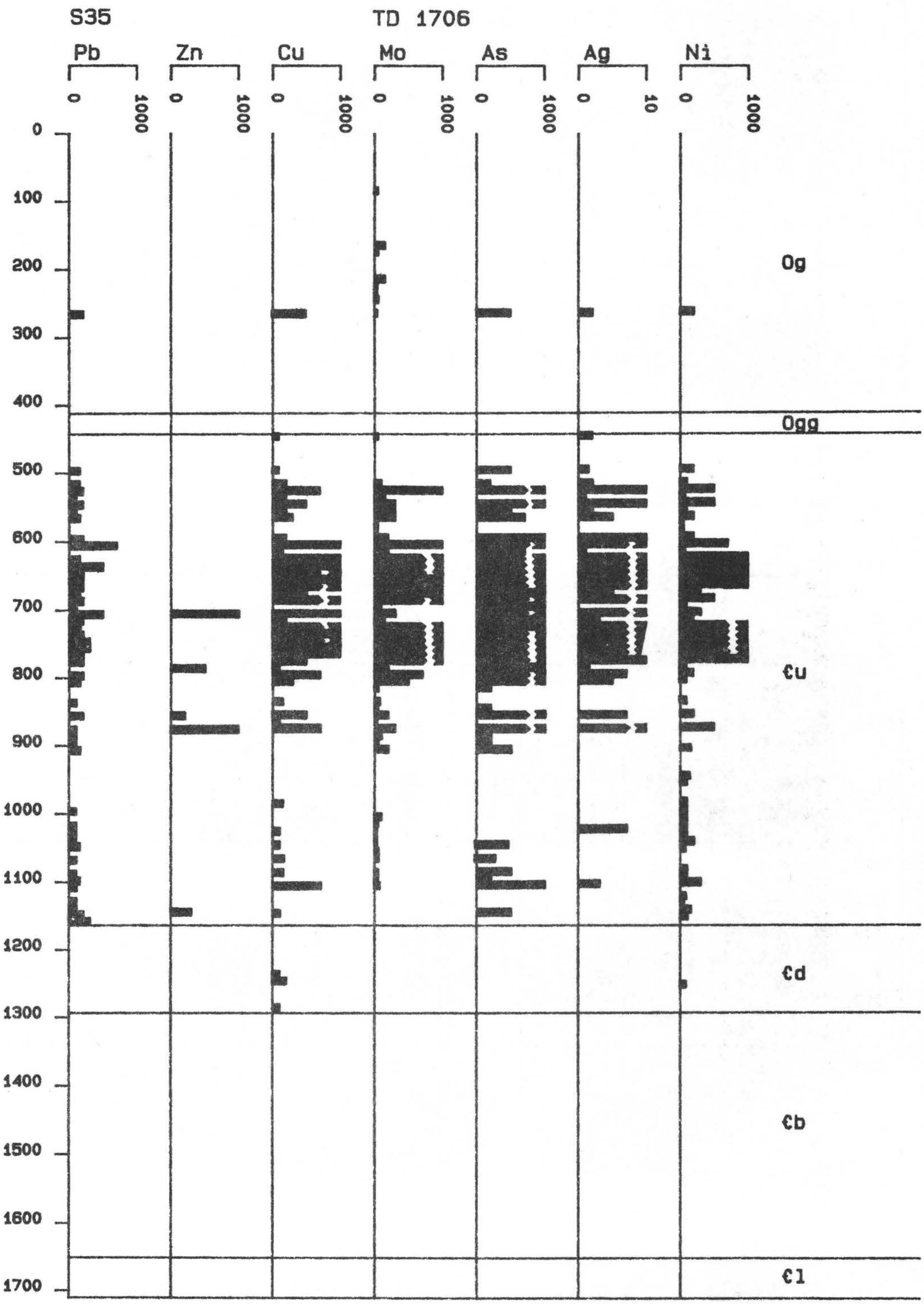
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Pb
Zn
Cu
Mo
As
Ag
Ni
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1000
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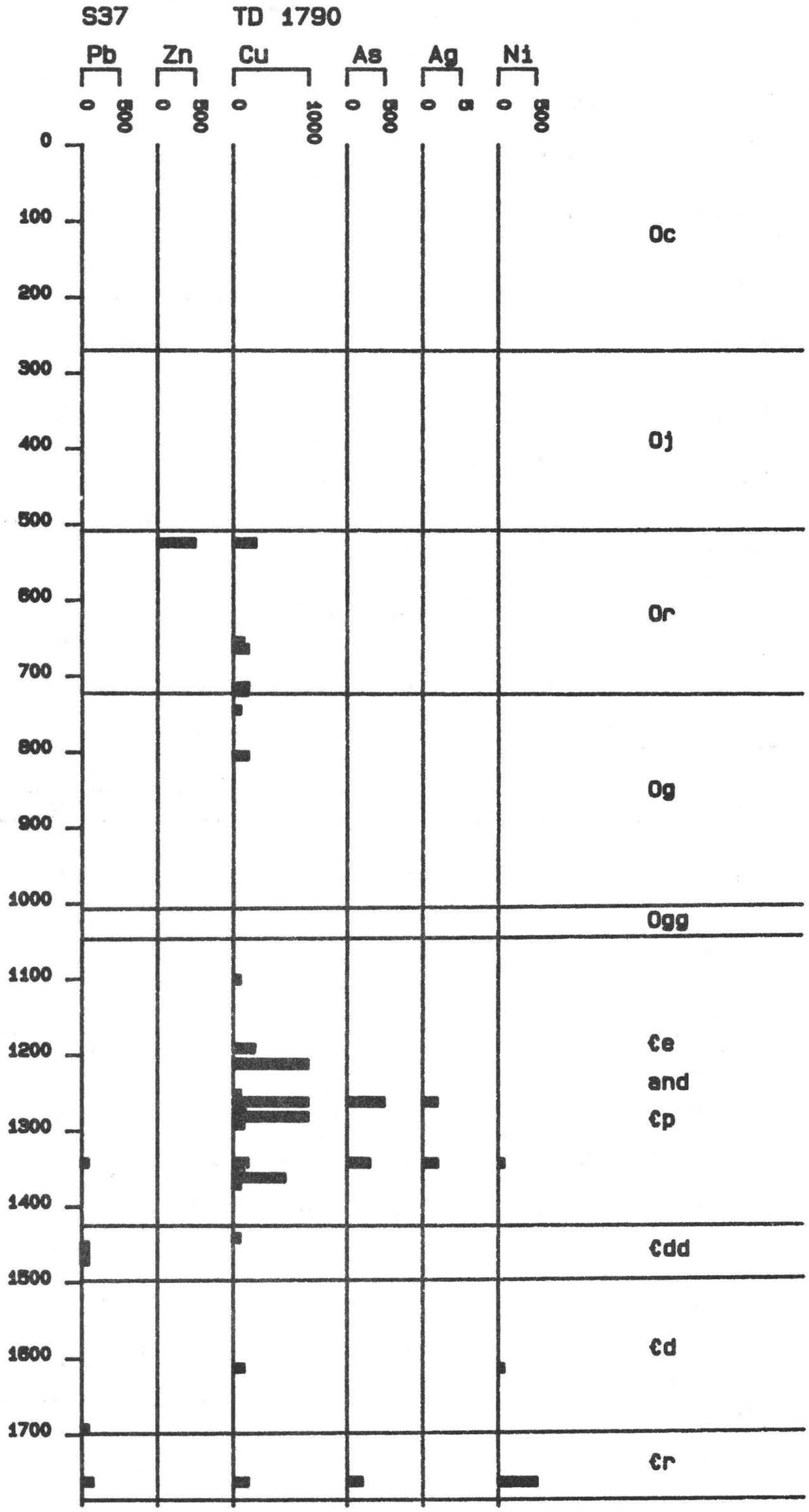
