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TO: Dave Bradley

FROM: Jim Cubbage

SUBJECT: Sediment Contamination in Eagle Harbor

DATE: 7 March 1988

Enclosed is the material about PAH and Eagle Harbor you loaned me. Thanks for the loan and the help. You requested I let you know of anything I found about fingerprinting PAH's. The following is a very preliminary review of some results of work I have done in preparation for intertidal sediment sampling in Elliott Bay north of the Wyckoff property.

The clustering algorithm used by Tetra Tech to associate different PAH in Eagle Harbor by location may not be appropriate. The authors of the report disclaim quantitative usefulness of clustering and to some extent they are correct in that statistical significance cannot be directly assessed. However, some methods may be more appropriate than others. They used Euclidean distance as the basis of clustering. These distances are related to the absolute concentrations of PAH as well as the relative concentrations of components and thus the samples with high concentrations of PAH have a disproportionate influence on the clustering. Perhaps this was their intent, but they appeared to be trying to minimize these effects by using log transforms and indexes. I ran similar data (levels of HPAH only from samples of sediments in Eagle Harbor along with sediment samples taken by Yake et al. near the Wyckoff site) through a clustering algorithm that grouped locations strictly on the basis of correlations in HPAH component ratios. LPAH were not considered in this evaluation. Total concentrations had no effect on the groupings. (Cluster on Pearson correlation coefficients; Farthest neighbors in each cluster used to assign distance). The results were intriguing.

Figure 1 shows the cluster routine output (SYSTAT Wilkinson 1985). Clearly three distinct groups or clusters appear. Figure 2 is a map of the study area with samples shaded as they fell into the three clusters. Group A (the pink) all are quite similar to creosote in their HPAH ratio constituents. Figure 3 shows the percent occurrence of each HPAH constituent in the three clustered groups. Group A follows a contour characteristic of Creosote. Group C (green on the map) is very similar to background contours (outer coast of Washington sediments) and group B (yellow on map) is relatively deficient in fluoranthene and pyrene. Though group B (yellow) is quite different from group A (Creosote group), Figure 4 shows strikingly similar contours of concentrations of HPAH heavier than pyrene suggesting some mechanism of differential degradation or, of course, a source of HPAH other than creosote (These concentrations are not normalized on total organic carbon).

Finally, Lee asked me for some background on which HPAH might be the best indicator of overall HPAH in a site. My answer, based on Figure 3 is that benzo(a)anthracene (B(a)A) appears to vary the least between samples and regions. It appears to be a somewhat constant 9-13% of HPAH in a given sample. Other samples in other areas tend to bear this out.

With the understanding that this is a preliminary analysis I hope it is helpful.

JC:jms
Attachments

cc: Unit files (2)
Segment file (1)

JOIN FA,PY,BA,CH,BFA,BAF/ROWS

DISTANCE METRIC IS 1-PEARSON CORRELATION COEFFICIENT
COMPLETE LINKAGE METHOD (FARTHEST NEIGHBOR)

