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Brent Pulsipher
Pacific Northwest National Laboratory

December 1990

Letter Report Prepared for
West Valley Nuclear Services by
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Summary

The vitrification facility at West Valley, New York will be used to incorporate nuclear waste into a vitrified waste form. Waste Acceptance Preliminary Specifications (WAPS) will be used to determine the acceptability of the waste form product. These specifications require chemical characterization of the waste form produced. West Valley Nuclear Services (WVNS) intends to characterize canister contents by obtaining "shard" samples from the top of the canisters prior to final sealing.

A study was conducted to determine whether shard samples taken from the top of canisters filled with vitrified nuclear waste could be considered representative and therefore used to characterize the elemental composition of the entire canister contents. Three canisters produced during the SF-12 melter run conducted at WVNS were thoroughly sampled by core drilling at several axial and radial locations and by obtaining shard samples from the top of the canisters. Chemical analyses were performed and the resulting data were statistically analyzed by Pacific Northwest Laboratory (PNL). The following general conclusions were derived.

- The chemical compositions derived from the shard samples were not statistically different from those derived from core samples, with the exception of chromium and nickel. Therefore, chemical analyses performed on shard samples are representative of the canister contents.

- For chromium and nickel, the shard concentrations were higher than the core sample concentrations. This result is not very troublesome because the weight percents for these two elemental oxides are <0.25%, which exempts them from the WAPS 1.1.2 requirement for reporting because they have no significant effect on waste acceptance.

- No linear trends were observed within the canisters (from top to bottom), with the exception of barium and zinc which were employed as tracers during run SF-12. This suggests that process variations during the SF-12 run were appropriately controlled.

- Statistically significant batch-to-batch variations (differences between Melter Feed Tank (MFT) batch compositions) were detected for many of the elemental constituents. These batch variations were quite small but were detectable due to the many samples obtained.

- For the major elemental constituents (wt% > 0.5%), the within canister relative standard deviations (RSD) were less than 3.5%, with the exception of magnesium (RSD=14%) and potassium (RSD=5.3%). This RSD includes analytical, sampling, axial, and radial variations.

If one can assume that the process controls employeed by WVNS during the SF-12 run are representative of those to be employeed during future melter runs, shard samples can be used to characterize the canister contents. However, if batch-to-batch variations cannot be controlled to the acceptable levels observed from the SF-12 data, the representativeness of shard samples will be in question. The estimates of process and within-canister variations provided herein will prove valuable in determining the required frequency and number of shard samples to meet waste form qualification objectives.

Introduction

Nuclear waste residing at West Valley, New York will be blended with glass-forming chemicals and be subjected to a ceramic melter. The vitrified product will be poured into canisters to be deposited in a geological repository. The glass waste form must meet specifications previously outlined in the Waste Acceptance Preliminary Specifications (WAPS). In order to demonstrate acceptability of the waste form, West Valley Nuclear Services plans on sampling and analyzing the glass product. The frequency and number of samples required to meet the specifications are being determined. This report deals with the logistics of obtaining a representative glass sample from a canister.

It is not feasible to obtain "random" samples from the canisters by core drilling at specific locations because this type of sampling would compromise the integrity of the canister and would increase the likelihood of water contacting the waste form. Likewise, obtaining grab samples from the pour stream would require a significant redesign of existing equipment. A more promising alternative is to obtain a "shard" sample from the top of the canister prior to permanent closure. However, a characterization of the canister contents from an analysis of the shard sample requires the demonstration that the shard sample is a representative sample from the canister.

An experiment to evaluate and demonstrate the representativeness of the shard samples was designed by PNL and WVNS. Samples were obtained and chemical analyses performed at WVNS. A statistical analysis of the data was then conducted at PNL. This report summarizes the findings of the statistical analysis and documents this experimental evaluation. It should be noted that this analysis applies only to the WVNS process. However, under several assumptions, the results may be applicable to other DOE waste-producing vitrification plants.

Experimental Design

Canister Selection

The WVNS melter is continuously fed from the MFT. Replenishing of the MFT contents is performed on a batch basis. One MFT batch will be converted to approximately 4 canisters of vitrified waste form. Regardless of the amount of control imposed on the feed makeup process, each MFT batch composition will be slightly different. Figure 1 is a hypothetical illustration of how variations in the MFT batch composition would be manifest in the waste glass being poured into the canisters.

As a new MFT batch of material is initially fed into the melter, the composition of the glass product begins migrating from the previous MFT batch composition to the new MFT batch composition (as represented by the curved lines in Figure 1). The waste product in the first canister filled after initiating the new MFT batch feed may contain an amount of material produced from the previous MFT batch as well as some mixture of the old and new batch materials. Thus, the final pours to the first canister could be represented by the first few tickmarks for a given MFT batch in Figure 1.

The waste form in the third and possibly fourth canisters filled would be more representative of the new MFT batch composition as shown by the leveling off portion of the curves in Figure 1. Thus, compositional differences between the waste product at the top of the canister and the bottom of the canister may not be very pronounced.

The material poured into the second canister filled after initiating a new MFT batch would be transitioning from the previous MFT composition to the new MFT composition. If significant differences exist between MFT batch compositions, these differences will be manifest by differences in composition within the second canister. The differences between the waste product composition at the top of the canister and the composition at the bottom of the canister is expected to be largest for the second canister (the greatest slope of the transitioning curve in Figure 1 would probably occur within the second canister).

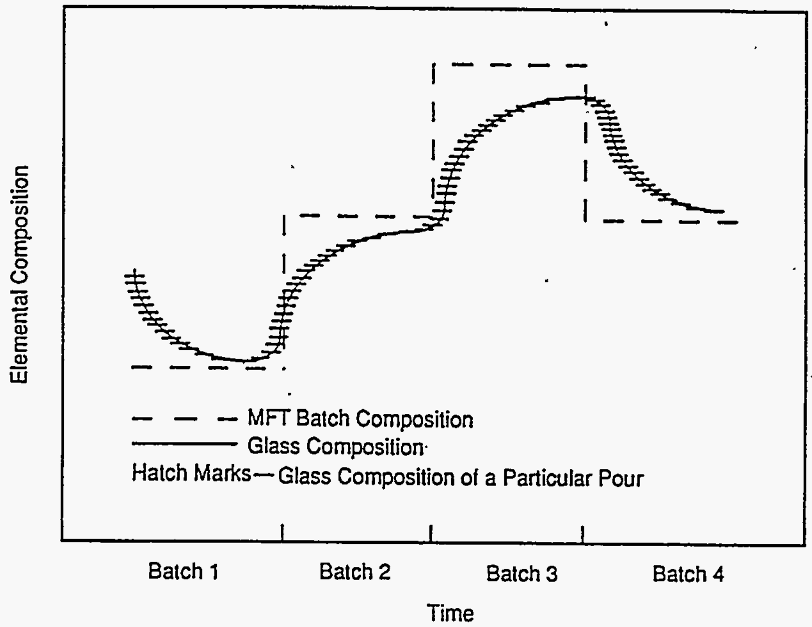


FIGURE 2. Hypothetical Illustriation of Effect of MFT Batch Compositional Differences

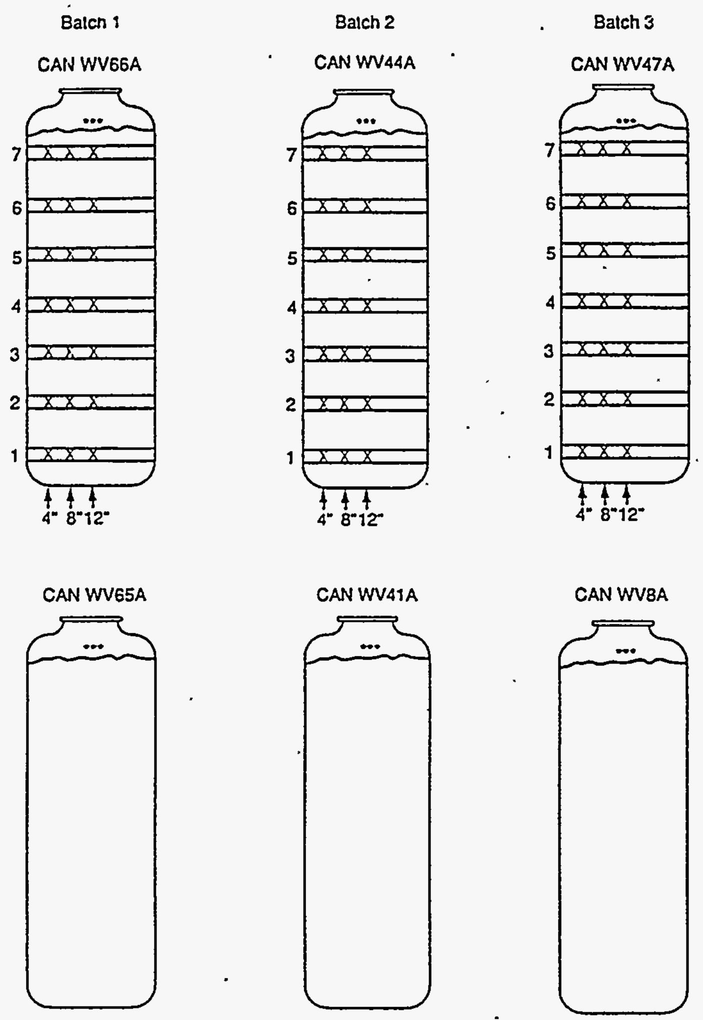
The objective of this study was to determine whether a shard sample taken from the top of a canister is representative of the entire contents of the canister. Based on the above discussion, it was determined that if a shard is not representative of the canister contents, the differences between the shard sample composition and the canister contents would be most pronounced within the second canister filled after initiating a new MFT batch. Thus, the variations within the second canisters represent a worst case scenario.

In the Fall of 1989, WVNS conducted an integrated melter run (SF-12) which produced approximately 15 canisters from three MFT batches. Control of the process was somewhat typical of that expected during future operations. Therefore, the batch-to-batch variations existing in the SF-12 run are representative of those which would occur during future operations. The second canisters produced (Cans 66A, 44A, and 47A) after initiating each of the three batches were chosen to evaluate the representativeness of shard samples. Shard samples were obtained from each canister produced and core samples were obtained from each second canister. The sampling schemes for each canister are outlined in the next section. It should be noted that Ba and Zn concentrations were purposely varied from batch-to-batch during the SF-12 run, so that they could be used as tracer elements.

Sampling Scheme

The objectives of this study required that samples be obtained from canisters in a systematic manner. Core samples must be representative of the entire canister contents. If samples were obtained only on the outside edge or near the bottom of each canister, characterization of the canister contents based on those samples could be questioned. Moreover, a sufficient number of samples are required to adequately characterize the canister contents. Sample locations were chosen to maximize the amount of information that could be derived through statistical analysis while minimizing the sampling and analysis effort.

Each of the three canisters chosen for this study were core drilled and glass specimens were obtained from the core samples (see WVNS-TRQ-021 and WVNS-TP-021 for more details). Approximately 50 grams of glass were obtained at the 4, 8, and 12 inch radial locations for each core drill axial location. Each canister was core drilled at seven axial locations. The seven axial locations were determined such that material from every other airlift would be sampled. A schematic of the sampling scheme is shown in Figure 2. This sampling scheme permits an analysis of the radial variations and the axial variations within each canister, which are descibed in the statistical analysis section of this report. Three shard samples were also taken from each canister, as indicated in Figure 2.



* - Shard Samples
X - Core Samples

FIGURE 3. Sampling Scheme for Core Drilling and Shard Samples

In addition to shard and core samples from canisters 66A, 44A, and 47A, three shard samples were obtained from each canister immediately preceding each of the three canisters chosen for core drilling. These preceding shard samples should be similar in composition to the core samples taken from the bottom of the core drilled canisters.

A total of 81 glass samples were available for analysis (3 canisters * 7 axial locations * 3 radial locations + 6 canisters * 3 shards per canister). Each of the 63 samples obtained from core drills were analyzed in duplicate, which resulted in a total of 144 chemical analyses. All chemical analyses were performed at WVNS and the data was delivered to PNL for statistical analysis.

Statistical Analysis Approach

Chemical analyses were performed on the shard and core samples and reported as normalized oxide weight percents. Twenty-three elemental oxides were reported. This data was received by PNL and entered into a data base in a format that would facilitate statistical analysis.

In order to determine the appropriate statistical methods and models to be applied, an understanding of the experimental setup and uncertainties was necessary. A major hypothesis for this study was that the sample-to-sample and analytical variations would be sufficiently large relative to the differences between the compositions at various axial locations that these axial variations would be negligible. To test this hypothesis, an estimate of the sampling and analytical uncertainty was required. The analytical laboratory at WVNS randomized the analysis of the core samples, but conducted the duplicate analyses of each core sample sequentially. Thus, the variation between duplicate core sample analyses represents a very short-term analytical uncertainty. This short-term analytical variation would not be the appropriate measure of uncertainty to test the hypothesis of axial variations because the variations between compositions at different axial locations includes sample-to-sample variations, long-term analytical variations, and axial differences.

The variation in composition between the 4-, 8-, and 12- inch radial samples taken at a particular axial location includes sample-to-sample variations, analytical variations, and radial variations. By treating the samples obtained from the three radial locations as random samples taken from the same axial location and assuming no consistent radial effect, the radial component of variation provides the estimate of sampling and analytical uncertainty required to test the above hypothesis. The assumption of no radial effect was examined and appears to hold true. Also, a comparison of sampling and analytical relative standard deviations (RSDs) derived from previous experiments compared favorably with the (RSDs) from radial and analytical variations observed herein (see Table 3).

The statistical technique of analysis of variance was performed to meet the following objectives:

1) Determine whether shard sample composition is significantly different from core sample compositions, and if such differences are consistent from batch-to-batch.

2) Determine whether there are significant batch-to-batch differences in composition.

3) Estimate short-term analytical and sample variations.

In the statistical analyses, the shard samples were treated as samples taken from other axial locations. The shards from the top of the canister immediately preceding the core drilled canister were treated as samples obtained below the bottom set of core samples. The shards from the top of the canister that was core drilled were treated as samples obtained above the top set of core samples. Thus, instead of seven axial locations, for the purposes of the statistical analyses, there were nine axial locations.

The primary statistical model used in the analyses was as follows:

$$y_{ijkl} = u + B_i + H_j + BH_{ij} + R_{(ij)k} + E_{(ijk)l}$$

where y_{ijkl} represents an observed elemental composition from the ith batch, jth axial height, kth radial sample, and lth analysis,

u represents the overall mean,

B_i represents the effect of the ith batch (average deviation from the overall mean,

H_j represents the effect of the jth axial location averaged over all batches,

BH_{ij} represents the interaction between the batch and height effects such that axial effects may not be the same for each batch,

$R_{(ij)k}$ represents the variation between radial samples from the ith batch and jth axial height,

$E_{(ijk)l}$ represents the variations between duplicate analyses on the kth radial sample from the jth axial height and ith batch.

Several variations of this model were examined, including contrasting the analytical results between the shard samples at the top or bottom of the canister and the core samples. Examining linear and quadratic trends across the axial heights; and combining the H_j and BH_{ij} terms to form a hierarchical nested model to estimate variance components.

A preliminary analysis was conducted and the residuals were examined visually to identify possible outliers. Several outliers were identified and are shown in Table 1. An investigation into the causes for these outliers was inconclusive. Thus, statistical analyses were first conducted excluding outliers and then conducted again including outliers, to determine the effect of excluding the outliers. The major conclusions from each set of analyses did not differ significantly. Because it appeared that some of the outliers were erroneous even though the suspicion could not be validated, the results presented in this report are based on statistical analyses excluding the outliers shown in Table 1.

The preliminary analyses also showed that variations in elemental composition between analytical duplicates appeared to be similar for all batch, axial location, radial location, and combinations. Additionally, the variability between radial samples appeared to be similar across all batch/axial location combinations. Thus, the assumptions of homogeneity of variance required for a valid analysis of variance appear to be satisfied.

In all of the analyses, the 95% level of confidence was applied to determine statistical significance. In other words, a statistically significant difference implies that one can be at least 95% confident that the absolute value of the true difference between two average values is greater than 0.

TABLE 1. Outliers Deleted from Satistical Analyses

Log #	Sample Name	Element
9001737 A&B	WV-44A-37-12 a&b	B, Li, Mn, Fe, Zr, Ni, Mo, Al (Entire observations were deleted)
9001732 A&B	WV-44A-47-8 a&b	Sr
9001709 A&B	WV-44A-86-8 a&b	Sr
901710 A&B	WV-66A-60-4 a&b	Sr
9001616 A	WV44A-SH1	K
9001617A	WV65A-SH2	Zn, Ba
9001633 A&B	WV66A-47.5-8 a&b	Ti
9001671 B	WV-44A-86-4 b	S, Mo, Cu, La
9001672 A	WV-44a-61-8a	S, Mo, Cu, La
9001632 B	WV-47A-24-4 b	Zn
9001627 B	WV-44A-74-8 b	Si
9001731 B	WV-47A-12-8 b	Ti
9001712 A	WV-66A-33-8 a	La, Li
9001614 A	WV-66A-sh2	Zn

Results of Statistical Analyses

The major objective of this study was to determine whether shard samples are representative of the canister contents. The statistical analyses revealed that for the majority of elemental oxides, there were no significant consistent differences between the shard average elemental concentrations and the core sample elemental concentrations. The average concentrations across each batch and axial location for each elemental oxide are shown in Figures A1 through A23.

Significant differences between shard concentrations and core concentrations were found for Cr, Ni, Zn, and Ba. The differences observed for Ba and Zn were expected, because they were used as tracer elements in the SF-12 run. An explanation for the Cr and Ni differences observed is less obvious. However, the average weight percents for Cr and Ni are sufficiently small (<0.25 wt.%) that the majority of the uncertainty is due to analytical variation. Thus, this observed difference between core sample and shard sample concentrations for Cr and Ni could be an artifact of a problem in the analytical laboratory. Moreover, Cr and Ni are minor constituents and will not factor into a determination of waste product acceptability, nor will WVNS be required to report minor constituents with weight percents less than 0.5% (see Waste Acceptance Preliminary Specification 1.1.2).

Tests were also conducted to determine whether any linear or quadratic trends could be detected along the axial heights within each canister. With the exception of the tracer elements (Ba and Zn), no significant consistent linear or quadratic trends were observed. This suggests that the differences between batch compositions were sufficiently small that any linearity was masked by sampling and analytical variations.

The statistical analyses revealed significant batch-to-batch differences for many of the elemental constituents. The average compositions for each batch are shown in Table 2. Although the batch-to-batch variation is statistically significant for many constituents, the differences between batch elemental weight percents are quite small. The ability to detect small differences in composition between batches is a function of the many samples obtained from each batch. This analysis provides an estimate of the expected batch-to-batch variation (process variation) when the process is being controlled similarly to the SF-12 run. This estimate is based

TABLE 2. Comparision of Elemental Oxide Weight Percent Analyses for Each Batch

Element	Batch 1	Batch 2	Batch 3	Significance[a]
Si	43.54	43.14	42.29	Y
Fe	11.75	11.96	12.32	Y
Na	11.54	11.69	11.84	Y
B	10.50	10.64	10.63	Y
Al	6.71	6.48	6.57	Y
K	3.69	3.75	3.73	N
Li	3.31	3.32	3.33	N
P	2.56	2.59	2.60	Y
Zr	2.10	2.25	2.34	Y
Mn	0.97	0.98	1.00	Y
Ti	0.82	0.83	0.84	Y
Mg	0.87	0.80	0.83	N
Ca	0.46	0.45	0.47	N
Zn	0.37	0.21	0.24	Y
Ni	0.23	0.22	0.23	N
Ba	0.09	0.21	0.19	Y
S	0.14	0.14	0.17	N
Cr	0.10	0.12	0.11	Y
Cs	0.092	0.095	0.103	Y
Cu	0.052	0.056	0.060	Y
Mo	0.051	0.049	0.050	Y
Sr	0.029	0.030	0.050	Y
La	0.021	0.017	0.022	N

(a) Y represents that one can be 95% confident that the true batch averages were significantly differenct. N means that no significant differences were detected at the 95% confidence levels.

on only three batches and, therefore, is not very precise; but it, nevertheless, provides some estimate of process variation.

At some axial locations, the weight percent averages for some elements differed significantly from the averages at other axial locations within a canister. These differences were not consistent across different elements nor across different canisters. In conducting numerous statistical tests, it is to be expected that some tests will reveal significant differences when, in fact, the true averages are the same. Such isolated differences could be an artifact of the number of statistical tests performed. These isolated differences are usually a result of significant variability among average concentrations at various axial heights and are manifest in larger axial height variance components, as discussed below.

Finally, an analysis was conducted to isolate and estimate the portions of total variation due to analytical, sampling, axial, and batch variations. The relative standard deviations for each component of variance are reported in Table 3. Although some systematic sampling occurred, if we assume that the samples are random, estimation of these components of variance is appropriate. These estimates are required to determine the appropriate frequency and procedure for sampling the canisters to meet waste form qualification objectives.