S37
TD 1790
Pb
Zn
Cu
As
Ag
Ni
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Or
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and
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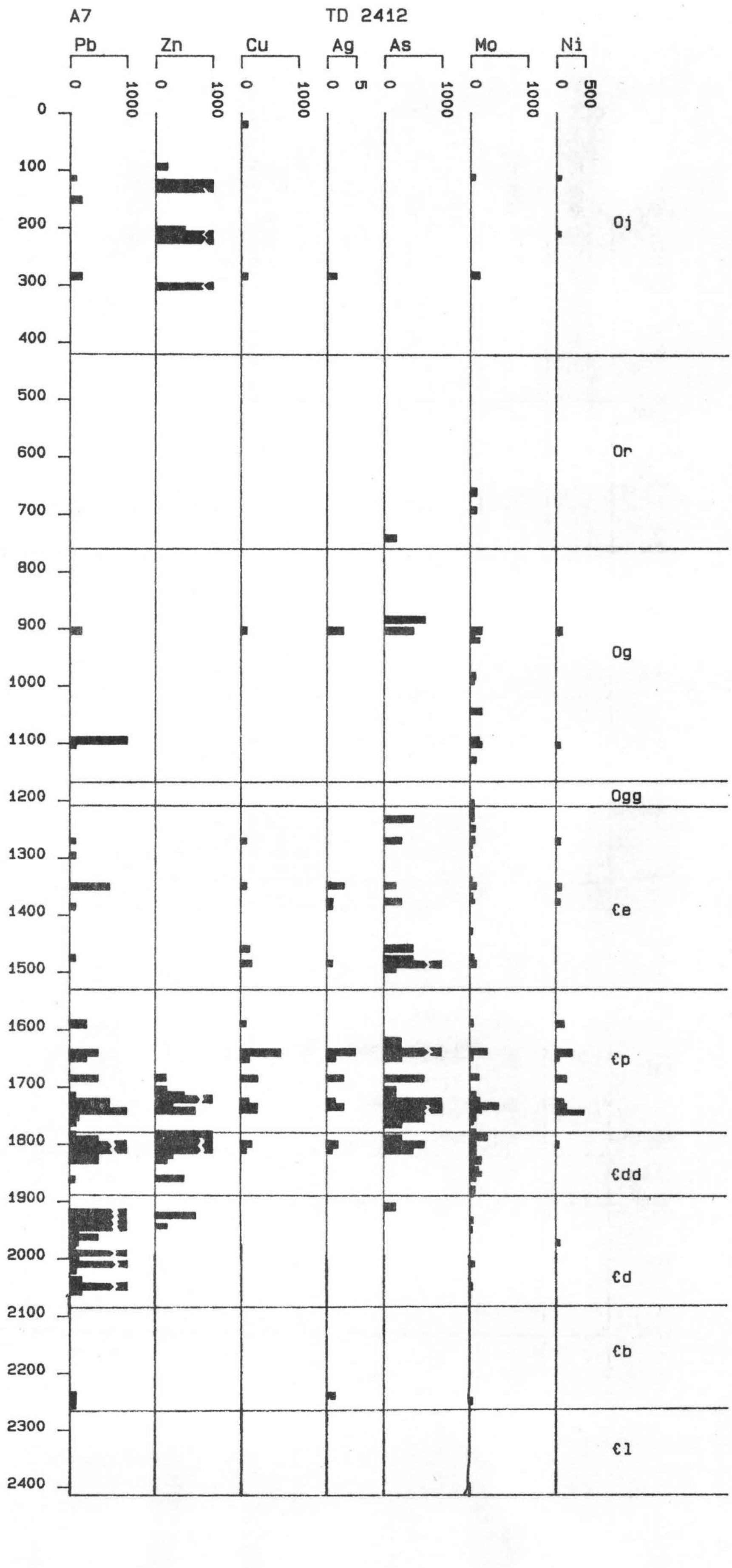