TREE DIAGRAM

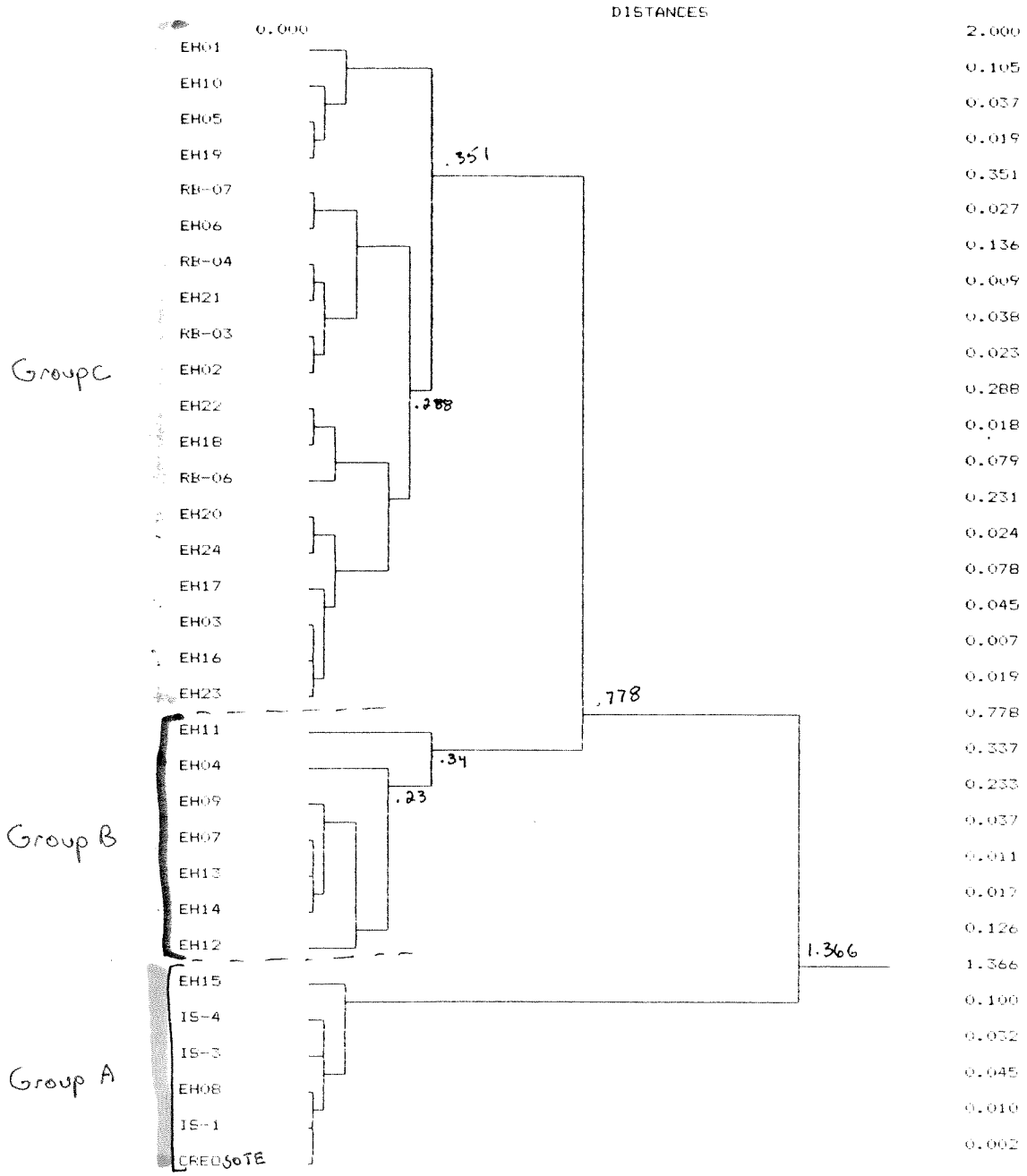


Figure 1. Clusters based on HPAH constituents