For the major constituents (wt% > 0.5%), the within-canister relative standard deviations are less than 3.5%, with the exception of Mg (RSD=14%) and K (RSD=5.3%). For the minor constituents (wt% < 0.5%) the within-canister RSD ranges from 5% to 68%. The batch-to-batch RSDs for the major constituents were less than 3.5% with the exception of Zr (RSD=5.4%). The batch-to-batch RSDs for the minor constituents ranged from 0.0% to 7.8%, excluding the tracer elements. Figure 4 shows the total relative standard deviations for each element and illustrates the portion of the total RSD due to within-canister variations including sampling and analytical variations and due to batch variations.

The analytical RSDs were very small and reflect only the short-term analytical variations. The variations between the different radial samples taken from a particular canister and axial location reflect radial variations as well as sampling and long-term analytical variations. As shown in Table 4, these RSDs are similar to combined sampling and analytical RSDs observed from a previous study (Pulsipher 1989). This suggests that the pure radial variations (excluding sampling and analytical variations) are probably negligible.

TABLE 3. Variance Components in Terms of Relative Standard Deviations with Sampling and Analytical Relative Standard Deviations (RSD) Compared with Previous Estimates

OBS	ELEMENTAL OXIDE	MEAN	SHORT-TERM ANALYTICAL RSD	SAMPLING[a] RSD	AXIAL HEIGHT RSD	BATCH RSD	WITHIN[b] CANISTER RSD	TOTAL RSD	COMBINED SAMPLING AND ANALYTICAL RSD	PREVIOUS[c] RSD ESTIMATE
1	Si	42.97	0.4	1.9	0.0	1.4	2.0	2.4	2.0	1.1
2	Fe	12.01	0.5	1.5	0.7	2.3	1.8	2.9	1.6	1.3
3	Na	11.70	0.5	1.5	0.2	1.2	1.6	2.0	1.6	2.8
4	B	10.59	0.5	1.8	1.0	0.5	1.9	2.0	1.7	1.9
5	Al	6.585	1.6	2.8	1.2	1.7	3.4	3.8	3.2	5.1
6	K	3.742	2.3	4.2	2.3	0.0	5.3	5.3	4.8	11.3
7	Li	3.325	0.5	2.0	0.6	0.0	2.1	2.1	2.0	2.8
8	P	2.586	0.9	1.3	0.7	0.9	1.7	1.9	1.6	3.9
9	Zr	2.232	0.6	1.9	0.8	5.4	2.0	5.8	2.0	1.2
10	Wn	0.985	0.5	1.3	0.8	1.3	1.5	2.0	1.3	2.5
11	Ti	0.830	0.8	2.5	0.0	0.9	2.6	2.3	2.6	1.8
12	Mg	0.826	6.2	10.7	6.5	3.2	14.0	14.3	12.4	11.2
13	Ca	0.463	5.8	10.1	5.1	0.0	12.7	12.7	11.6	30.9
14	Zn	0.274	0.8	3.4	9.6[c]	30.2	10.2	31.9	3.5	
15	Ni	0.226	2.5	5.9	3.7[d]	0.0	7.4	7.4	6.5	8.3
16	Ba	0.161	2.8	6.0	11.4[c]	38.5	13.2	40.7	6.6	13.5

OBS	ELEMENTAL OXIDE	MEAN	SHORT-TERM ANALYTICAL RSD	SAMPLING(a) RSD	AXIAL HEIGHT RSD	BATCH RSD	WITHIN(b) CANISTER RSD	TOTAL RSD	COMBINED SAMPLING AND ANALYTICAL RSD	PREVIOUS(c) RSD ESTIMATE
17	S	0.142	26.2	59.9	16.9	0.0	67.5	67.5	85.3	33.6
18	Cr	0.107	3.7	15.7	19.0[d]	7.1	24.9	25.9	16.2	23.0
19	Cs	0.096	3.6	3.3	0.0	5.7	4.8	7.4	4.8	19.8
20	Cu	0.056	5.2	7.3	0.0	7.8	8.9	11.8	8.9	.
21	Mo	0.050	3.2	5.4	0.0	2.0	8.3	6.6	6.3	.
22	Sr	0.030	4.3	6.5	4.5	1.6	9.0	9.2	7.8	5.4
23	La	0.021	29.3	39.3	0.0	6.1	49.0	49.4	49.0	.

Conclusions and Recommendations

Based on the statistical analyses, the shard samples appear to be representative of the canister contents for all elemental constituents except Ni and Cr. The Ni and Cr are minor constituents and are not expected to affect waste product acceptability nor is there a requirement to report the elemental concentration for these minor constituents.

No trends within each canister were detectable with the exception of the elements used for tracer studies in the SF-12 run. The fact that trends were observed for the two tracer elements lends credibility to the statistical analyses. No trends suggests that shard samples can be considered as representative samples of the canister contents..

Estimates of variation between batches, axial locations, radial locations, and duplicate analyses were obtained. The within-canister relative standard deviations for the major elemental constituents were relatively small except for Mg and, perhaps, K. Control during the SF-12 run maintained the batch-to-batch relative standard deviations to less than 3.5% for the major constituents with Zr as an exception. These estimates will prove valuable in determining the frequency and number of glass samples required to meet waste form qualification objectives.

In summary, assuming that process controls employed during the SF-12 run are representative of those imposed during future operations of the WVNS melter process (i.e., batch-to-batch variations in composition are controlled to acceptable levels), shard samples obtained from the top of the canisters will be representative of the canister contents. However, estimates derived herein for within-canister variability should be incorporated into uncertainty estimates associated with reported canister compositions derived from shard samples.

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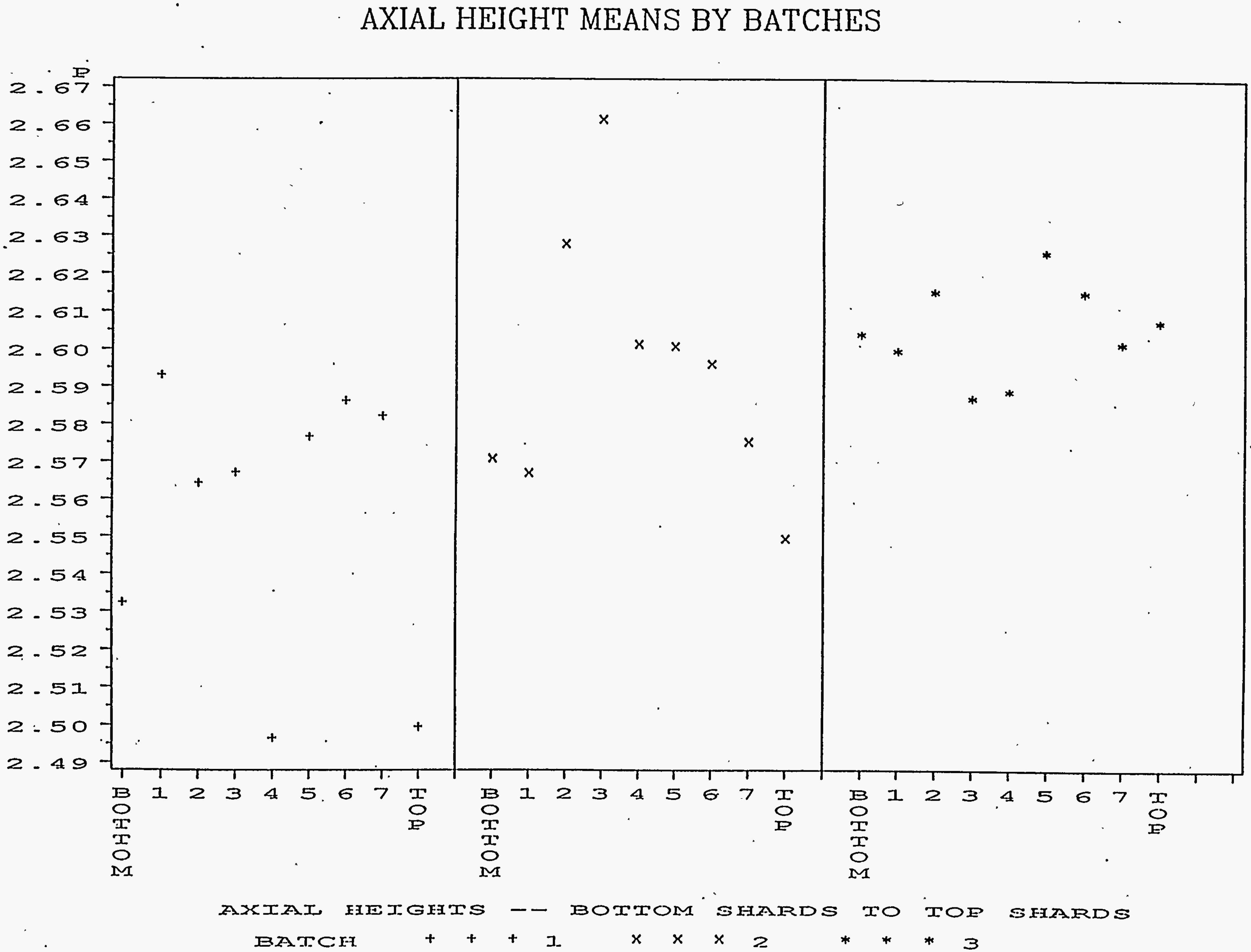
APPENDIX A

PLOTS OF AXIAL HEIGHT MEANS FOR EACH BATCH



AXIAL HEIGHT MEANS BY BATCHES
P
2.67
2.66
2.65
2.64
2.63
2.62
2.61
2.60
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2.58
2.57
2.56
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2.53
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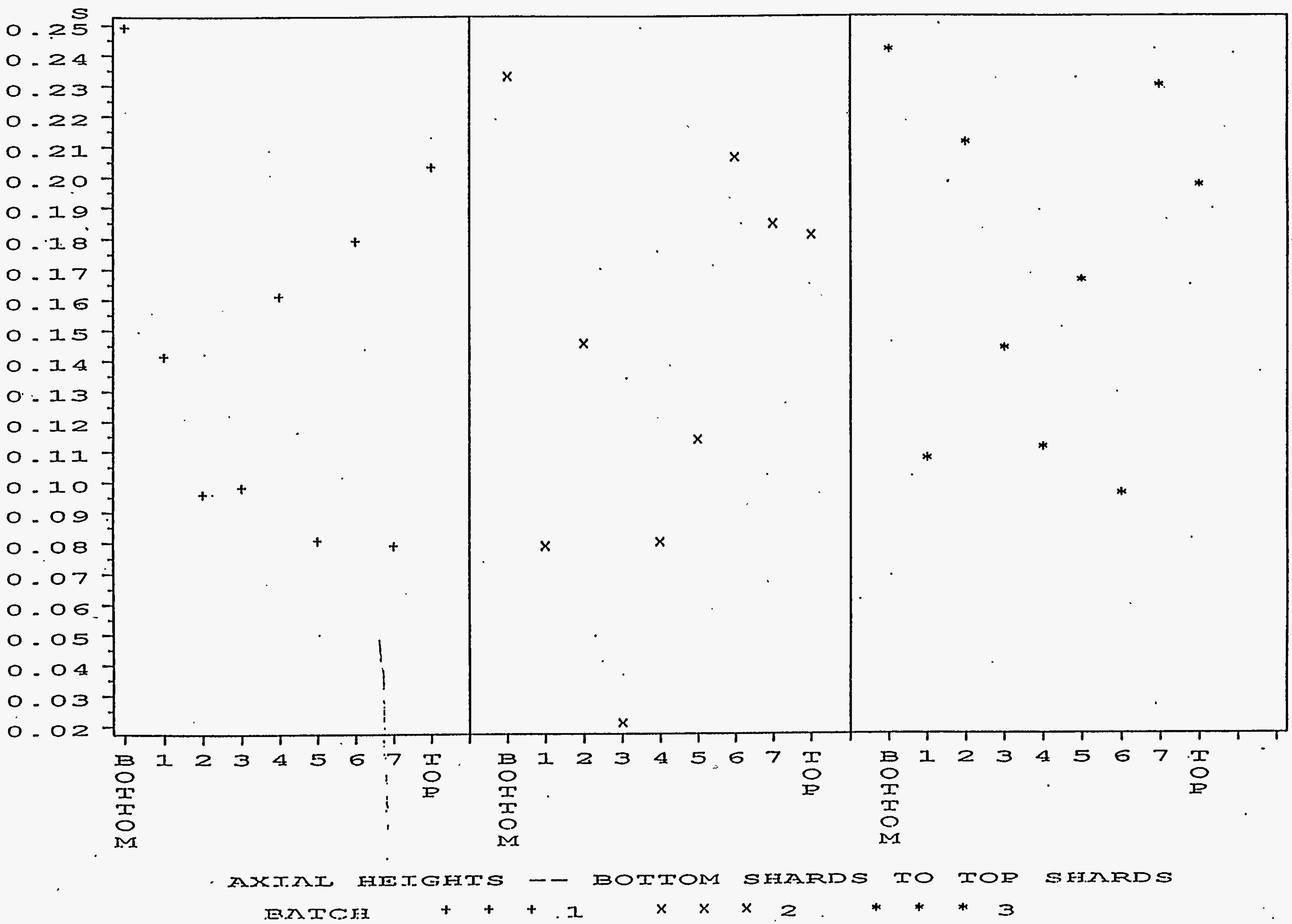
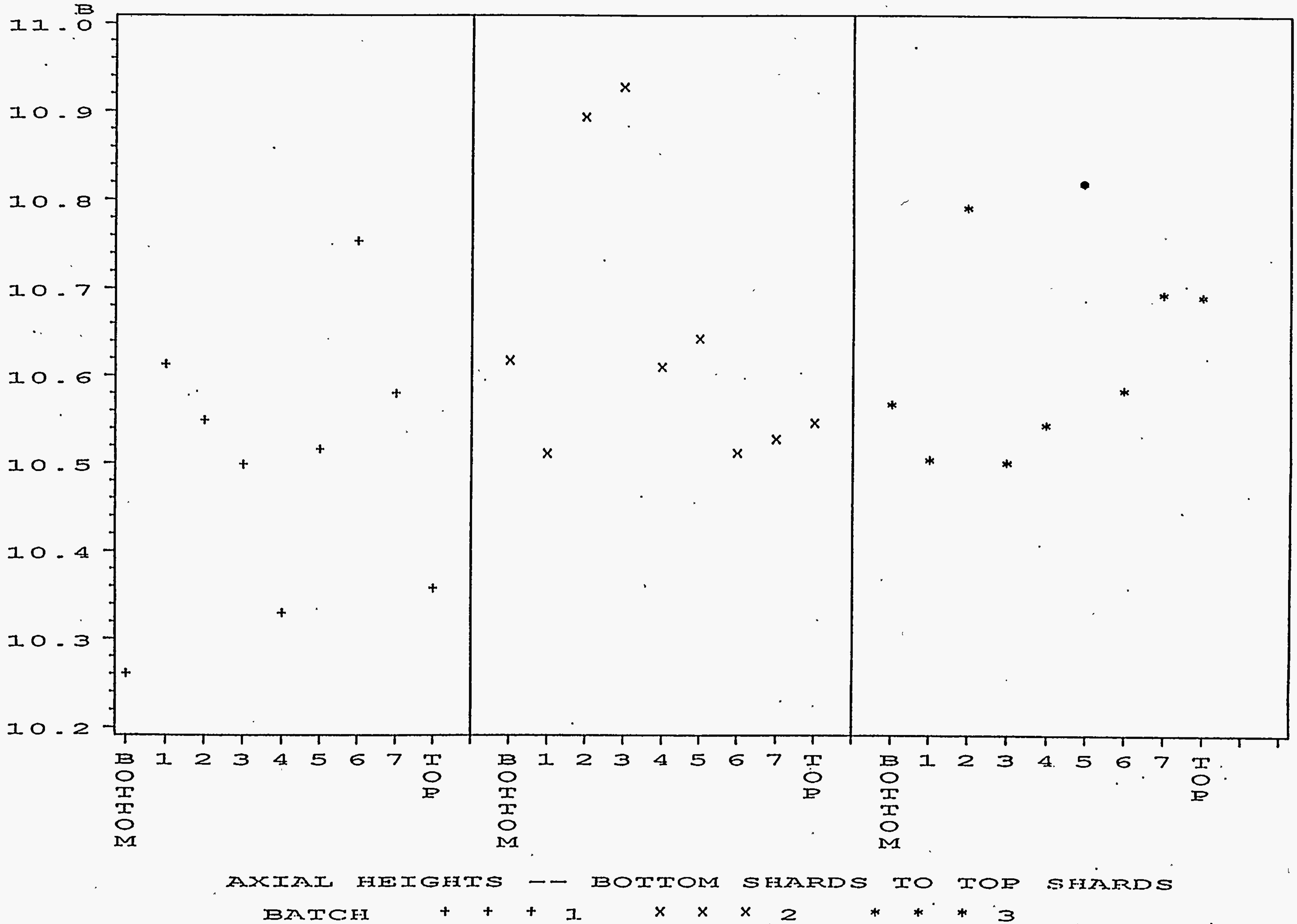
2.50
2.49
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
AXIAL HEIGHTS -- BOTTOM SHARDS TO TOP SHARDS
BATCH + + + 1 x x x 2 * * * 3