A7
TD 2412
Pb
Zn
Cu
Ag
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Mo
Ni
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Or
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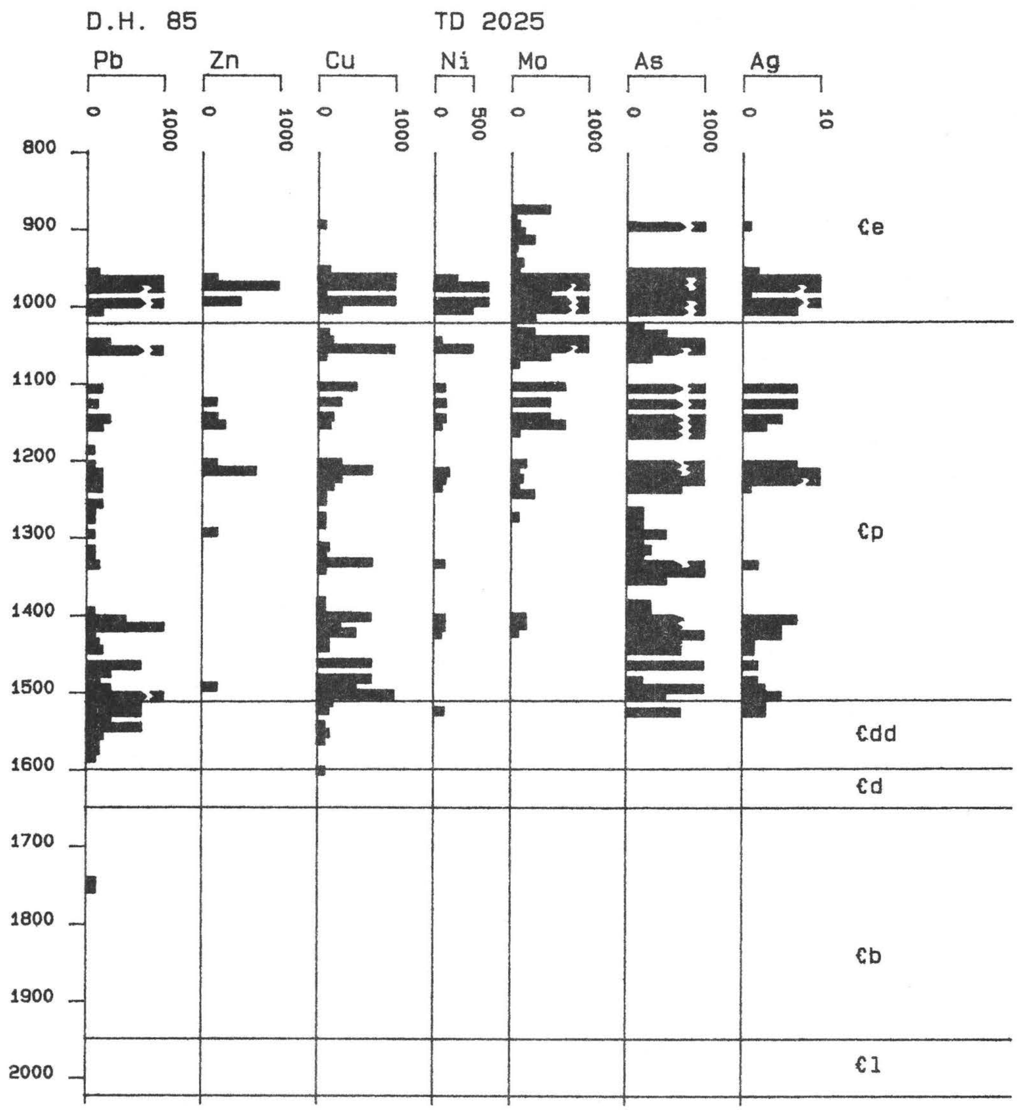
D.H. 85