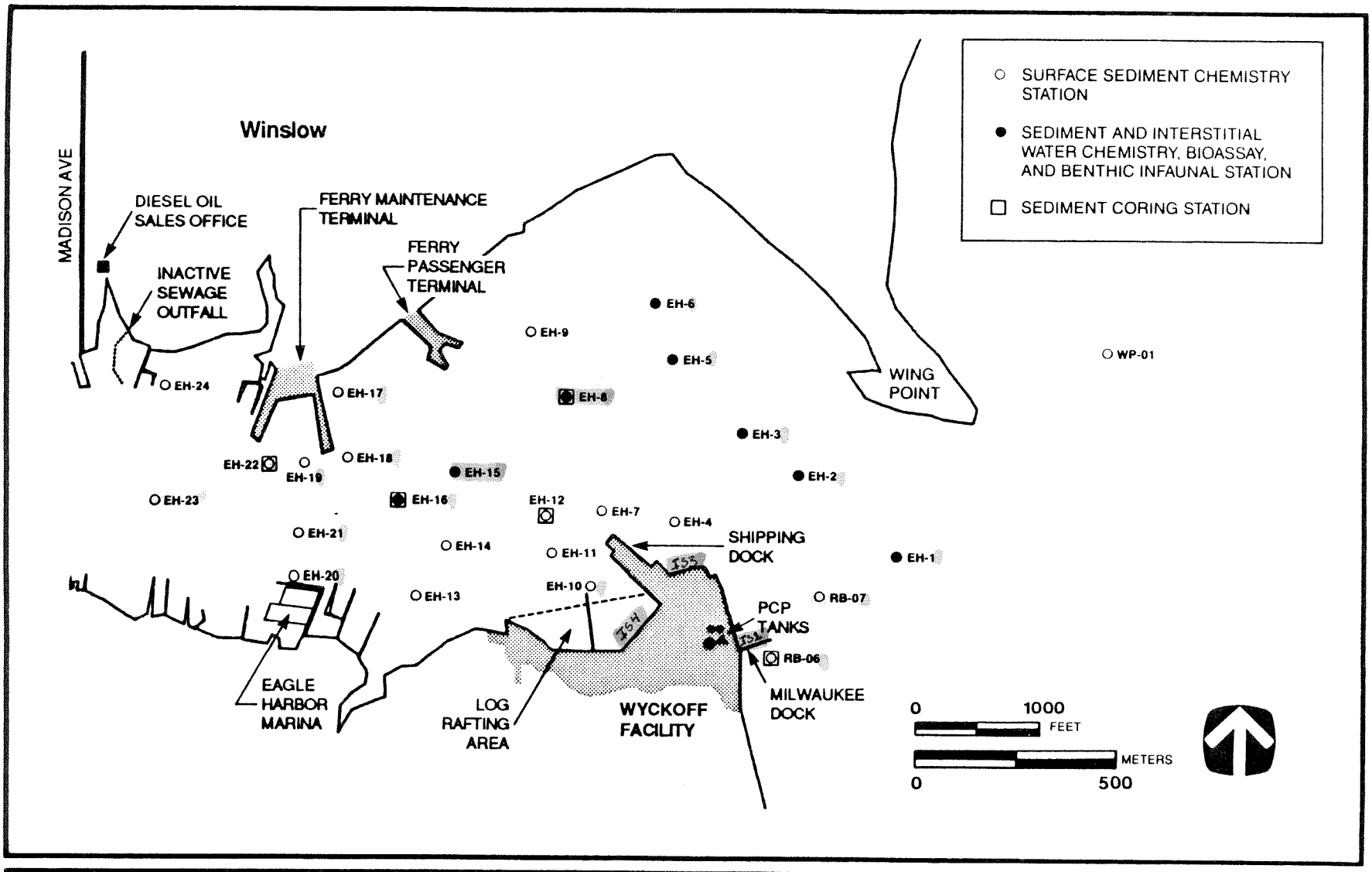


Figure 2a. Sample station locations in the study area.