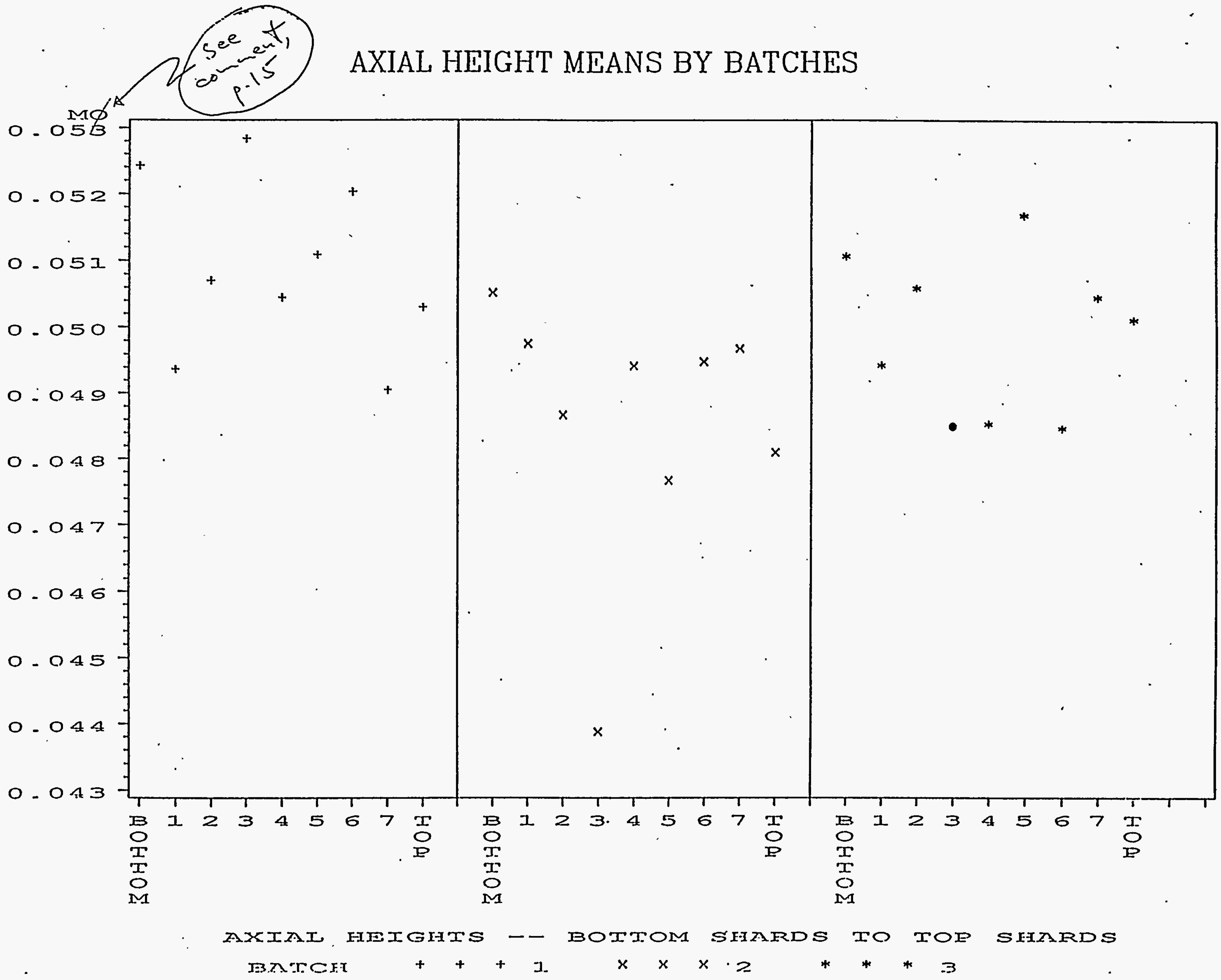
AXIAL HEIGHT MEANS BY BATCHES

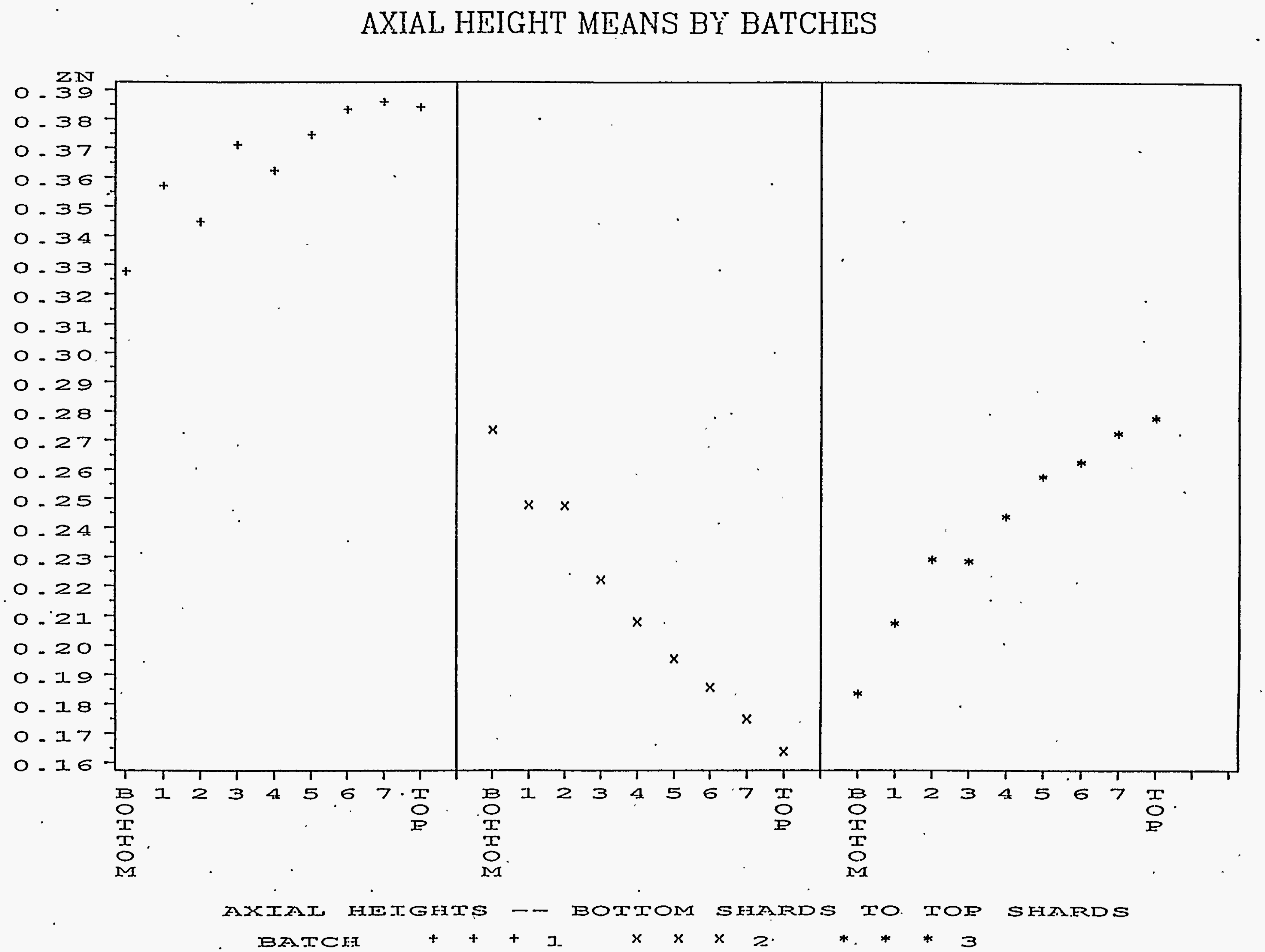


AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES




AXIAL HEIGHT MEANS BY BATCHES
ZN
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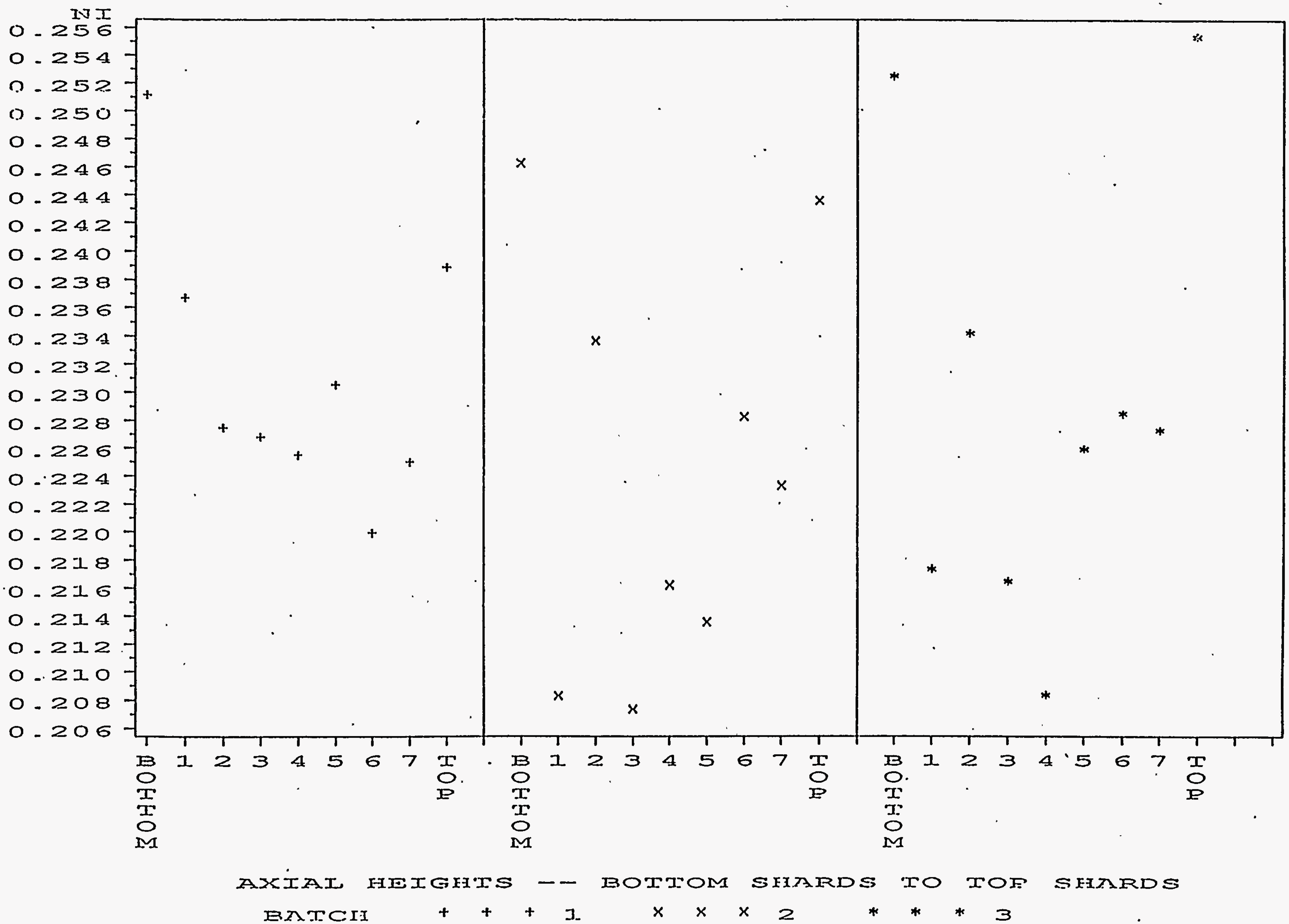
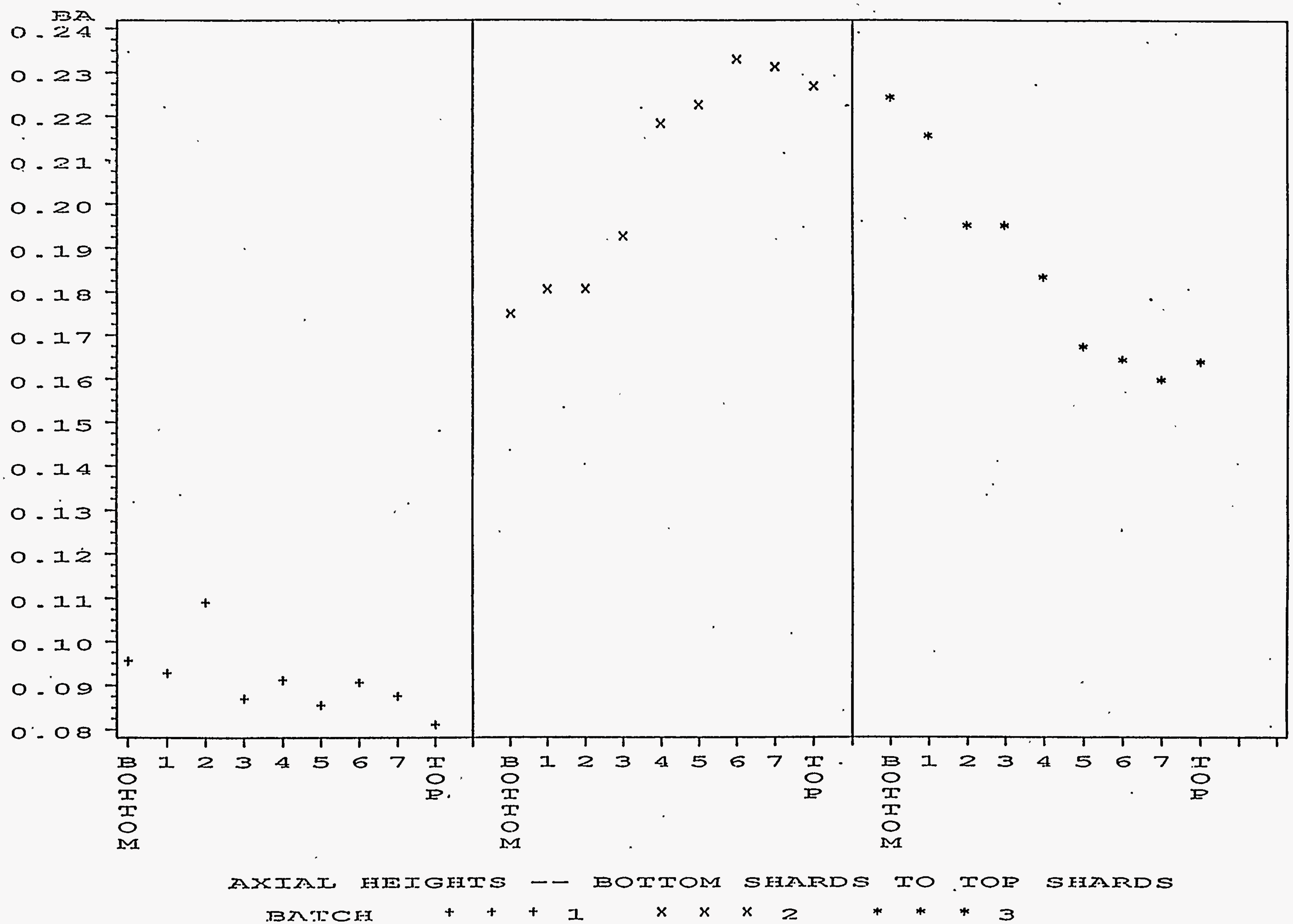
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
AXIAL HEIGHTS -- BOTTOM SHARDS TO TOP SHARDS
BATCH + + + 1 x x x 2 * * * 3