TD 2025
Pb
Zn
Cu
Ni
Mo
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Ag
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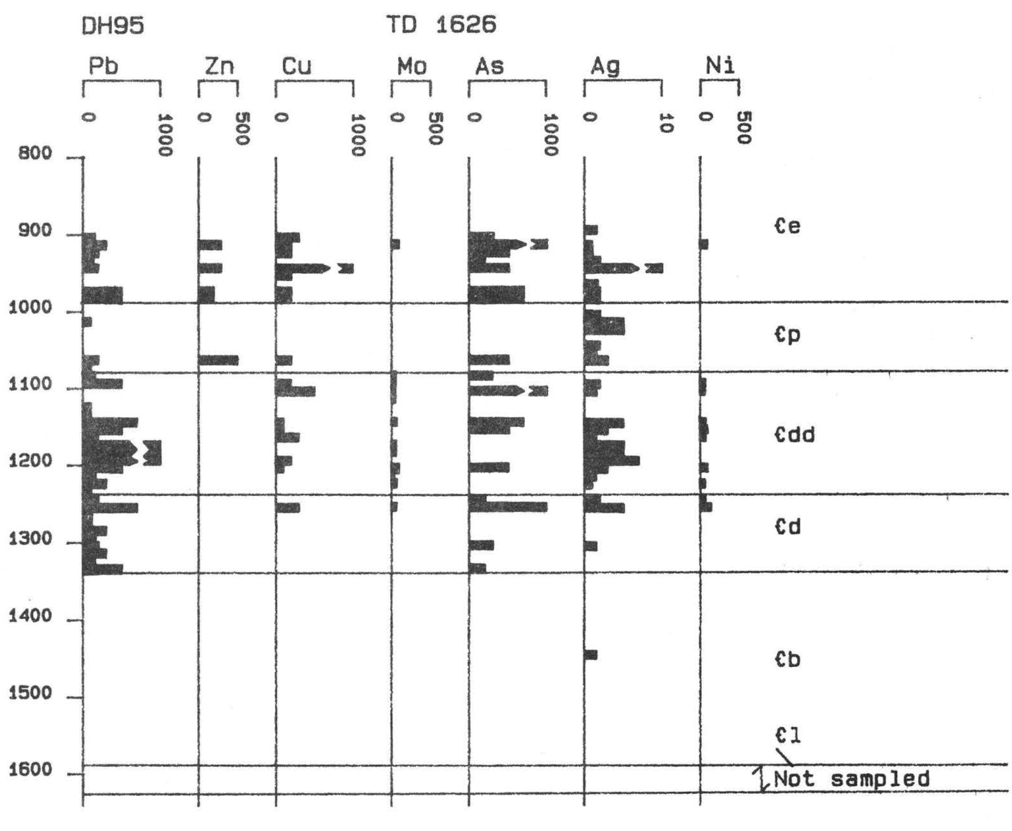
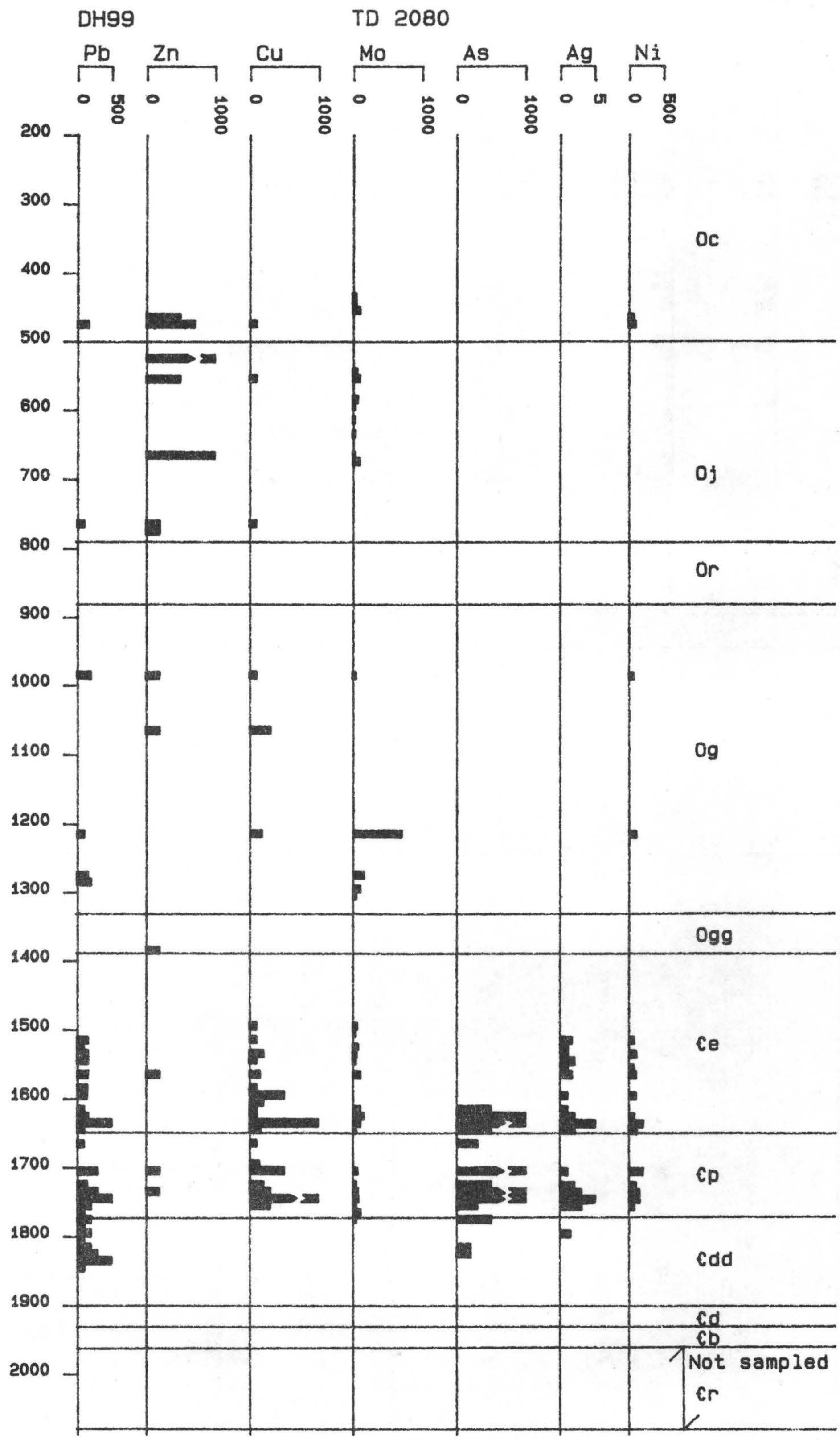
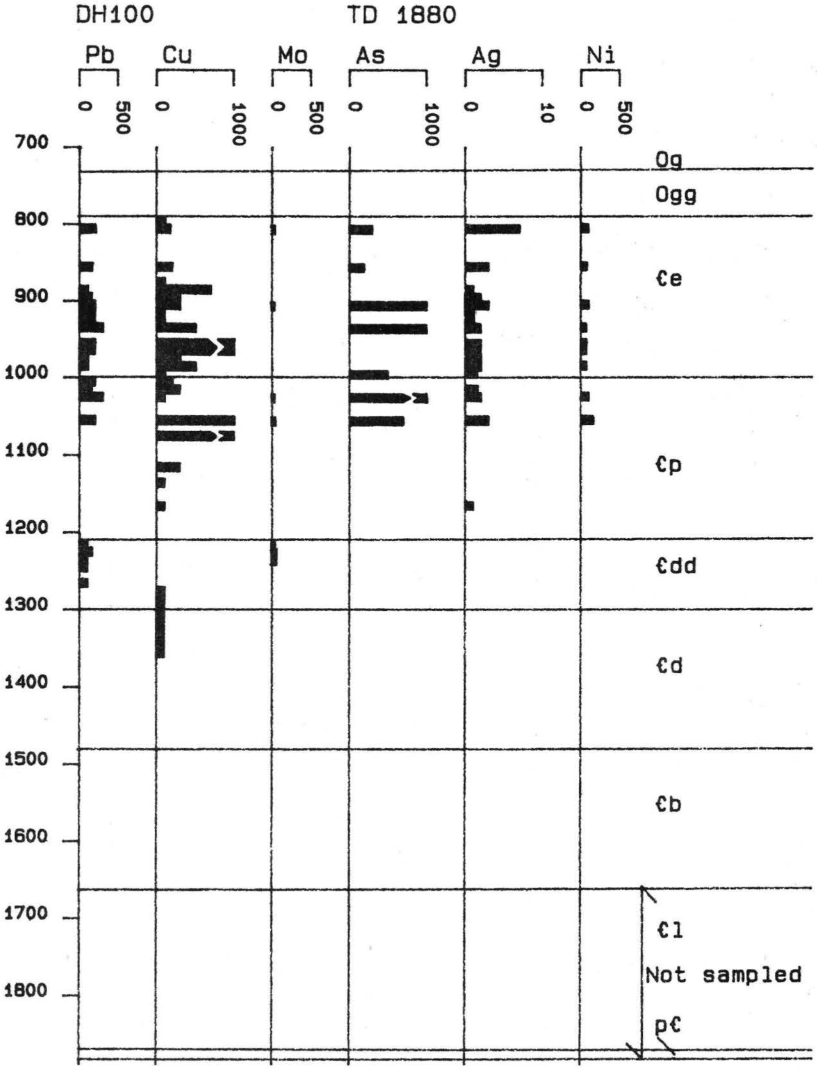