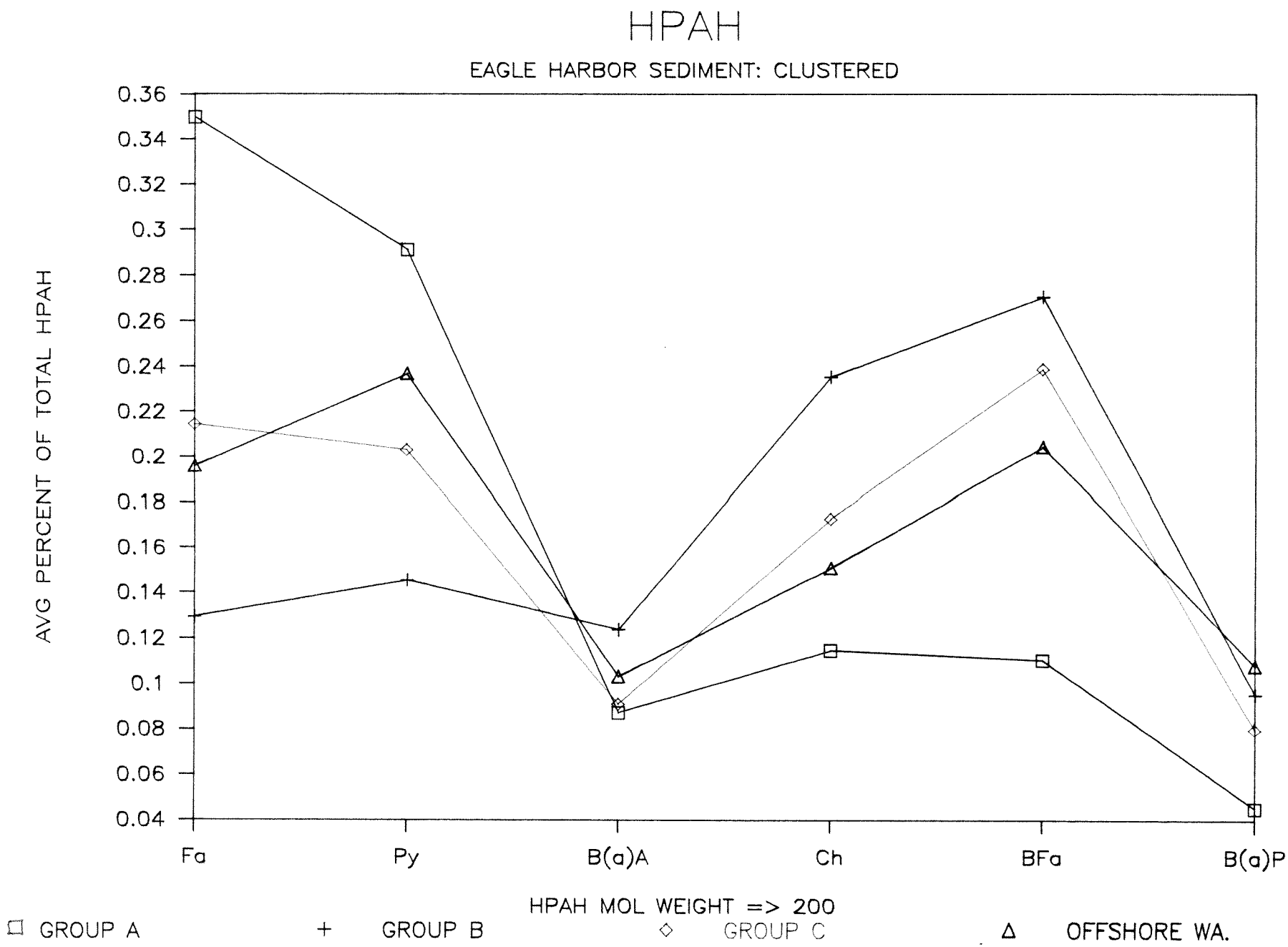
HPAH
EAGLE HARBOR SEDIMENT: CLUSTERED
AVG PERCENT OF TOTAL HPAH
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
Fa
Py
B(a)A
Ch
BFa
B(a)P
HPAH MOL WEIGHT => 200
GROUP A
GROUP B
GROUP C
OFFSHORE WA.