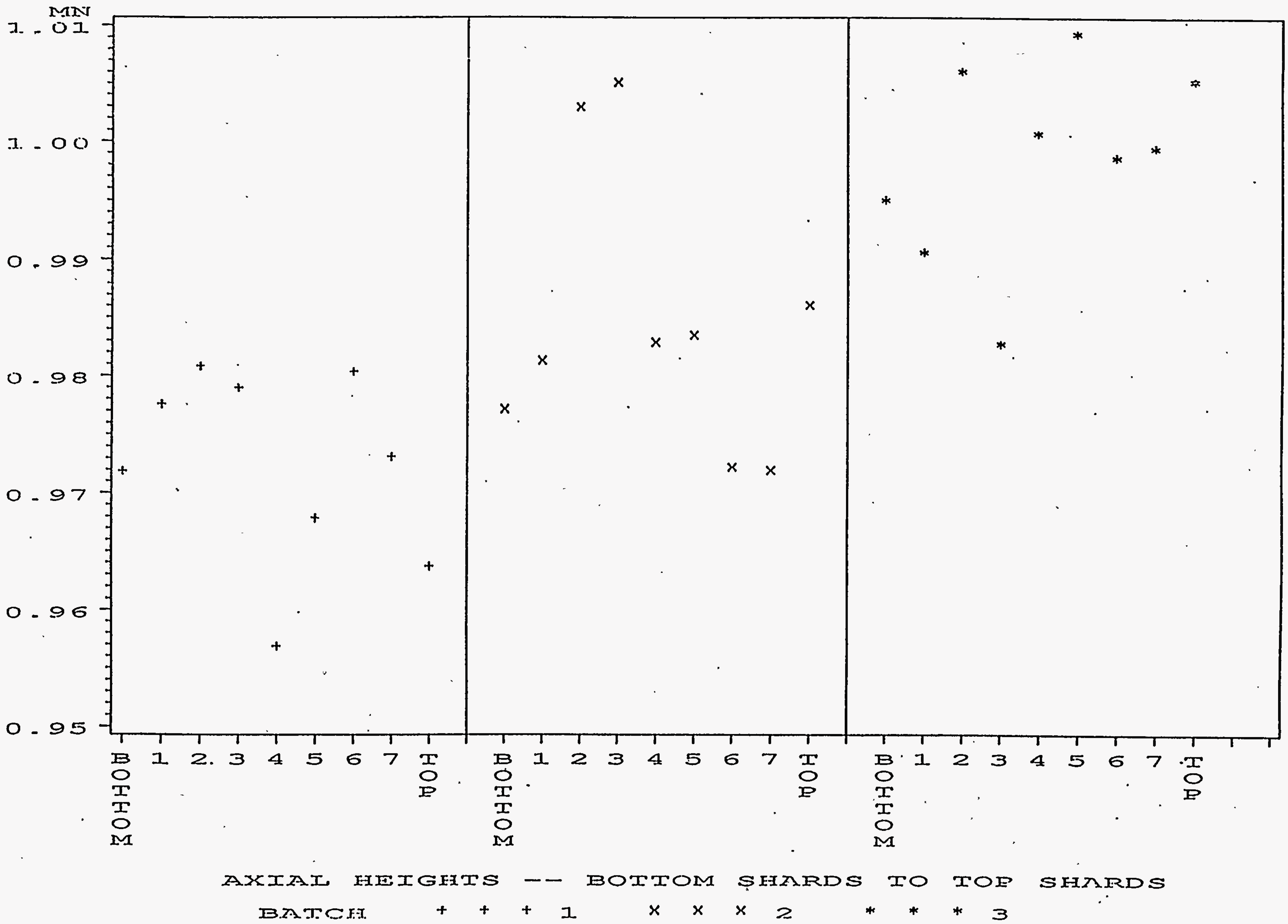
AXIAL HEIGHT MEANS BY BATCHES



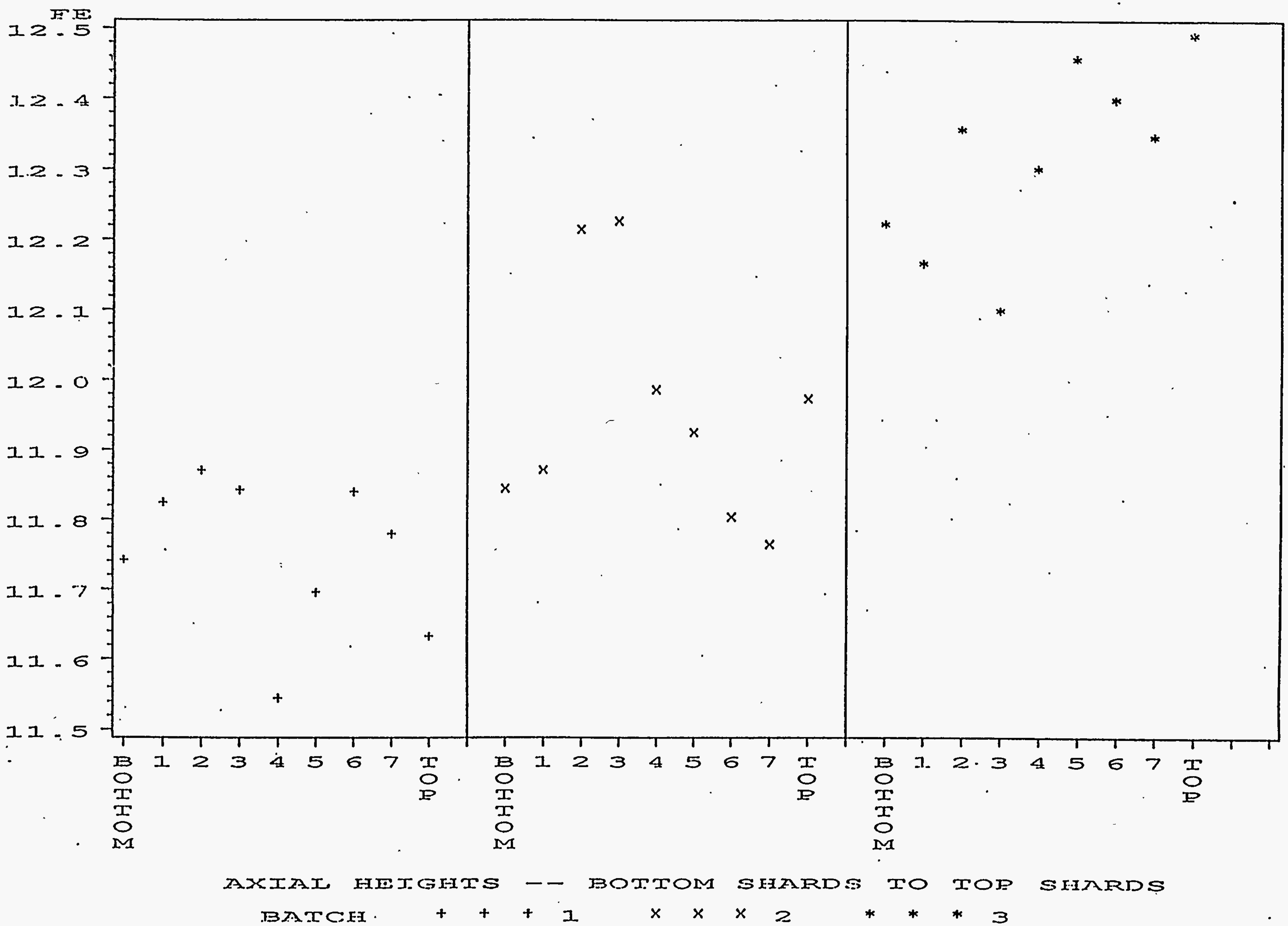
AXIAL HEIGHT MEANS BY BATCHES



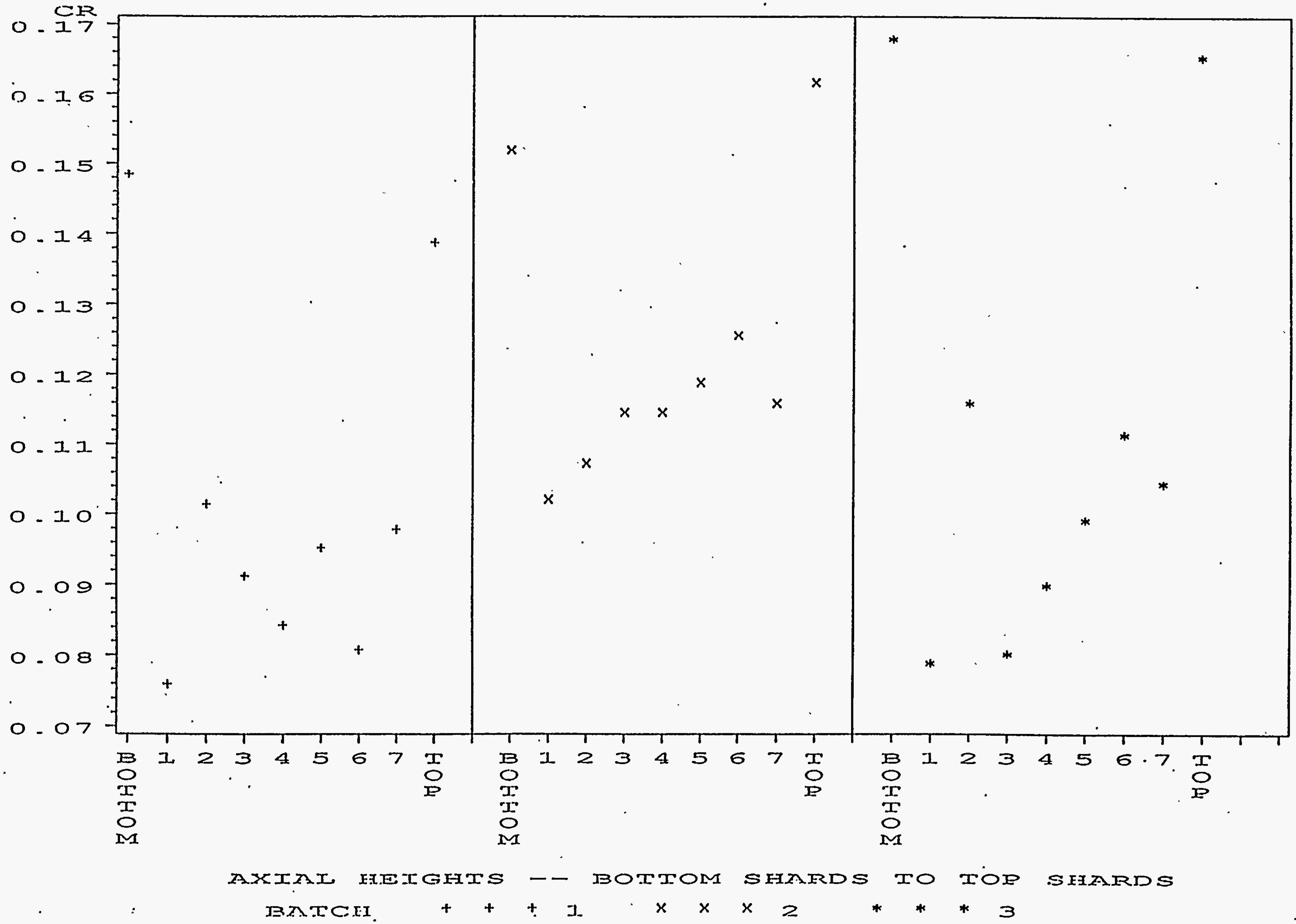
AXIAL HEIGHT MEANS BY BATCHES



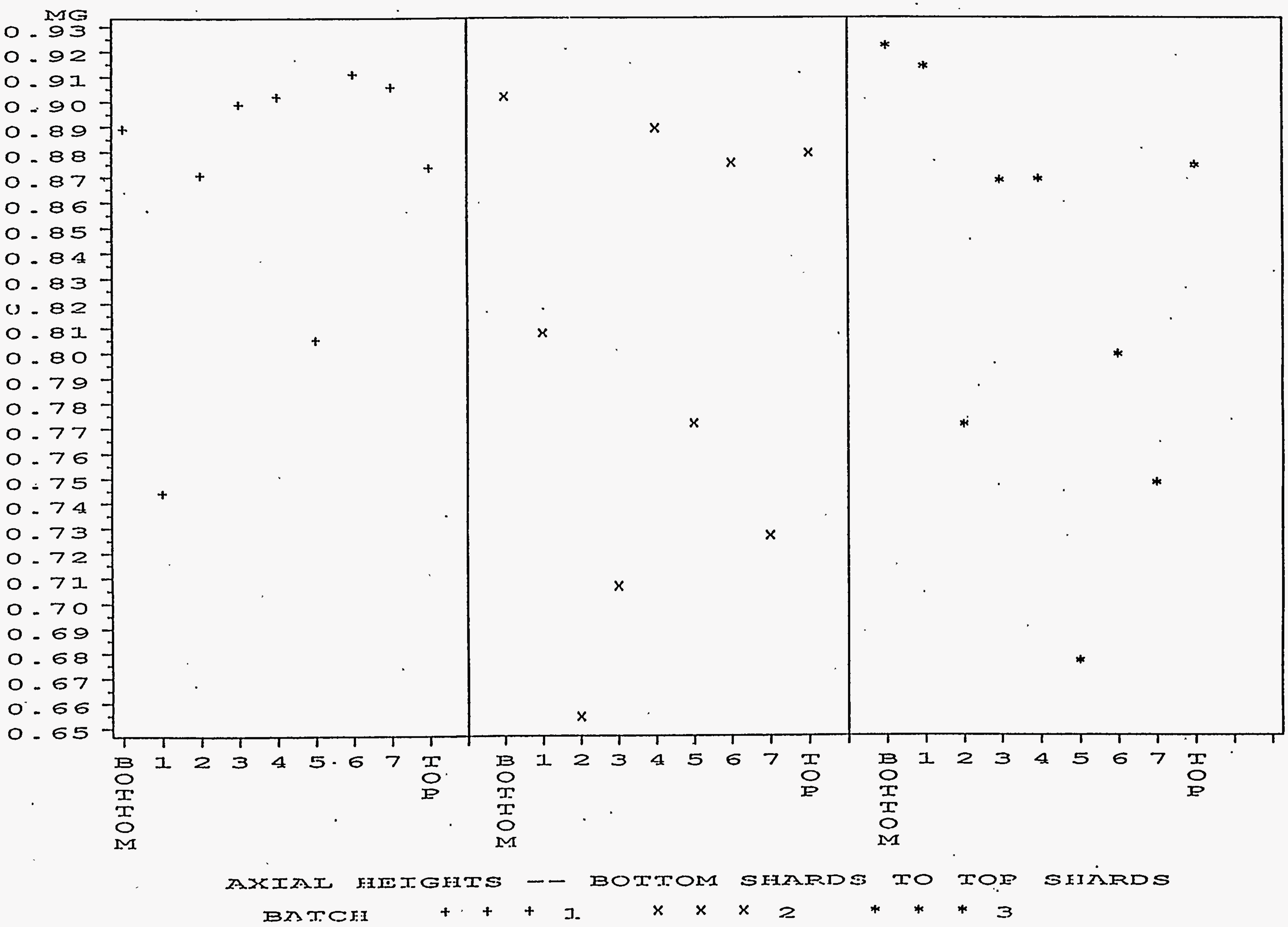
AXIAL HEIGHT MEANS BY BATCHES

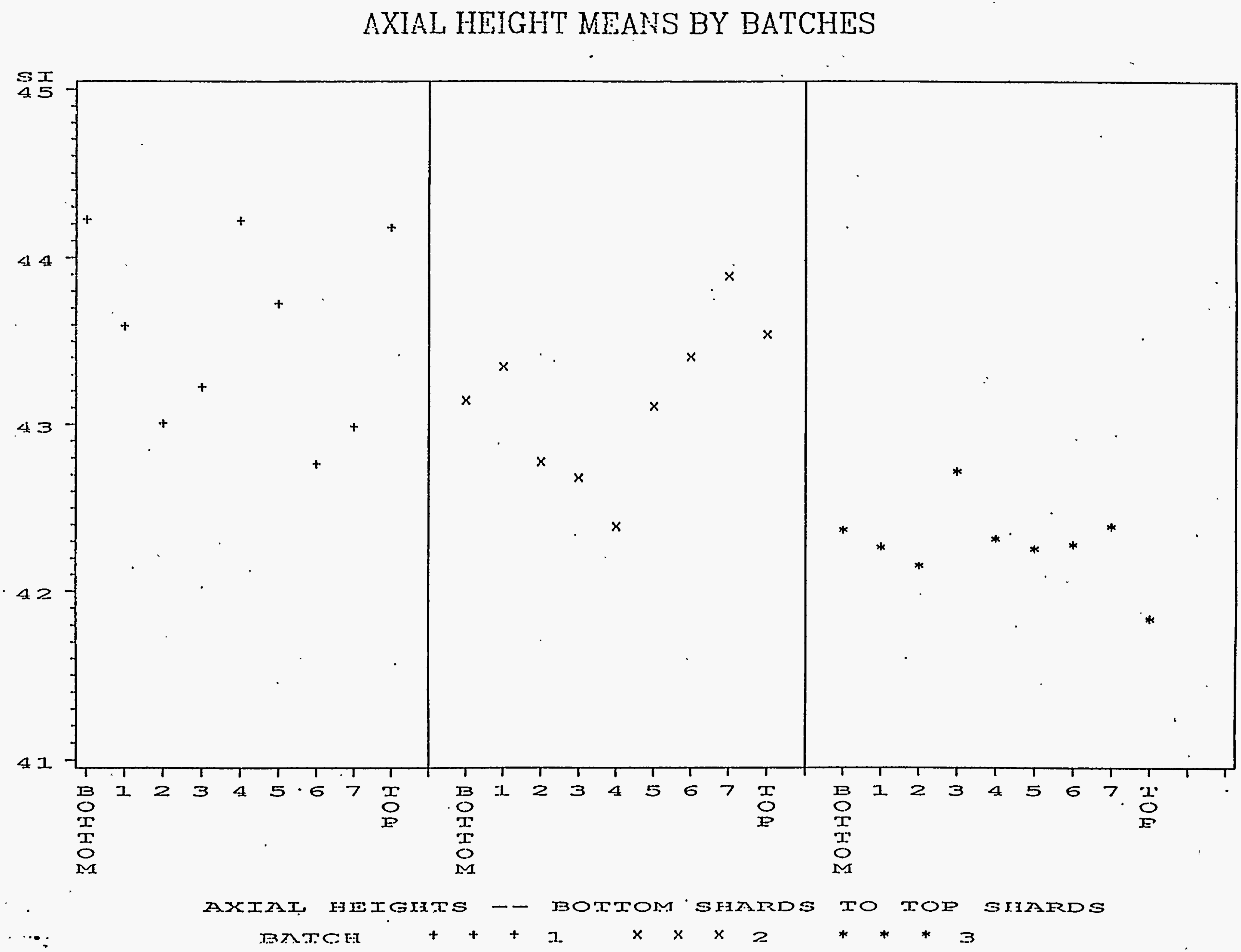


AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES




AXIAL HEIGHT MEANS BY BATCHES
SI
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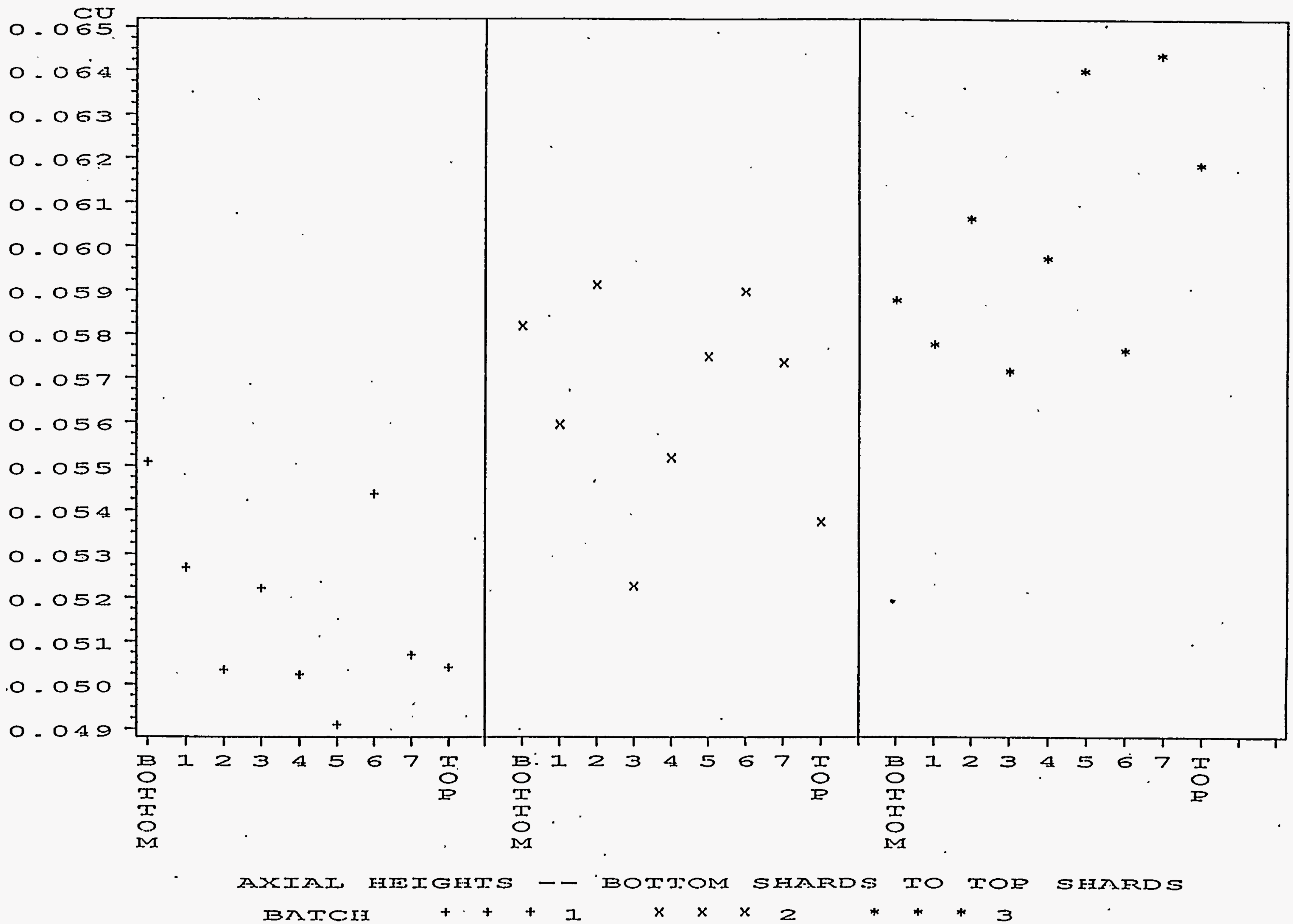
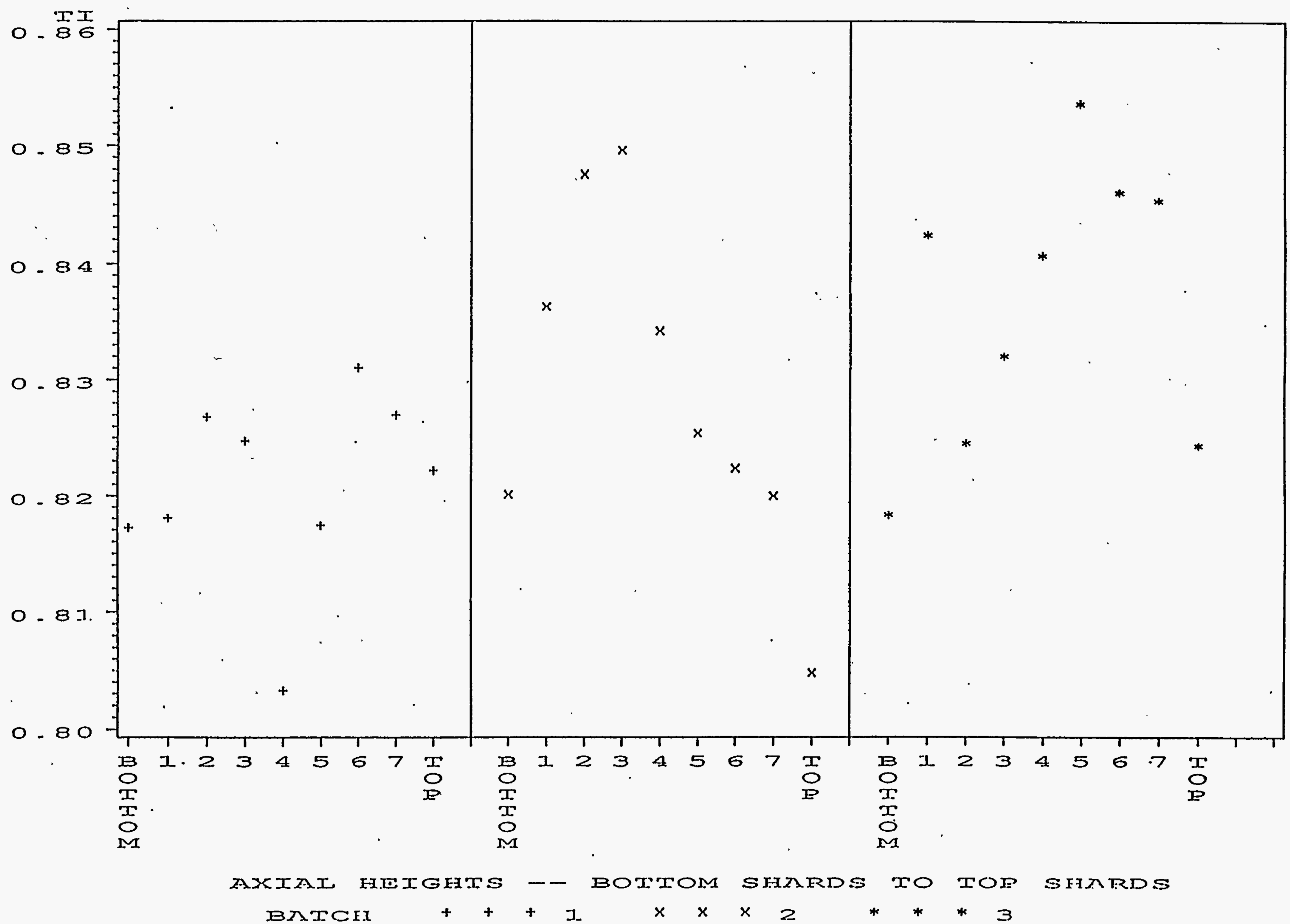
44
43
42
41
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
AXIAL HEIGHTS -- BOTTOM SHARDS TO TOP SHARDS
BATCH + + + 1 x x x 2 * * * 3