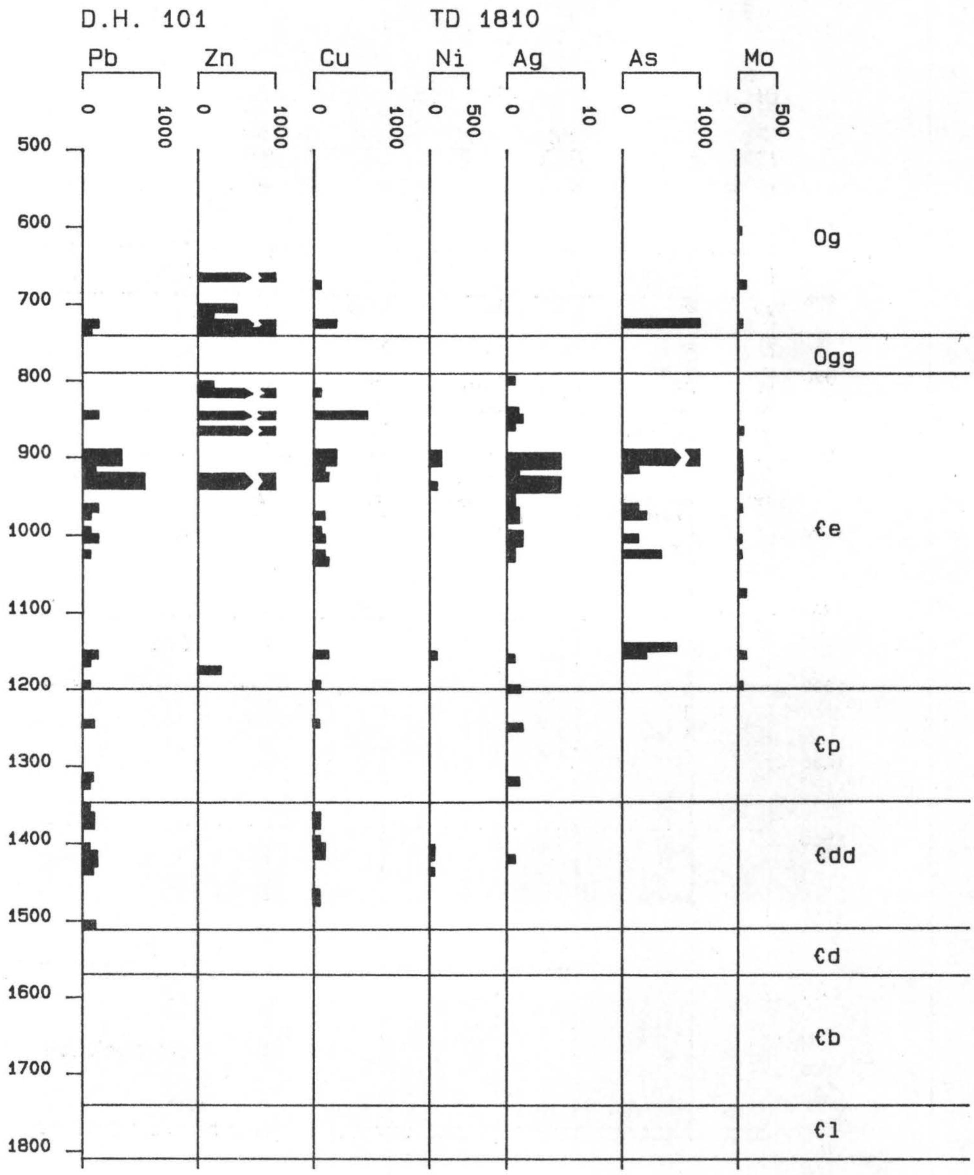
€l


DH95
TD 1626
Pb
Zn
Cu
Mo
As
Ag
Ni
0
1000
500
10
800
900
1000
1100
1200
1300
1400
1500
1600
€e
€p
€dd
€d
€b
€l
Not sampled


DH99
TD 2080
Pb
Zn
Cu
Mo
As
Ag
Ni
0
500
1000
5