Figure 3

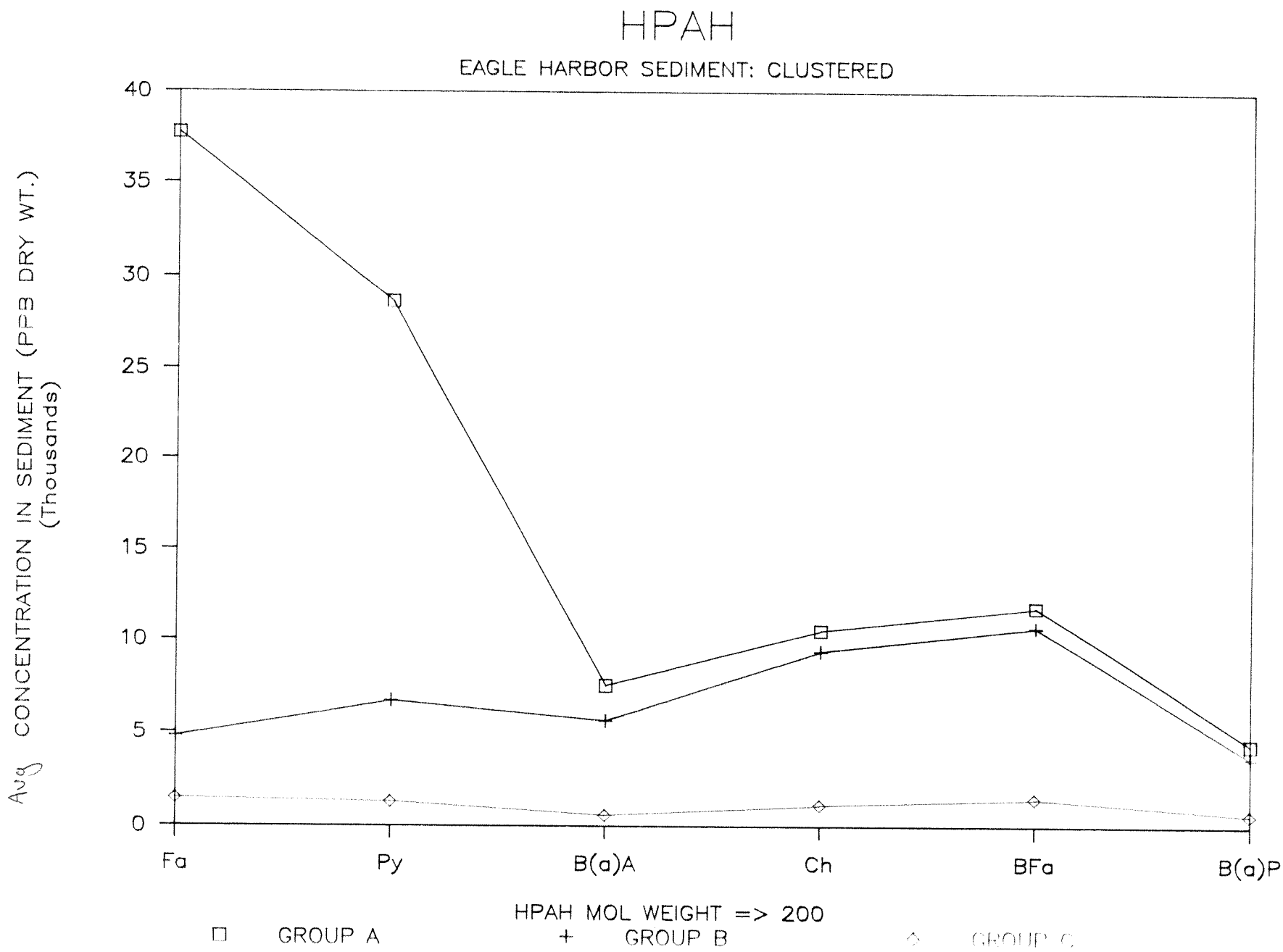
HPAH
EAGLE HARBOR SEDIMENT: CLUSTERED
Avg CONCENTRATION IN SEDIMENT (PPB DRY WT.)
(Thousands)
40
35
30
25
20
15
10
5
0
Fa
Py
B(a)A
Ch
BFa
B(a)P
HPAH MOL WEIGHT => 200
GROUP A
GROUP B
GROUP C

Fig. 4