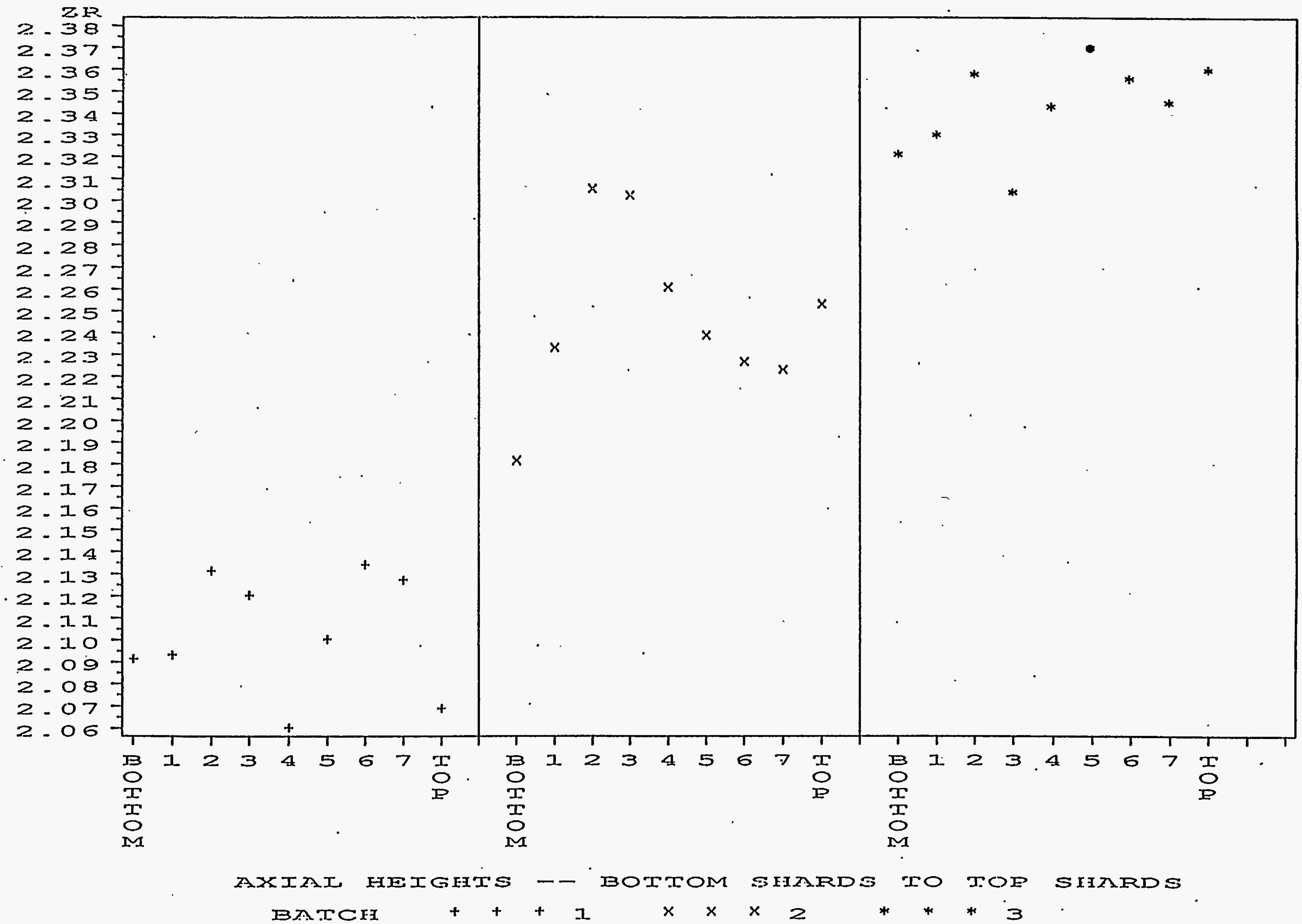
AXIAL HEIGHT MEANS BY BATCHES



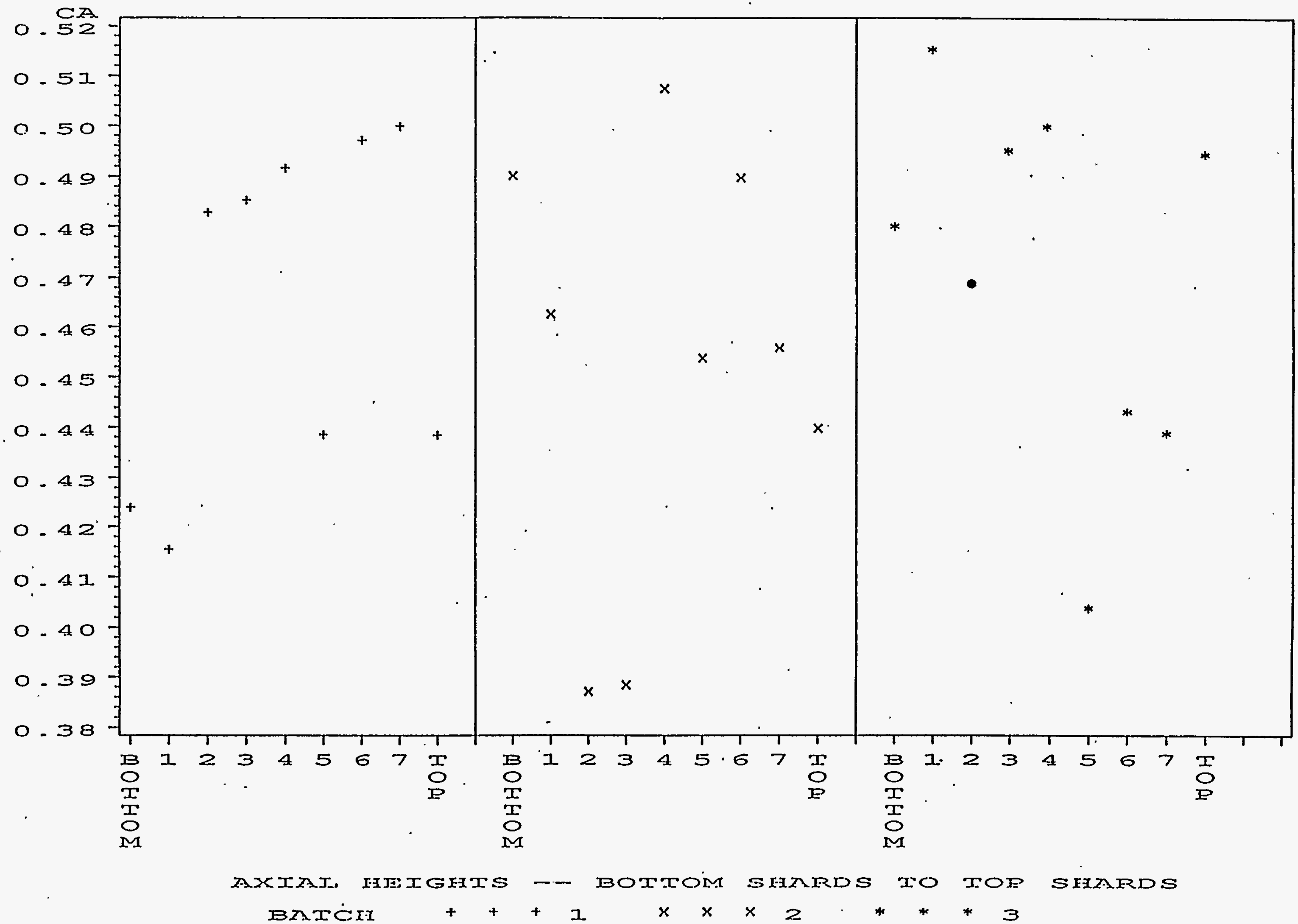
AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES



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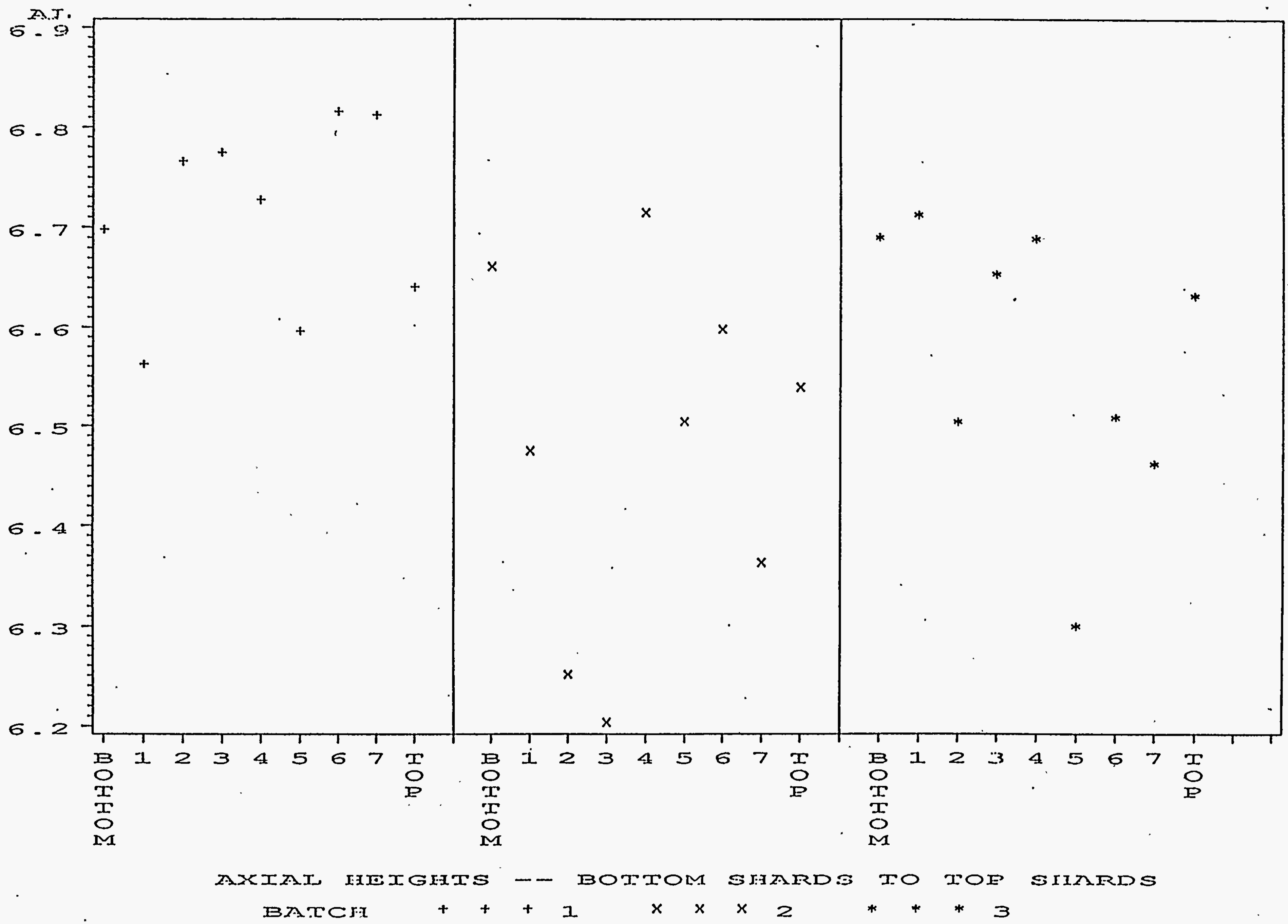

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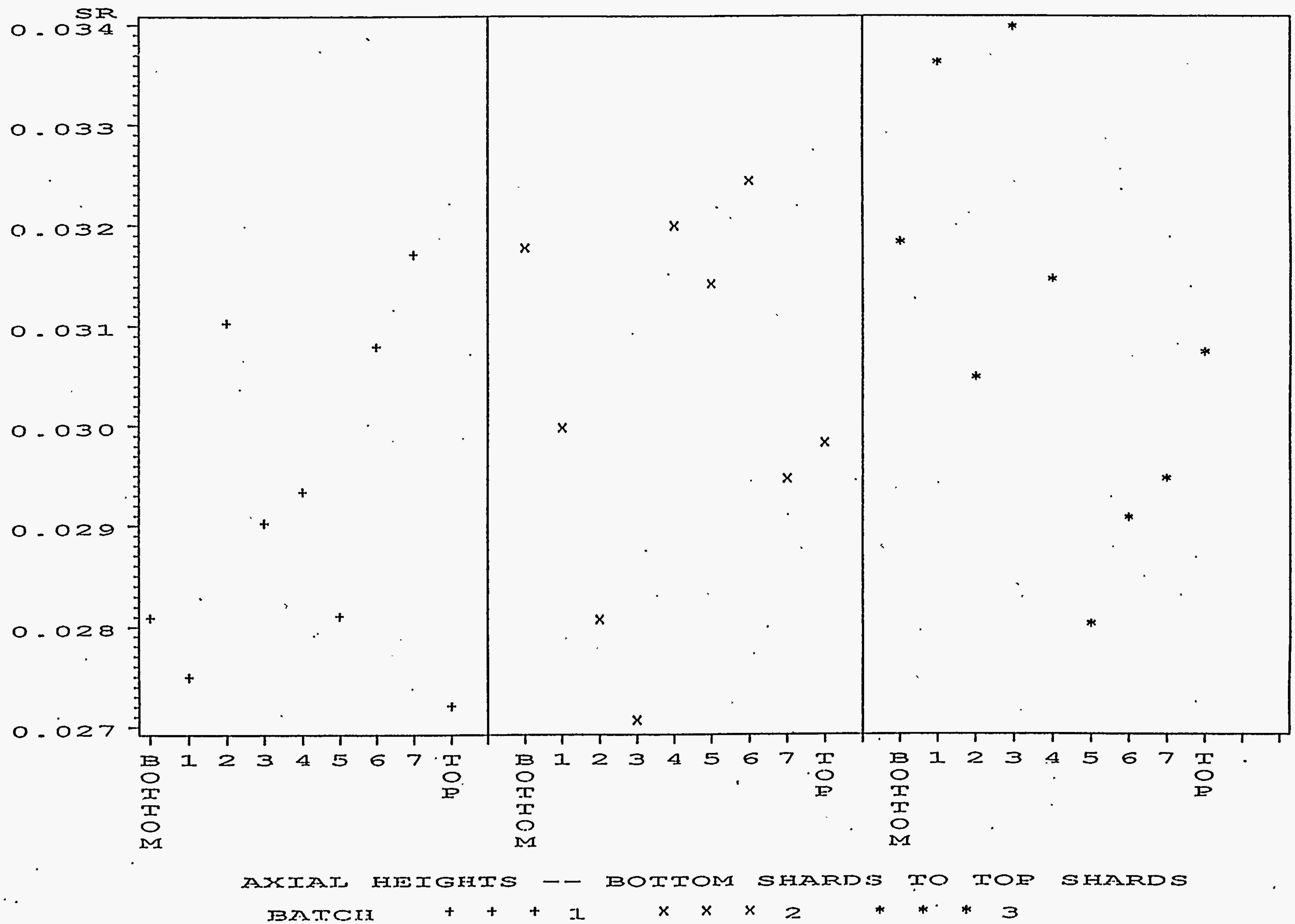
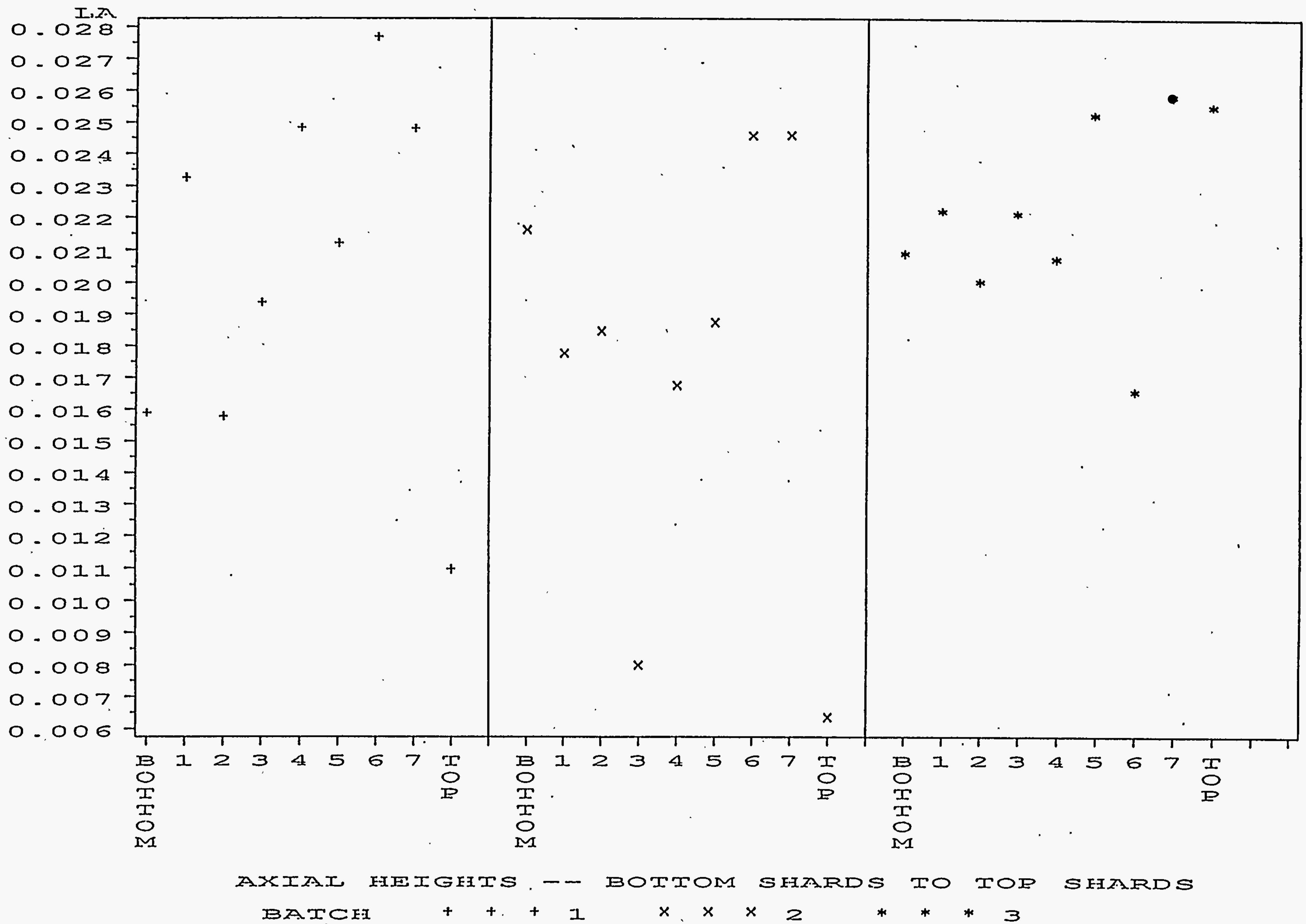
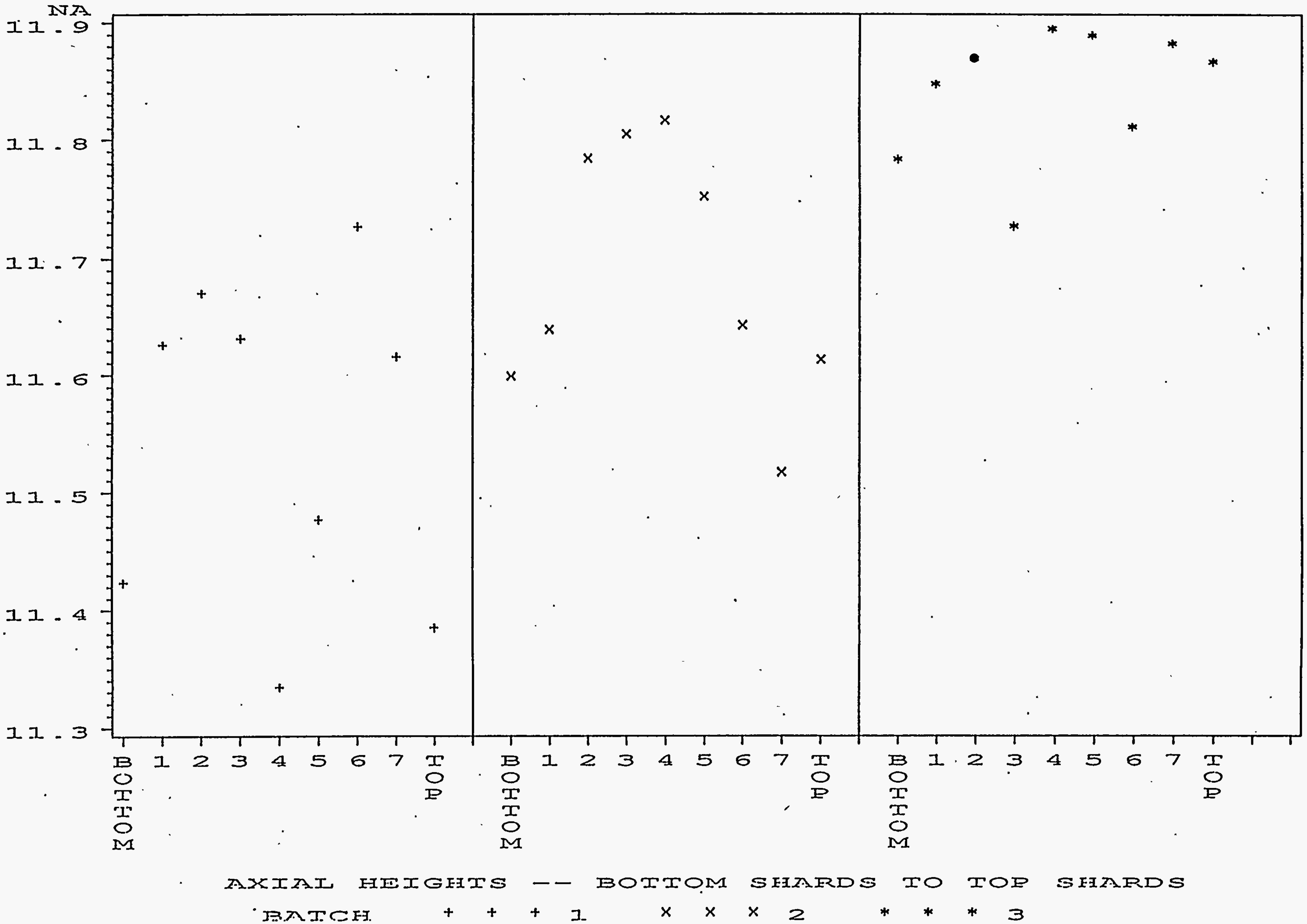
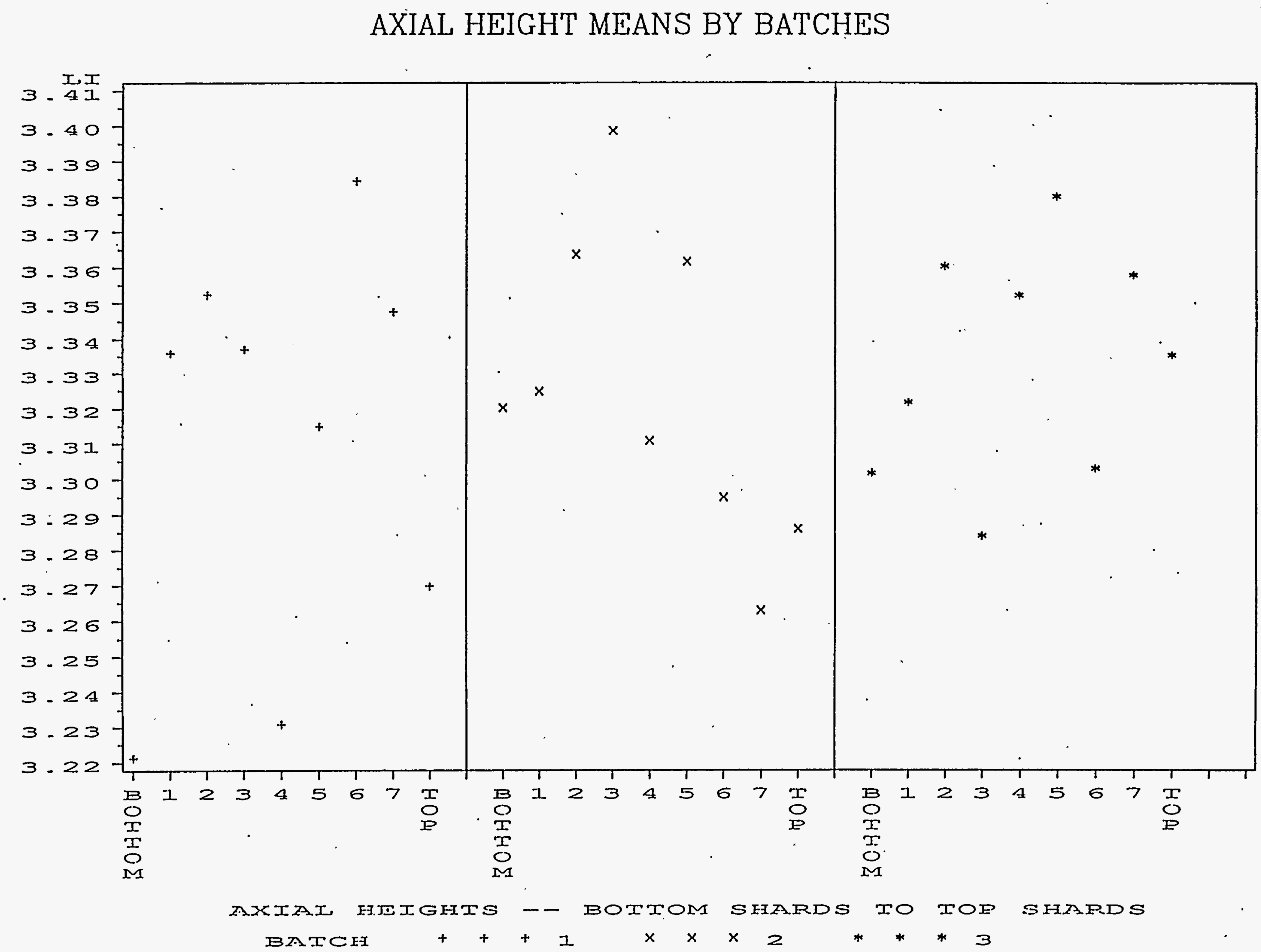


AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES




AXIAL HEIGHT MEANS BY BATCHES
LI
3.41
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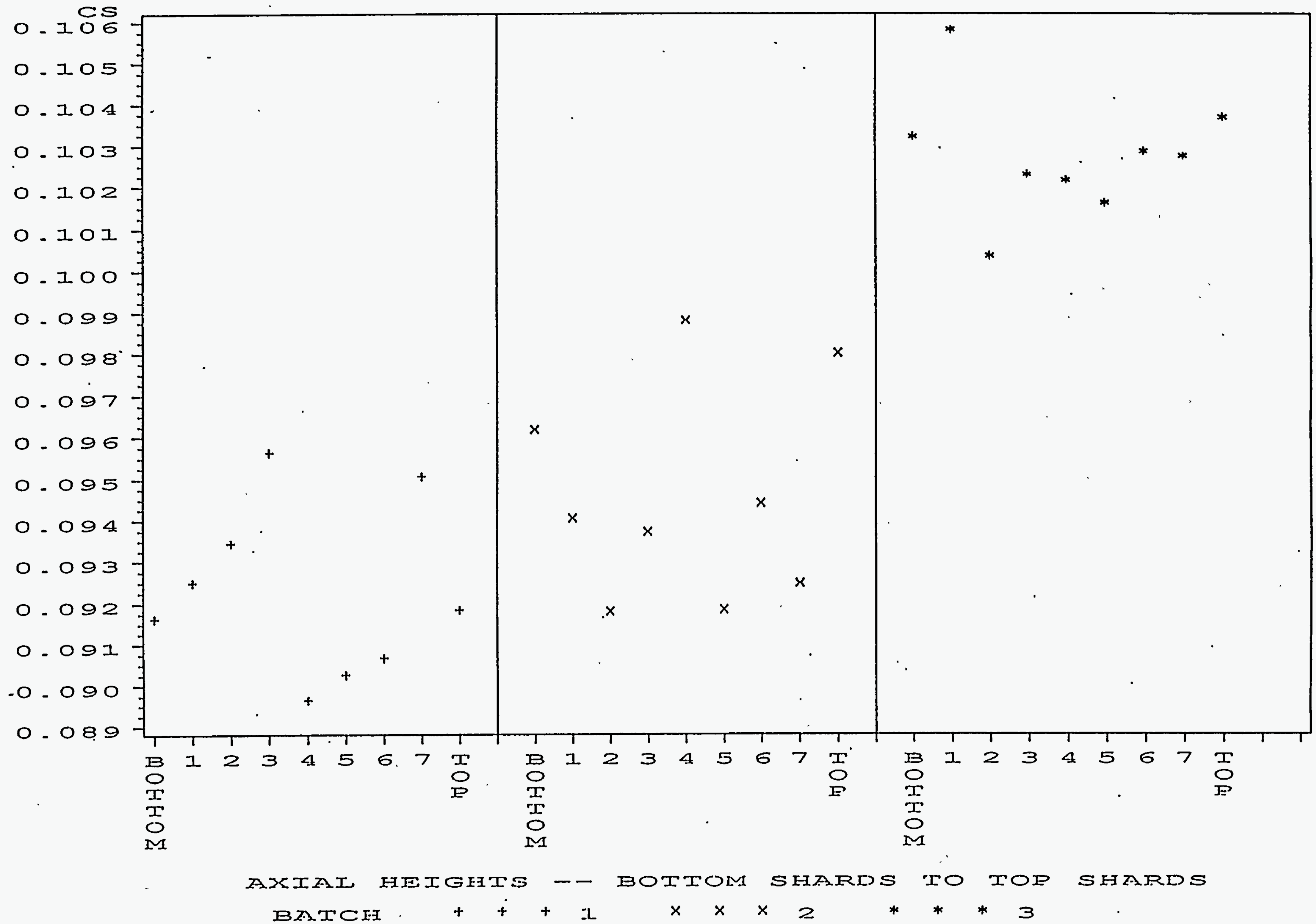
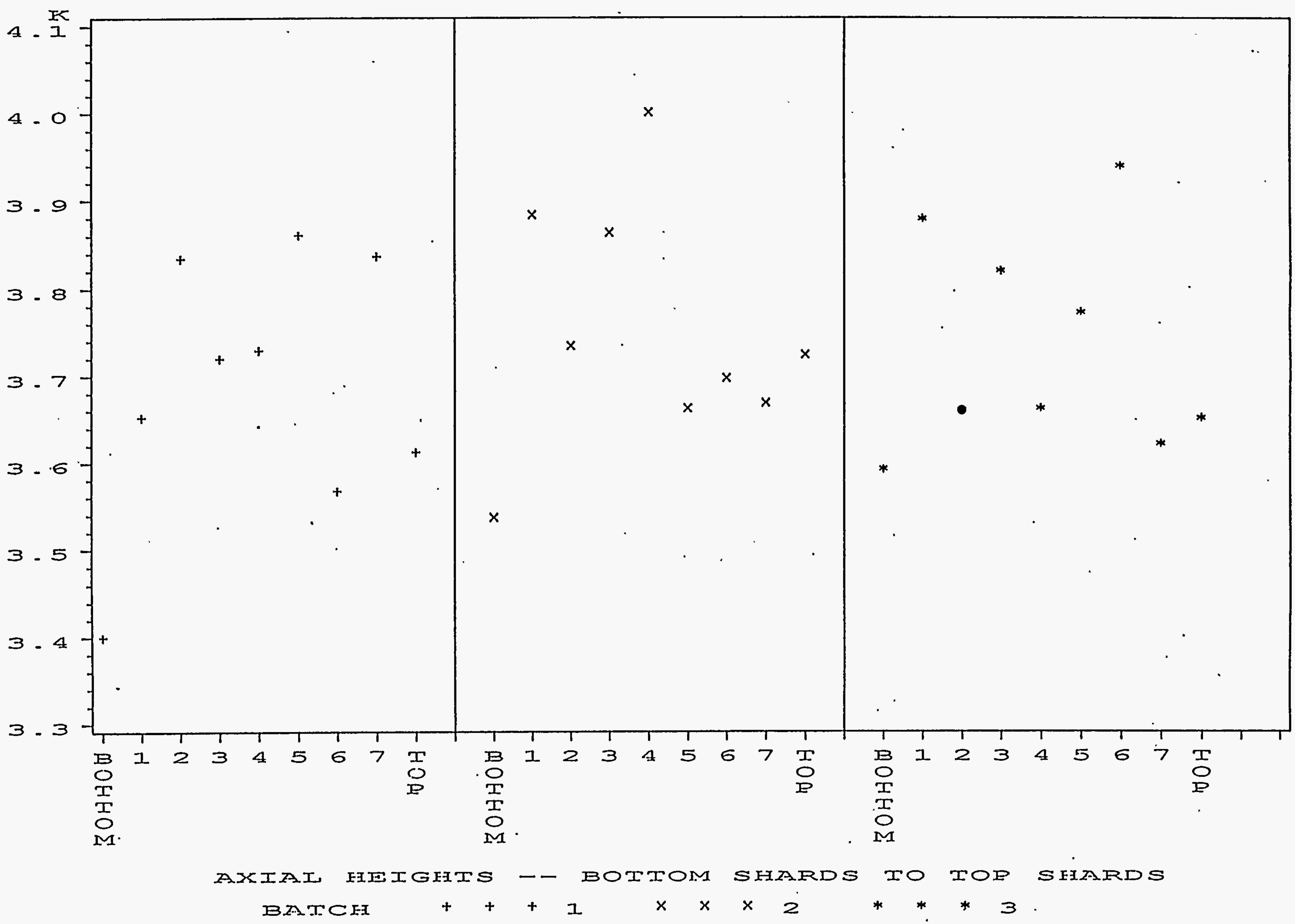
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
BOTTOM 1 2 3 4 5 6 7 TOP
AXIAL HEIGHTS -- BOTTOM SHARDS TO TOP SHARDS
BATCH + + + 1 x x x 2 * * * 3

AXIAL HEIGHT MEANS BY BATCHES



AXIAL HEIGHT MEANS BY BATCHES



APPENDIX B

LISTING OF DATA

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
1	9001610A	WV-65A-SH1	65	2.53537	0.21440	10.2336	0.050386	0.34309	0.25209	0.09633	0.97151	11.7635	0.14368	0.86886
2	9001617A	WV-65A-SH2	65	2.50911	0.21621	10.2965	0.050798	0.23705	0.24584	0.15805	0.97463	11.7817	0.14887	0.90365
3	9001623A	WV-65A-SH3	65	2.55287	0.31718	10.2523	0.056091	0.31230	0.25562	0.09485	0.96948	11.6787	0.15271	0.89467
4	9001699A	WV-66A-17.5-4	66	2.64731	0.00000	10.6917	0.044428	0.36180	0.23889	0.08893	0.99127	12.0397	0.08356	0.76143
5	9001699B	WV-66A-17.5-4	66	2.62809	0.00206	10.6855	0.045828	0.36303	0.24145	0.08975	0.98788	12.0213	0.09176	0.76590
6	9001677A	WV-66A-17.5-8	66	2.57695	0.11776	10.4052	0.047296	0.34990	0.22467	0.09283	0.96532	11.6542	0.06338	0.81857
7	9001677B	WV-66A-17.5-8	66	2.53561	0.10615	10.2660	0.046809	0.34464	0.22427	0.09036	0.95448	11.5138	0.06393	0.78617
8	9001656A	WV-66A-17.5-1	66	2.57611	0.29088	10.8780	0.055412	0.36295	0.24314	0.09257	0.98920	11.9251	0.07776	0.55981
9	9001656B	WV-66A-17.5-1	66	2.59451	0.33148	10.7515	0.056486	0.36056	0.24803	0.10255	0.97715	11.7921	0.07524	0.77238
10	9001667A	WV-66A-33-4	66	2.57156	0.16003	10.6430	0.049290	0.37153	0.22081	0.08860	0.98408	11.8587	0.10356	0.70970
11	9001667B	WV-66A-33-4	66	2.54801	0.18299	10.5968	0.049704	0.36343	0.23250	0.09203	0.97703	11.7591	0.10156	0.80246
12	9001712A	WV-66A-33-8	66	2.53422	0.18216	10.2278	0.053621	0.31932	0.23288	0.14012	0.95696	11.5722	0.11494	0.90533
13	9001712B	WV-66A-33-8	66	2.53976	0.05085	10.4909	0.048958	0.31066	0.23010	0.13129	0.97304	11.8245	0.11232	0.90681
14	9001704A	WV-66A-33-12	66	2.59056	0.00000	10.6807	0.051210	0.35114	0.22333	0.10230	0.99591	12.0894	0.08743	0.94871
15	9001704B	WV-66A-33-12	66	2.60196	0.00000	10.6560	0.051458	0.35269	0.22545	0.10025	0.99803	12.1225	0.08874	0.95090
16	9001707A	WV-66A-47.5-4	66	2.64626	0.00000	10.5804	0.057464	0.37769	0.23603	0.09503	0.98955	12.0214	0.10378	0.93521
17	9001707B	WV-66A-47.5-4	66	2.62266	0.00000	10.5402	0.057478	0.37726	0.23661	0.09451	0.98950	12.0096	0.10387	0.95405
18	9001633A	WV-66A-47.5-8	66	2.54709	0.17073	10.5777	0.050376	0.37305	0.22530	0.07924	0.98009	11.8659	0.08973	0.93672
19	9001633B	WV-66A-47.5-8	66	2.52358	0.15020	10.5802	0.050512	0.37305	0.22619	0.08282	0.98245	11.8923	0.09578	0.90900

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
1	44.1111	0.053867	0.80135	2.03774	0.45058	6.80899	0.028396	0.016151	11.4566	3.26349	0.08872	3.41029	4	1	1	0.0	0
2	44.2172	0.054478	0.82576	2.18565	0.41944	6.53715	0.028508	0.009239	11.3951	3.21631	0.09478	3.49398	8	2	1	0.0	0
3	44.3412	0.056925	0.82442	2.05119	0.40180	6.74760	0.027371	0.022270	11.4192	3.18416	0.09143	3.29570	12	3	1	0.0	0
4	43.0226	0.047944	0.82957	2.12669	0.39593	6.54869	0.026486	0.012982	11.7349	3.35758	0.09196	3.85568	4	.	1	17.5	1
5	43.1008	0.049135	0.82889	2.12411	0.38525	6.61118	0.026051	0.018462	11.7046	3.33980	0.08965	3.79962	4	.	1	17.5	1
6	44.0453	0.051039	0.80665	2.06308	0.46208	6.68783	0.02859[illegible]	0.018600	11.5544	3.31800	0.09307	3.55526	8	.	1	17.5	1
7	44.9159	0.049199	0.79878	2.04111	0.45077	6.56245	0.027727	0.015370	11.3802	3.27033	0.09302	3.46292	8	.	1	17.5	1
8	43.4974	0.058374	0.82766	2.11779	0.32071	6.25047	0.025850	0.032791	11.7015	3.37494	0.09160	3.65000	12	.	1	17.5	1
9	42.9900	0.060454	0.81661	2.08756	0.47818	6.71212	0.030291	0.041345	11.6787	3.35504	0.09568	3.59211	12	.	1	17.5	1
10	43.8658	0.048039	0.82238	2.11265	0.43179	6.50208	0.027236	0.017376	11.5400	3.32591	0.09049	3.45540	4	.	1	33.0	2
11	43.5149	0.048624	0.81564	2.09436	0.47879	6.66414	0.028800	0.020739	11.5353	3.31128	0.09205	3.68978	4	.	1	33.0	2
12	43.8184	0.057464	0.80940	2.09192	0.49676	6.73038	0.034512	0.042252	11.4196	3.16497	0.09096	4.00377	8	.	1	33.0	2
13	43.1769	0.044675	0.81431	2.14078	0.49232	6.78023	0.032242	0.011612	11.5781	3.27442	0.08835	3.94683	8	.	1	33.0	2
14	41.7791	0.051361	0.84913	2.17376	0.50497	6.97260	0.031049	0.014960	11.9756	3.43033	0.10123	3.99519	12	.	1	33.0	2
15	41.8851	0.051906	0.85001	2.17495	0.49219	6.94575	0.032330	0.014217	11.9731	3.41943	0.09762	3.91541	12	.	1	33.0	2
16	41.9837	0.061515	0.85136	2.16483	0.49465	6.92444	0.030565	0.038503	11.9186	3.40073	0.10070	3.98756	4	.	1	47.5	3
17	42.0174	0.060584	0.84906	2.16293	0.51225	6.94949	0.031534	0.039376	11.8744	3.38420	0.09791	4.03517	4	.	1	47.5	3
18	43.1921	0.049843	0.74809	2.12690	0.48289	6.78307	0.027856	0.002958	11.5699	3.33565	0.09289	3.69193	8	.	1	47.5	3
19	43.2071	0.047682	0.74782	2.13182	0.48215	6.73698	0.027972	0.009088	11.6368	3.34793	0.09374	3.66477	8	.	1	47.5	3

OBS	LOG__	SAMPLE_N	CAN	P__OXID	S__OXID	B__OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
20	9001679A	WV-66A-47.5-1	66	2.52998	0.13072	10.3458	0.050571	0.36242	0.21703	0.08681	0.96503	11.6083	0.07523	0.87607
21	9001679B	WV-66A-47.5-1	66	2.53341	0.13766	10.3698	0.050648	0.36383	0.21977	0.08400	0.96735	11.6537	0.07868	0.78174
22	9001710A	WV-66A-60-4	66	2.48850	0.17830	10.2420	0.052100	0.36127	0.22710	0.08899	0.94935	11.4877	0.08223	0.90361
23	9001710B	WV-66A-60-4	66	2.45839	0.10228	10.2094	0.050409	0.36319	0.22337	0.09358	0.95493	11.5507	0.08007	0.90770
24	9001697A	WV-66A-60-8	66	2.50103	0.12934	10.3345	0.048566	0.36618	0.21896	0.09003	0.95719	11.5499	0.07591	0.91074
25	9001697B	WV-66A-60-8	66	2.55593	0.15668	10.4079	0.048723	0.36749	0.22039	0.09202	0.95544	11.5599	0.07397	0.91053
26	9001634A	WV-66A-60-12	66	2.49067	0.15198	10.3931	0.051130	0.35717	0.22497	0.09660	0.96232	11.5110	0.10025	0.92077
27	9001634B	WV-66A-60-12	66	2.48530	0.24753	10.3939	0.051751	0.35950	0.23818	0.08666	0.96201	11.6138	0.09334	0.85789
28	9001738A	WV-66A-75-4	66	2.62164	0.06650	10.4775	0.050513	0.37713	0.23214	0.08970	0.96651	11.6930	0.12610	0.91213
29	9001738B	WV-66A-75-4	66	2.59645	0.03696	10.4433	0.050406	0.37540	0.22948	0.09003	0.96676	11.7217	0.12336	0.89193
30	9001739A	WV-66A-75-8	66	2.62202	0.02576	10.6551	0.049454	0.37795	0.23210	0.08722	0.97403	11.7880	0.07008	0.74334
31	9001739B	WV-66A-75-8	66	2.55191	0.05294	10.5811	0.050439	0.37589	0.23018	0.09100	0.96744	11.6878	0.07558	0.91862
32	9001669A	WV-66A-75-12	66	2.53909	0.13286	10.4630	0.051754	0.37220	0.22627	0.07409	0.96777	11.6762	0.08765	0.64938
33	9001669B	WV-66A-75-12	66	2.52902	0.16941	10.4773	0.053950	0.36912	0.23301	0.08130	0.96490	11.6090	0.08869	0.71528
34	9001666A	WV-66A-85.5-4	66	2.57558	0.16695	10.6520	0.049969	0.38075	0.22635	0.08695	0.97602	11.7658	0.06623	0.83543
35	9001666B	WV-66A-85.5-4	66	2.55548	0.15864	10.6409	0.049119	0.37935	0.21890	0.08838	0.97443	11.7576	0.06539	0.90844
36	9001684A	WV-66A-85.5-8	66	2.61559	0.05924	10.8518	0.049835	0.38755	0.18997	0.09223	0.99065	11.9480	0.05830	0.94398
37	9001684B	WV-66A-85.5-8	66	2.62441	0.00000	10.8280	0.047447	0.38656	0.19428	0.08650	0.99545	12.0038	0.05620	0.93435
38	9001631A	WV-66A-85.5-1	66	2.55963	0.32651	10.7612	0.057018	0.38318	0.24364	0.09608	0.97285	11.7829	0.12312	0.92694