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Oc
Oj
Or
Og
Ogg
Ce
Cp
Cdd
Cd
Cb
Not sampled
Cr


DH100
TD 1880
Pb
Cu
Mo
As
Ag
Ni
0 500
0 1000
0 500
0 1000
0 10
0 500
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Og
Ogg
Ꞓe
Ꞓp
Ꞓdd
Ꞓd
Ꞓb
Ꞓl
Not sampled
pꞒ


D.H. 101
TD 1810
Pb
Zn
Cu
Ni
Ag
As
Mo
0
1000
0
1000
0
1000
0
500
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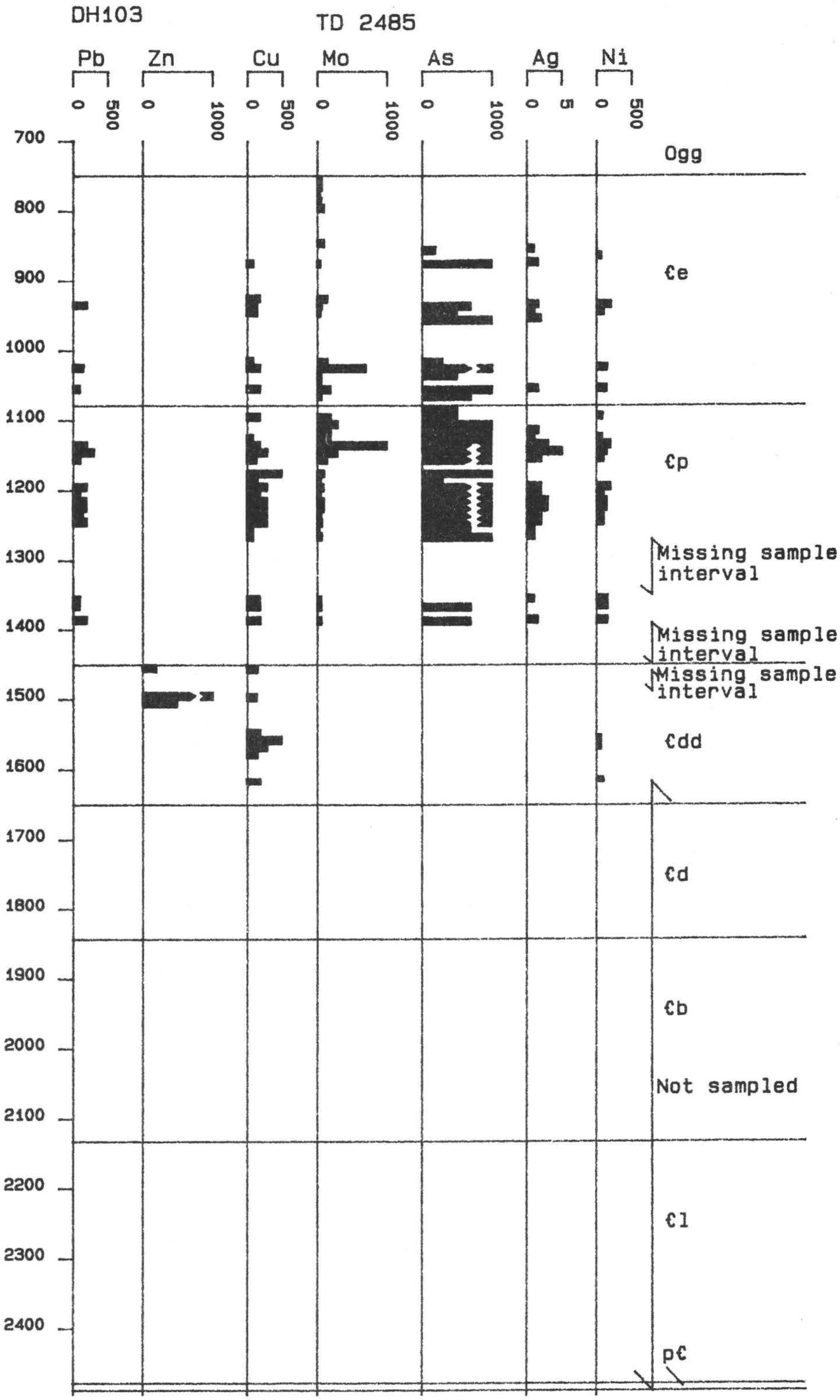
10
0
1000
0
500
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Og
Ogg
€e
€p
€dd
€d
€b
€l


DH103
TD 2485
Pb
Zn
Cu
Mo
As
Ag
Ni
0 500
0 1000
0 500
0 1000
0 1000
0 5
0 500
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
Ogg
Ce
Cp
Missing sample interval
Missing sample interval
Missing sample interval
Cdd
Cd
Cb
Not sampled
Cl
pC