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
20	44.3823	0.046678	0.79853	2.06678	0.48062	6.70517	0.028653	0.013413	11.3774	3.26728	0.09315	3.49208	12	.	1	47.5	3
21	44.5549	0.047012	0.79999	2.06957	0.45879	6.55012	0.027572	0.012898	11.4100	3.28648	0.09542	3.44675	12	.	1	47.5	3
22	44.3798	0.054145	0.80616	2.06688	0.53233	6.76271	0.045632	0.025445	11.1984	3.14526	0.08725	3.83478	4	.	1	60.0	4
23	44.2938	0.049364	0.80565	2.07387	0.53382	6.72816	0.045163	0.027686	11.2646	3.16117	0.08678	3.93599	4	.	1	60.0	4
24	44.0135	0.048382	0.80623	2.06793	0.48593	6.66770	0.029605	0.023416	11.3874	3.24512	0.10071	3.94167	8	.	1	60.0	4
25	43.9941	0.049342	0.80769	2.06503	0.48619	6.67541	0.029868	0.025951	11.3699	3.25672	0.08703	3.80366	8	.	1	60.0	4
26	44.3243	0.048119	0.78817	2.03055	0.49358	6.84283	0.030625	0.028326	11.3009	3.27728	0.08602	3.48926	12	.	1	60.0	4
27	44.2995	0.052048	0.80577	2.05825	0.41781	6.68791	0.027245	0.018170	11.4844	3.29981	0.09014	3.36907	12	.	1	60.0	4
28	43.1299	0.047298	0.81505	2.10998	0.49159	6.85241	0.029751	0.019898	11.5090	3.31698	0.09035	3.97494	4	.	1	75.0	5
29	43.1968	0.046257	0.81300	2.10976	0.48254	6.77428	0.029655	0.021683	11.4833	3.30823	0.09243	4.11630	4	.	1	75.0	5
30	43.3622	0.048175	0.82925	2.12176	0.42513	6.58604	0.028584	0.019297	11.5978	3.34999	0.10114	3.90560	8	.	1	75.0	5
31	43.0729	0.048605	0.82868	2.10769	0.46089	6.89275	0.030564	0.023934	11.6414	3.34151	0.09122	3.87694	8	.	1	75.0	5
32	44.9637	0.050862	0.81054	2.08162	0.37403	6.10830	0.023582	0.017207	11.2994	3.27602	0.08211	3.67243	12	.	1	75.0	5
33	44.6394	0.053382	0.80775	2.07229	0.39689	6.36401	0.026496	0.025229	11.3260	3.29608	0.08433	3.61707	12	.	1	75.0	5
34	43.5153	0.050878	0.82257	2.12313	0.47813	6.65750	0.029505	0.023474	11.5759	3.34183	0.09116	3.50848	4	.	1	85.5	6
35	43.4881	0.048391	0.81885	2.11720	0.50016	6.75433	0.030364	0.021518	11.5608	3.32733	0.08981	3.44648	4	.	1	85.5	6
36	42.1752	0.050034	0.85367	2.16656	0.51481	6.89916	0.031473	0.021433	11.8595	3.43569	0.09289	3.71237	8	.	1	85.5	6
37	42.3277	0.048030	0.83753	2.16943	0.50020	6.86415	0.030349	0.013976	11.8449	3.42902	0.09354	3.68413	8	.	1	85.5	6
38	42.5081	0.062871	0.82546	2.11256	0.50014	6.87033	0.031833	0.044018	11.7520	3.38184	0.08805	3.58980	12	.	1	85.5	6

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
39	9001631B	WV-66A-85.5-1	66	2.58658	0.36406	10.7881	0.058835	0.38296	0.24632	0.09432	0.97284	11.7787	0.11556	0.91560
40	9001708A	WV-66A-103-4	66	2.52658	0.14806	10.3862	0.048577	0.37791	0.21176	0.08873	0.95370	11.4549	0.08148	0.91050
41	9001708B	WV-66A-103-4	66	2.52868	0.15487	10.3453	0.049227	0.37715	0.21576	0.08827	0.95162	11.4742	0.09139	0.90789
42	9001695A	WV-66A-103-8	66	2.59635	0.09349	10.6709	0.053520	0.39351	0.21881	0.09157	0.98915	11.9759	0.13186	0.88713
43	9001695B	WV-66A-103-8	66	2.63691	0.05946	10.7911	0.052982	0.39022	0.23831	0.08872	0.98464	11.9446	0.11853	0.92922
44	9001700A	WV-66A-103-1	66	2.61007	0.00000	10.6303	0.043889	0.38880	0.23119	0.08186	0.98063	11.9257	0.08435	0.88095
45	9001700B	WV-66A-103-1	66	2.59448	0.01795	10.6550	0.046106	0.38832	0.23413	0.08662	0.97910	11.9021	0.07959	0.91802
46	9001613A	WV-66A-SH1	66	2.50879	0.24330	10.3816	0.050154	0.38027	0.24076	0.08041	0.95824	11.5991	0.13789	0.88061
47	9001606A	WV-66A-SH2	66	2.55514	0.21059	10.4581	0.050377	0.39082	0.23506	0.07671	0.96374	11.6280	0.13531	0.83776
48	9001614A	WV-66A-SH2	66	2.44354	0.13524	10.1386	0.049366	0.30912	0.24478	0.08724	0.97298	11.6857	0.14337	0.90084
49	9001608A	WV-66A-SH3	66	2.49081	0.22359	10.4533	0.051292	0.38129	0.23493	0.07989	0.95991	11.6199	0.13875	0.87451
50	9001612A	WV-41A-SH1	41	2.56357	0.22883	10.4795	0.049440	0.26966	0.24397	0.16789	0.97016	11.7628	0.14683	0.86395
51	9001625A	WV-41A-SH3	41	2.57797	0.23690	10.7545	0.051588	0.27714	0.24853	0.18182	0.98409	11.9246	0.15700	0.93975
52	9001706A	WV-44A-7-4	44	2.58533	0.00000	10.6563	0.049421	0.25282	0.20729	0.18732	0.99805	12.1559	0.09148	0.97580
53	9001706B	WV-44A-7-4	44	2.64844	0.00000	10.6400	0.052569	0.25083	0.21732	0.18265	0.99865	12.1755	0.09692	0.93293
54	9001668A	WV-44A-7-8	44	2.49619	0.09925	10.5796	0.049549	0.24883	0.21060	0.15891	0.98224	11.7806	0.11447	0.57416
55	9001668B	WV-44A-7-8	44	2.53247	0.16178	10.5594	0.050826	0.24776	0.21117	0.16501	0.97554	11.7375	0.11694	0.65585
56	9001730A	WV-44A-7-12	44	2.59602	0.12073	10.3069	0.048129	0.24865	0.19437	0.19876	0.96394	11.6223	0.09489	0.92237
57	9001730B	WV-44A-7-12	44	2.54322	0.09142	10.3229	0.048037	0.23734	0.20905	0.19070	0.96930	11.7534	0.09772	0.78444

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
39	42.5700	0.066058	0.82798	2.11626	0.48907	6.85029	0.031201	0.041743	11.7637	3.39052	0.08856	3.46074	12	.	1	85.5	6
40	44.0402	0.047917	0.80948	2.08449	0.51259	6.77073	0.034717	0.023287	11.3567	3.26227	0.09635	3.77284	4	.	1	103.0	7
41	43.9895	0.048582	0.80805	2.07870	0.50345	6.76751	0.032974	0.025473	11.3235	3.24602	0.09957	3.89231	4	.	1	103.0	7
42	42.1702	0.059260	0.83945	2.15828	0.50163	6.85957	0.031195	0.039430	11.9482	3.43641	0.09178	3.76250	8	.	1	103.0	7
43	41.9730	0.053612	0.85723	2.16921	0.50017	6.88410	0.030382	0.024227	11.8045	3.43398	0.09702	3.93785	8	.	1	103.0	7
44	42.8898	0.045464	0.82198	2.13650	0.47954	6.73842	0.029652	0.013370	11.6027	3.34832	0.09180	3.94473	12	.	1	103.0	7
45	42.8574	0.049368	0.82574	2.13685	0.50204	6.85341	0.031319	0.023062	11.6572	3.35768	0.09389	3.71059	12	.	1	103.0	7
46	44.1058	0.052055	0.80399	2.06317	0.46047	6.67254	0.028292	0.016156	11.4011	3.28671	0.09307	3.55554	4	1	1	200.0	8
47	44.2155	0.050959	0.86197	2.07786	0.44098	6.50414	0.026615	0.011054	11.3801	3.28339	0.09189	3.51392	8	2	1	200.0	8
48	44.2458	0.046568	0.81304	2.06617	0.40808	6.75176	0.026556	0.000000	11.3695	3.22047	0.09301	3.84830	8	2	1	200.0	8
49	44.1401	0.052036	0.80964	2.06880	0.44407	6.63395	0.027362	0.016665	11.3896	3.28818	0.08942	3.53215	12	3	1	200.0	8
50	43.8309	0.055740	0.80974	2.15271	0.46080	6.50325	0.030248	0.013763	11.4664	3.28734	0.09439	3.54811	4	1	2	0.0	0
51	42.4556	0.060628	0.83043	2.21036	0.51934	6.81860	0.033292	0.029452	11.7313	3.35286	0.09796	3.52617	12	3	2	0.0	0
52	41.6830	0.056594	0.85672	2.29003	0.53209	6.84913	0.033705	0.012817	11.9733	3.42999	0.09917	4.02369	4	.	2	7.0	1
53	41.8185	0.061167	0.85915	2.28944	0.46841	6.72997	0.031055	0.020904	11.9637	3.40328	0.09452	4.06415	4	.	2	7.0	1
54	44.5383	0.054107	0.82301	2.20531	0.35868	6.04905	0.025897	0.010514	11.4692	3.34040	0.09453	3.73666	8	.	2	7.0	1
55	44.5291	0.058349	0.81969	2.19263	0.39823	6.12170	0.027213	0.021981	11.4390	3.30524	0.07811	3.59446	8	.	2	7.0	1
56	43.5788	0.053190	0.82739	2.20382	0.54497	6.68342	0.031979	0.021711	11.5231	3.23099	0.10023	3.88336	12	.	2	7.0	1
57	43.9181	0.052265	0.83148	2.21716	0.47261	6.41526	0.029994	0.018623	11.4643	3.23867	0.09773	3.99629	12	.	2	7.0	1

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
58	9001658A	WV-44A-23-4	44	2.61298	0.25358	10.8254	0.053933	0.23467	0.22496	0.19898	0.99080	11.9418	0.09896	0.76090
59	9001658B	WV-44A-23-4	44	2.64311	0.14433	10.7715	0.049398	0.23056	0.20537	0.20352	0.98559	11.8417	0.08852	0.84103
60	9001652A	WV-44A-23-8	44	2.58107	0.22665	11.0324	0.052029	0.24002	0.25678	0.18376	1.00015	12.0440	0.11656	0.45329
61	9001652B	WV-44A-23-8	44	2.59496	0.24833	11.0319	0.051810	0.23829	0.23700	0.18633	0.99980	12.0696	0.11262	0.44597
62	9001698A	WV-44A-23-12	44	2.68550	0.00000	10.8761	0.042094	0.27161	0.24185	0.15116	1.02180	12.7368	0.11694	0.64760
63	9001698B	WV-44A-23-12	44	2.64974	0.00000	10.8190	0.042740	0.26882	0.23589	0.16045	1.01943	12.6503	0.11026	0.77754
64	9001685A	WV-44A-37-4	44	2.61835	0.00000	10.8949	0.046055	0.22148	0.18105	0.20849	1.00973	12.2274	0.13644	0.82279
65	9001685B	WV-44A-37-4	44	2.62553	0.00000	10.9161	0.042444	0.22042	0.17387	0.19448	1.01237	12.2778	0.13016	0.78888
66	9001696A	WV-44A-37-8	44	2.70495	0.04633	10.9633	0.043599	0.22353	0.23662	0.18212	1.00069	12.2071	0.09466	0.57523
67	9001696B	WV-44A-37-8	44	2.69641	0.03751	10.9352	0.043416	0.22279	0.23791	0.18555	0.99757	12.1908	0.09705	0.63898
68	9001737A	WV-44A-37-12	44	2.54436	0.18539	10.1954	0.052959	0.21066	0.22819	0.21041	0.94095	11.5375	0.11003	0.88781
69	9001737B	WV-44A-37-12	44	2.62331	0.26984	10.3253	0.059002	0.21530	0.23927	0.19967	0.94680	11.5817	0.11462	0.61240
70	9001736A	WV-44A-47-4	44	2.60698	0.14491	10.5905	0.050543	0.20607	0.21995	0.21219	0.97657	11.9568	0.10633	0.72423
71	9001736B	WV-44A-47-4	44	2.62166	0.19279	10.5738	0.054032	0.20854	0.22627	0.22301	0.97537	11.9237	0.11042	0.90701
72	9001732A	WV-44A-47-8	44	2.55306	0.09185	10.5346	0.049295	0.20844	0.22070	0.22467	0.96898	11.7817	0.13520	0.88315
73	9001732B	WV-44A-47-8	44	2.56041	0.05114	10.5569	0.046986	0.20593	0.21773	0.22355	0.97046	11.8138	0.13443	0.88254
74	9001705A	WV-44A-47-12	44	2.64068	0.00000	10.6959	0.048694	0.20809	0.20293	0.21462	1.00071	12.1753	0.09892	0.99459
75	9001705B	WV-44A-47-12	44	2.62521	0.00000	10.7055	0.046992	0.21041	0.20970	0.21174	1.00512	12.2634	0.10225	0.94315
76	9001673A	WV-44A-61-4	44	2.64706	0.17329	10.5186	0.048183	0.20065	0.21871	0.21490	0.97819	11.8507	0.12547	0.72029

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
58	42.9154	0.062652	0.82490	2.23418	0.47536	6.46788	0.031222	0.029938	11.7608	3.35773	0.09151	3.55149	4	.	2	23	2
59	43.1511	0.058384	0.83580	2.23963	0.49730	6.59338	0.031913	0.022260	11.6636	3.32927	0.09297	3.47979	4	.	2	23	2
60	43.3496	0.060911	0.84827	2.27258	0.31374	5.96246	0.026710	0.019038	11.7099	3.39373	0.08707	3.76928	8	.	2	23	2
61	43.3907	0.061632	0.84546	2.26952	0.30711	5.94697	0.027089	0.021108	11.6991	3.39181	0.08848	3.73440	8	.	2	23	2
62	42.0903	0.055293	0.86933	2.41657	0.33866	6.06990	0.023777	0.006612	11.9142	3.34596	0.09900	3.97898	12	.	2	23	2
63	41.7504	0.055936	0.86164	2.40081	0.39013	6.46480	0.027703	0.011822	11.9567	3.36338	0.09184	3.89064	12	.	2	23	2
64	42.1250	0.053401	0.84556	2.29996	0.47864	6.57616	0.031490	0.011417	11.8627	3.42972	0.09509	3.82420	4	.	2	37	3
65	42.2597	0.047569	0.84454	2.30640	0.44914	6.34690	0.029593	0.000000	11.8505	3.43903	0.09674	3.94791	4	.	2	37	3
66	43.2560	0.053297	0.85560	2.30807	0.28703	5.86630	0.022711	0.007620	11.7582	3.36383	0.09213	3.85107	8	.	2	37	3
67	43.0809	0.054805	0.85269	2.29568	0.33887	6.02538	0.024454	0.012911	11.7480	3.36216	0.09092	3.82998	8	.	2	37	3
68	43.0437	0.058649	0.83542	2.15042	0.49265	7.70057	0.034489	0.032476	11.3785	3.15775	0.08927	3.92232	12	.	2	37	3
69	43.6832	0.068066	0.85284	2.16634	0.34073	7.25565	0.028701	0.047362	11.2429	3.10014	0.08948	3.93746	12	.	2	37	3
70	43.0669	0.054140	0.82520	2.24166	0.44822	6.42539	0.030031	0.014317	11.6381	3.28590	0.09559	4.07951	4	.	2	47	4
71	42.5364	0.060345	0.82582	2.23286	0.48498	6.76160	0.032063	0.030318	11.7556	3.26579	0.09323	3.90442	4	.	2	47	4
72	42.8196	0.056336	0.82230	2.23126	0.54528	6.79153	0.057556	0.026138	11.7505	3.23047	0.09623	3.92112	8	.	2	47	4
73	42.7857	0.053460	0.82165	2.23209	0.53859	6.78354	0.055722	0.020735	11.7687	3.23847	0.10103	3.93642	8	.	2	47	4
74	41.5004	0.054506	0.85375	2.30927	0.53221	6.82762	0.033746	0.006632	12.0135	3.42861	0.09936	4.05999	12	.	2	47	4
75	41.6255	0.052328	0.85638	2.31912	0.49557	6.69578	0.032097	0.002334	11.9749	3.41445	0.10739	4.10077	12	.	2	47	4
76	43.5412	0.060950	0.81946	2.22200	0.42514	6.34075	0.029628	0.021494	11.7196	3.31904	0.09871	3.70597	4	.	2	61	5

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
77	9001673B	WV-44A-61-4	44	2.59620	0.18405	10.5295	0.048701	0.19397	0.21524	0.21131	0.97781	11.8363	0.12276	0.75980
78	9001672A	WV-44A-61-8	44	2.57820	0.41599	10.5592	0.058696	0.19350	0.24128	0.23055	0.95946	11.6359	0.12333	0.75330
79	9001672B	WV-44A-61-8	44	2.56557	0.20129	10.5399	0.051293	0.19300	0.23076	0.21716	0.97343	11.7893	0.11537	0.70696
80	9001686A	WV-44A-61-12	44	2.62069	0.00000	10.8667	0.044267	0.19602	0.18671	0.22881	1.00818	12.2409	0.11228	0.82183
81	9001686B	WV-44A-61-12	44	2.59736	0.01067	10.8395	0.045923	0.19562	0.18898	0.23272	1.00371	12.1936	0.11385	0.86776
82	9001729A	WV-44A-74-4	44	2.58412	0.13275	10.3788	0.048141	0.18271	0.22857	0.24288	0.96906	11.7582	0.11722	0.91991
83	9001729B	WV-44A-74-4	44	2.60184	0.14019	10.3268	0.048257	0.18272	0.22625	0.24165	0.96565	11.7339	0.11775	0.91297
84	9001627A	WV-44A-74-8	44	2.58100	0.27945	10.6047	0.050565	0.18528	0.22091	0.22489	0.96339	11.6760	0.11539	0.91590
85	9001627B	WV-44A-74-8	44	2.58863	0.30816	10.7742	0.053149	0.18917	0.22718	0.24292	0.98070	11.8902	0.12472	0.93404
86	9001674A	WV-44A-74-12	44	2.63157	0.17406	10.4916	0.047976	0.18772	0.23506	0.22008	0.97923	11.9209	0.14005	0.76615
87	9001674B	WV-44A-74-12	44	2.58947	0.20354	10.4939	0.048835	0.18690	0.23156	0.22625	0.97525	11.8387	0.13807	0.80251
88	9001671A	WV-44A-86-4	44	2.55976	0.12494	10.5896	0.047711	0.17312	0.22052	0.21867	0.98075	11.8844	0.11043	0.64164
89	9001671B	WV-44A-86-4	44	2.59611	0.39779	10.6904	0.057385	0.17562	0.23794	0.22739	0.97208	11.7694	0.12216	0.51440
90	9001709A	WV-44A-86-8	44	2.53267	0.12151	10.2546	0.046757	0.17349	0.21968	0.24055	0.95932	11.6514	0.11389	0.91289
91	9001709B	WV-44A-86-8	44	2.55932	0.22270	10.2406	0.052607	0.17577	0.23212	0.24492	0.95477	11.5800	0.12209	0.90422
92	9001665A	WV-44A-86-12	44	2.60669	0.17617	10.8285	0.048402	0.17860	0.21442	0.22490	0.99328	11.9874	0.11010	0.67191
93	9001665B	WV-44A-86-12	44	2.59724	0.27752	10.5611	0.052938	0.17318	0.21524	0.23195	0.97134	11.7096	0.11672	0.71475
94	9001616A	WV-44A-SH1	44	2.50612	0.18987	10.4299	0.048403	0.14197	0.24534	0.22862	0.98804	11.9680	0.16269	0.90960
95	9001607A	WV-44A-SH2	44	2.54847	0.18483	10.5313	0.047672	0.17262	0.24143	0.22267	0.97783	11.8581	0.16031	0.80762

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
77	43.5821	0.061048	0.82211	2.22442	0.42312	6.40939	0.029808	0.023365	11.7206	3.32442	0.09431	3.60985	4	.	2	61	5
78	43.6637	0.072724	0.81469	2.18063	0.45396	6.52439	0.033251	0.049718	11.6557	3.33792	0.08047	3.38350	8	.	2	61	5
79	44.0440	0.058967	0.80728	2.19641	0.43164	6.32606	0.030176	0.022875	11.4830	3.29977	0.08490	3.63090	8	.	2	61	5
80	41.9606	0.051842	0.84529	2.30949	0.49075	6.66715	0.032370	0.009814	11.9693	3.45236	0.09694	3.78762	12	.	2	61	5
81	41.8570	0.054606	0.84352	2.30010	0.49743	6.75684	0.033260	0.016121	11.9628	3.43604	0.09581	3.85678	12	.	2	61	5
82	43.3409	0.053377	0.82685	2.22847	0.52083	6.67325	0.033078	0.022291	11.5900	3.25222	0.09924	3.79706	4	.	2	74	6
83	43.2625	0.053841	0.82470	2.22357	0.50254	6.64959	0.032905	0.023495	11.5157	3.22514	0.09699	4.09108	4	.	2	74	6
84	43.5047	0.060845	0.81136	2.20786	0.49682	6.58535	0.032355	0.020397	11.5856	3.28384	0.09125	3.50216	8	.	2	74	6
85	42.3678	0.064486	0.82730	2.24637	0.51574	6.77982	0.034538	0.034967	11.8450	3.35805	0.09038	3.52253	8	.	2	74	6
86	43.5649	0.058999	0.82199	2.23081	0.43391	6.39641	0.030070	0.019778	11.6481	3.32426	0.09427	3.58213	12	.	2	74	6
87	43.3519	0.062290	0.82189	2.22322	0.46844	6.50183	0.031643	0.026521	11.6706	3.32504	0.09433	3.68733	12	.	2	74	6
88	44.3087	0.052203	0.81111	2.22764	0.38082	6.10063	0.028174	0.010585	11.4518	3.29960	0.09333	3.68386	4	.	2	86	7
89	44.1170	0.070949	0.82534	2.21711	0.35671	6.08347	0.030009	0.043072	11.6075	3.34618	0.09137	3.45067	4	.	2	86	7
90	43.9190	0.052632	0.80851	2.21433	0.59199	6.73776	0.062702	0.021710	11.3498	3.14806	0.08994	3.77686	8	.	2	86	7
91	43.7633	0.062806	0.81147	2.19936	0.57961	6.72725	0.056405	0.040538	11.4098	3.13755	0.08549	3.83733	8	.	2	86	7
92	43.3822	0.056910	0.83886	2.28252	0.38026	6.17413	0.028549	0.017248	11.7738	3.34274	0.09779	3.58462	12	.	2	86	7
93	43.8443	0.062180	0.82452	2.19693	0.44511	6.35404	0.031125	0.032879	11.5102	3.30269	0.09692	3.67756	12	.	2	86	7
94	44.3246	0.052292	0.83241	2.25948	0.43056	6.61578	0.030272	0.004384	11.5976	3.25951	0.09738	2.67719	4	1	2	200	8
95	43.7459	0.054108	0.82021	2.21698	0.40118	6.36911	0.028505	0.012653	11.5410	3.26819	0.09762	3.69169	8	2	2	200	8

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
96	9001597A	WV-44A-SH3	44	2.59352	0.16807	10.6766	0.048210	0.17658	0.24395	0.22933	0.99231	12.0925	0.16228	0.92034
97	9001605A	WV-48A-SH1	48	2.63438	0.20883	10.6414	0.049842	0.19441	0.25069	0.22817	0.99991	12.3346	0.16735	0.93635
98	9001618A	WV-48A-SH2	48	2.53389	0.28522	10.2717	0.052220	0.16127	0.25443	0.21337	0.98743	12.0969	0.16819	0.89056
99	9001624A	WV-48A-SH3	48	2.64365	0.23074	10.7874	0.051131	0.19505	0.25247	0.23121	0.99773	12.2329	0.16804	0.93942
100	9001681A	WV-47A-12-4	47	2.57565	0.17878	10.4149	0.048045	0.20343	0.20659	0.21161	0.98157	12.0189	0.06770	0.90299
101	9001681B	WV-47A-12-4	47	2.59965	0.16451	10.4213	0.048300	0.20317	0.20246	0.20756	0.98335	12.0237	0.06375	0.87575
102	9001731A	WV-47A-12-8	47	2.57854	0.10355	10.2679	0.049710	0.20906	0.23391	0.22013	0.98351	12.1057	0.11229	0.92558
103	9001731B	WV-47A-12-8	47	2.61946	0.18827	10.2810	0.050767	0.20793	0.23974	0.21933	0.97783	12.0392	0.11917	0.86029
104	9001703A	WV-47A-12-12	47	2.60322	0.00000	10.8084	0.048513	0.20993	0.20856	0.21374	1.00969	12.4125	0.05364	0.96281
105	9001703B	WV-47A-12-12	47	2.62136	0.01028	10.8302	0.051235	0.21036	0.21263	0.22101	1.00750	12.3972	0.05647	0.95508
106	9001632A	WV47A-24-4-A	47	2.62417	0.20305	10.7095	0.050357	0.23351	0.23370	0.19716	1.00468	12.3821	0.12181	0.92632
107	9001632B	WV47A-24-4-B	47	2.60834	0.14083	10.6595	0.047711	0.31495	0.22302	0.18779	1.00612	12.3767	0.11610	0.93673
108	9001659A	WV47A-24-8-A	47	2.66634	0.22877	10.7943	0.052181	0.22767	0.23749	0.19591	1.00300	12.3083	0.11429	0.74020
109	9001659B	WV47A-24-8-B	47	2.62037	0.17079	10.7696	0.049199	0.22677	0.22797	0.19484	1.00628	12.3458	0.10894	0.74112
110	9001653A	WV47A-24-12-A	47	2.60003	0.25378	10.9193	0.051868	0.22845	0.23868	0.19736	1.00952	12.3774	0.11734	0.58079
111	9001653B	WV47A-24-12-B	47	2.57273	0.27021	10.8937	0.052208	0.22869	0.24418	0.19749	1.00689	12.3458	0.11654	0.70153
112	9001711A	WV-47A-36-4	47	2.54621	0.23589	10.4287	0.049730	0.22943	0.22637	0.19757	0.97023	11.9742	0.09382	0.91183
113	9001711B	WV-47A-36-4	47	2.56752	0.32100	10.3516	0.052865	0.22697	0.23275	0.20407	0.95895	11.8305	0.10151	0.89827
114	9001683A	WV-47A-36-8	47	2.58592	0.13298	10.4237	0.046916	0.22650	0.20568	0.18326	0.98756	12.1298	0.06348	0.85335

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
96	42.5595	0.054784	0.76172	2.28330	0.48742	6.63144	0.030693	0.002040	11.7003	3.32996	0.09901	3.75617	12	3	2	200	8
97	41.9446	0.058877	0.77105	2.34358	0.51353	6.72369	0.032609	0.019190	11.8578	3.34395	0.10352	3.64162	4	1	3	0	0
98	43.3774	0.059472	0.83903	2.29548	0.41760	6.55843	0.029795	0.018703	11.6298	3.23157	0.10347	3.52410	8	2	3	0	0
99	41.7828	0.057965	0.84474	2.32371	0.50904	6.78757	0.033082	0.024807	11.8627	3.32917	0.10267	3.61205	12	3	3	0	0
100	43.2302	0.055022	0.81213	2.27498	0.50638	6.65109	0.031836	0.016399	11.6581	3.27875	0.10218	3.57282	4	.	3	12	1
101	43.2789	0.053586	0.81332	2.28129	0.50537	6.58616	0.031314	0.013749	11.6715	3.28833	0.10115	3.58173	4	.	3	12	1
102	42.7746	0.057005	0.84376	2.31223	0.51298	6.66645	0.032554	0.031154	11.6622	3.20611	0.10681	4.00419	8	.	3	12	1
103	42.6359	0.061370	0.95102	2.30450	0.49435	6.59361	0.032915	0.037314	11.7434	3.23302	0.10763	4.00190	8	.	3	12	1
104	40.8981	0.056340	0.86852	2.40259	0.53328	6.85940	0.034612	0.010187	12.1558	3.45617	0.10667	4.08745	12	.	3	12	1
105	40.7674	0.063234	0.87399	2.40487	0.53927	6.91538	0.038516	0.024403	12.1963	3.46777	0.11049	4.02506	12	.	3	12	1
106	41.9396	0.058500	0.77527	2.36550	0.50419	6.68451	0.031176	0.013414	11.8252	3.34932	0.10082	3.66616	4	.	3	24	2
107	42.0266	0.054082	0.77014	2.36702	0.51126	6.65771	0.030244	0.000000	11.8129	3.34026	0.10043	3.71158	4	.	3	24	2
108	42.2663	0.065132	0.85272	2.34955	0.44960	6.46782	0.030562	0.031152	11.8924	3.33900	0.10275	3.58463	8	.	3	24	2
109	42.4127	0.058716	0.85135	2.35807	0.47011	6.49428	0.030284	0.019429	11.9158	3.35433	0.10074	3.47247	8	.	3	24	2
110	42.2199	0.063479	0.85074	2.35759	0.43024	6.27386	0.029877	0.025600	11.8637	3.39205	0.09831	3.82022	12	.	3	24	2
111	42.0577	0.063826	0.84674	2.34965	0.44684	6.44594	0.030729	0.030645	11.9074	3.38711	0.09906	3.70445	12	.	3	24	2
112	42.7613	0.061361	0.83071	2.28305	0.52937	6.72757	0.040673	0.029607	11.6250	3.24167	0.10246	3.90328	4	.	3	36	3
113	43.1104	0.067212	0.82750	2.25518	0.50147	6.69467	0.035521	0.045508	11.5983	3.21789	0.09555	3.80484	4	.	3	36	3
114	43.1844	0.051447	0.82226	2.29312	0.49508	6.54608	0.030298	0.005719	11.6535	3.27903	0.09971	3.70026	8	.	3	36	3

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
115	9001683B	WV-47A-36-8	47	2.59497	0.16997	10.4551	0.048166	0.22645	0.20626	0.18800	0.98405	12.0870	0.06436	0.85395
116	9001733A	WV-47A-36-12	47	2.62662	0.00385	10.7074	0.047135	0.23108	0.22376	0.19620	0.99866	12.3453	0.08511	0.78640
117	9001733B	WV-47A-36-12	47	2.59996	0.00000	10.6376	0.046146	0.22983	0.20384	0.20114	0.99688	12.2283	0.07277	0.90570
118	9001688A	WV-47A-50-4	47	2.66054	0.12663	10.8151	0.052864	0.24903	0.20208	0.19155	1.01563	12.5395	0.09189	0.85844
119	9001688B	WV-47A-50-4	47	2.62708	0.06294	10.8029	0.049744	0.24664	0.19806	0.18741	1.02111	12.6226	0.08779	0.83887
120	9001678A	WV-47A-50-8	47	2.53923	0.03718	10.3415	0.044146	0.24556	0.23503	0.18153	1.00167	12.3161	0.11775	0.91900
121	9001678B	WV-47A-50-8	47	2.58818	0.15185	10.4232	0.049376	0.24236	0.23112	0.17917	0.98959	12.1546	0.11591	0.85398
122	9001680A	WV-47A-50-12	47	2.54370	0.12187	10.4446	0.047458	0.23994	0.19821	0.17667	0.99032	12.1312	0.06575	0.82793
123	9001680B	WV-47A-50-12	47	2.57366	0.16714	10.4335	0.047605	0.23880	0.18576	0.18404	0.98601	12.0408	0.06000	0.91477
124	9001687A	WV-47A-63-4	47	2.66303	0.00413	10.8534	0.047043	0.25705	0.20011	0.17994	1.02483	12.6454	0.08668	0.85817
125	9001687B	WV-47A-63-4	47	2.64391	0.02826	10.8759	0.047937	0.26497	0.19953	0.17302	1.02302	12.6599	0.08917	0.78102
126	9001670A	WV-47A-63-8	47	2.55347	0.15943	10.5625	0.051420	0.24797	0.23476	0.16575	0.99261	12.2226	0.11482	0.70024
127	9001670B	WV-47A-63-8	47	2.55640	0.14788	10.5535	0.050900	0.24964	0.23719	0.16998	0.99574	12.2689	0.11919	0.66443
128	9001657A	WV-47A-63-12	47	2.65532	0.28242	10.9926	0.053850	0.26194	0.24033	0.15347	1.00888	12.4987	0.09298	0.55721
129	9001657B	WV-47A-63-12	47	2.68235	0.37540	11.0746	0.058977	0.26348	0.24357	0.16120	1.01090	12.4471	0.09173	0.49703
130	9001734A	WV-47A-76-4	47	2.60327	0.05105	10.5412	0.047672	0.26023	0.21483	0.17323	0.99649	12.3318	0.10394	0.91517
131	9001734B	WV-47A-76-4	47	2.61988	0.06819	10.6035	0.048959	0.26252	0.21715	0.16293	0.99991	12.3977	0.10199	0.78696
132	9001735A	WV-47A-76-8	47	2.61564	0.07780	10.5988	0.049170	0.26204	0.23008	0.16585	0.99806	12.4777	0.10474	0.79736
133	9001735B	WV-47A-76-8	47	2.61559	0.09085	10.6319	0.049522	0.26221	0.22986	0.16711	0.99985	12.4700	0.10534	0.71138

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
115	43.1614	0.054483	0.81895	2.29027	0.50499	6.59182	0.030657	0.013198	11.6951	3.28598	0.09664	3.57816	8	.	3	36	3
116	42.0999	0.055036	0.84780	2.35247	0.45459	6.57608	0.032475	0.019137	11.8985	3.35109	0.10978	3.95171	12	.	3	36	3
117	41.9955	0.053384	0.84473	2.34995	0.48470	6.78520	0.034265	0.019610	11.8896	3.32777	0.10964	3.98344	12	.	3	36	3
118	40.9773	0.070364	0.86644	2.39765	0.49257	6.81289	0.033055	0.041338	12.1985	3.44966	0.10143	3.75556	4	.	3	50	4
119	41.1073	0.065420	0.86574	2.40852	0.48956	6.74964	0.031966	0.028124	12.2073	3.44096	0.10255	3.75767	4	.	3	50	4
120	42.5667	0.056749	0.84205	2.34338	0.51086	6.70362	0.031385	0.012780	11.8617	3.32355	0.10257	3.66599	8	.	3	50	4
121	43.0285	0.056919	0.82800	2.30257	0.49472	6.61413	0.030795	0.017626	11.6929	3.30496	0.10149	3.54801	8	.	3	50	4
122	43.1835	0.053602	0.82197	2.30753	0.49814	6.54640	0.029925	0.008675	11.6956	3.30164	0.10261	3.66277	12	.	3	50	4
123	43.0328	0.055447	0.81992	2.29990	0.51350	6.70618	0.031638	0.015925	11.7149	3.29163	0.10230	3.58369	12	.	3	50	4
124	41.0607	0.059466	0.86462	2.41493	0.50263	6.75888	0.031682	0.016887	12.1248	3.45397	0.10312	3.78851	4	.	3	63	5
125	41.1414	0.060467	0.86663	2.41336	0.47480	6.61370	0.030433	0.016424	12.1203	3.45031	0.10396	3.92167	4	.	3	63	5
126	43.2446	0.060979	0.83236	2.30786	0.41748	6.32627	0.028555	0.021703	11.6280	3.34222	0.09506	3.68941	8	.	3	63	5
127	43.1951	0.060606	0.83501	2.31625	0.40186	6.27697	0.028662	0.023442	11.6403	3.34439	0.10794	3.75580	8	.	3	63	5
128	42.5152	0.066769	0.85822	2.38226	0.35298	5.93515	0.023854	0.028319	11.8534	3.33329	0.10548	3.74741	12	.	3	63	5
129	42.3823	0.075732	0.86509	2.38648	0.27292	5.88693	0.024962	0.044733	11.9693	3.35685	0.09414	3.73420	12	.	3	63	5
130	41.9723	0.053763	0.84033	2.35438	0.51400	6.72684	0.031206	0.016694	11.8275	3.29556	0.09971	4.02886	4	.	3	76	6
131	42.1629	0.054849	0.85014	2.36652	0.43040	6.47997	0.028511	0.012914	11.8264	3.29507	0.10491	4.11780	4	.	3	76	6
132	41.9421	0.054749	0.84549	2.36247	0.44969	6.55531	0.029118	0.011462	11.8368	3.30252	0.10544	4.12762	8	.	3	76	6
133	42.1686	0.056229	0.84815	2.36718	0.43491	6.45730	0.029104	0.015352	11.7978	3.30254	0.10767	4.08169	8	.	3	76	6

OBS	LOG_	SAMPLE_N	CAN	P_OXID	S_OXID	B_OXID	MO_OXID	ZN_OXID	NI_OXID	BA_OXID	MN_OXID	FE_OXID	CR_OXID	MG_OXID
134	9001675A	WV-47A-76-12	47	2.60909	0.12370	10.5560	0.047089	0.26386	0.23591	0.15649	0.99980	12.3686	0.12408	0.81394
135	9001675B	WV-47A-76-12	47	2.62769	0.16458	10.5698	0.048415	0.26432	0.24316	0.15957	0.99771	12.3515	0.12802	0.76879
136	9001655A	WV-47A-88-4	47	2.58940	0.27222	10.9341	0.053488	0.27691	0.22555	0.16781	1.01049	12.4482	0.08952	0.69176
137	9001655B	WV-47A-88-4	47	2.60619	0.25171	10.9755	0.052505	0.27754	0.22601	0.16528	1.01419	12.5392	0.09056	0.62748
138	9001651A	WV-47A-88-8	47	2.60010	0.22980	10.5019	0.048365	0.26814	0.22561	0.15684	0.99040	12.1983	0.10767	0.87112
139	9001651B	WV-47A-88-8	47	2.55252	0.24975	10.5653	0.048995	0.26903	0.22971	0.15540	0.99141	12.2876	0.11671	0.80524
140	9001676A	WV-47A-88-12	47	2.64039	0.25800	10.6371	0.052207	0.27231	0.23539	0.15717	0.99338	12.2919	0.11481	0.69841
141	9001676B	WV-47A-88-12	47	2.62073	0.11834	10.5497	0.047169	0.26991	0.22154	0.15531	0.99687	12.3135	0.10718	0.79301
142	9001626A	WV-47A-SH1	47	2.62717	0.26563	10.8439	0.052466	0.27741	0.26065	0.17954	1.00736	12.5169	0.16952	0.93430
143	9001596A	WV-474-SH2	47	2.63023	0.15684	10.6569	0.049109	0.28076	0.25539	0.16281	1.00819	12.5347	0.16540	0.93539
144	9001609A	WV-47A-SH3	47	2.56493	0.16924	10.5717	0.048756	0.27478	0.25012	0.14905	1.00021	12.4222	0.16111	0.75334

OBS	SI_OXID	CU_OXID	TI_OXID	ZR_OXID	CA_OXID	AL_OXID	SR_OXID	LA_OXID	NA_OXIDE	LI_OXIDE	CS_OXIDE	K_OXIDE	RADIAL	SHARD	BATCH	DEPTH	HEIGHT
134	42.7146	0.061347	0.84395	2.34308	0.42226	6.41430	0.028218	0.018188	11.7605	3.29596	0.09924	3.69989	12	.	3	76	6
135	42.7156	0.064869	0.84845	2.34213	0.40725	6.41539	0.028295	0.024731	11.8209	3.32572	0.10022	3.58291	12	.	3	76	6
136	41.7676	0.066394	0.85240	2.37399	0.46483	6.47831	0.030835	0.033250	11.9486	3.41148	0.10886	3.70397	4	.	3	88	7
137	41.8867	0.064918	0.85497	2.38393	0.45175	6.36126	0.030132	0.029609	11.9287	3.41409	0.10153	3.66619	4	.	3	88	7
138	42.6523	0.060676	0.83079	2.30801	0.46579	6.60609	0.029869	0.016714	11.7873	3.31072	0.10473	3.62873	8	.	3	88	7
139	42.8141	0.061801	0.83547	2.31951	0.42623	6.46895	0.028582	0.022753	11.7383	3.30000	0.09682	3.61582	8	.	3	88	7
140	42.6781	0.071191	0.85464	2.34379	0.37572	6.34488	0.028293	0.034039	12.0024	3.36841	0.10019	3.44730	12	.	3	88	7
141	42.5442	0.061205	0.84393	2.34133	0.44794	6.51160	0.029077	0.018698	11.8909	3.34311	0.10436	3.67047	12	.	3	88	7
142	41.1139	0.068827	0.85379	2.36987	0.53295	6.84549	0.033915	0.042117	11.9973	3.36390	0.10217	3.54095	4	1	3	200	8
143	41.5044	0.057829	0.77915	2.38076	0.54691	6.77621	0.031335	0.019774	11.8564	3.34070	0.10507	3.76573	8	2	3	200	8
144	42.8883	0.058925	0.83998	2.32927	0.40320	6.27369	0.026950	0.014660	11.7473	3.30143	0.10379	3.64713	12	3	3	200	8