The Canada/Alberta Partnership on Mineral Development

MDA Contract M92-04-004

Phase I of
A Study to
Assess the Potential of
Co Product Minerals and Metals
In Alberta's Oil Sand Deposits

By
Gulf Canada Resources Limited
Calgary, Alberta.

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Executive Summary

A study was initiated to evaluate the potential of co product minerals and metals in Alberta's oil sand deposits. Phase I, which comprises this study, concentrated on determining suitable methods of sampling and analysis. The goal is to determine the concentration of elements in oil sand as a function of:

- geological facies
- the bitumen phase
- the organic phase

Two cores from the Sandalta oil sand lease (mineable oil sands lease 30) were selected for this phase of the study. The cores were selected to represent the main geological facies present. One core contains a good section of rich oil sand. The other contains a section of lower grade oil sand and waste.

Methods for sampling cores and extracting representative samples were explored. Recommended procedures are outlined in the report.

Methods for determining the presence and concentration of 55 elements were also explored. Methods chosen for the work program included:

- induced neutron activation analysis (INAA or INA)
- induced coupled plasma (ICP),
- fire assay

Each method of analysis is suitable for some elements and not for others. The neutron activation method has inherent advantages so was used wherever it was suitable. ICP was used as a back-up. Fire assay methods were used to detect the extent of precious metals.

Two hundred samples were extracted from the cores and prepared for elemental analysis. In addition a limited number of samples were obtained to examine different grades of ore, different types of tailings, and leachate from a pilot plant that was investigating extraction of aluminum from tailings material.

In all over 10,000 analyses were performed. Analysis work was split between three laboratories to allow completion in the time available.

The data was analyzed statistically, by comparing duplicate analyses, by plotting trends, by cross plotting results and by plotting the results on bore hole logs.

<u>Principal findings:</u>

1. Procedures were developed to:

- secure representative samples,
- prepare samples for analysis,
- analyze to determine the presence and concentration of elements present,
- manage and interpret data.

2. 200 samples were extracted from two core holes cores and over 10,000 analyses performed to determine the concentration of elements present.

3. The concentration of elements ranged from one part per billion to 500 million parts per billion. It is a challenge to appraise results that span eight orders of magnitude.

4. Occasionally, elemental cross plots from one hole did not agree with the results from the other hole. In those cases it was found that concentrations indicated by ICP analysis were significantly higher than concentrations indicated by INA analysis. It is believed that aluminum was affecting the ICP analysis of certain elements (Cd, Mo, and Pb,)

5. Aside from the anomalies noted above, results were shown to be accurate. This indicates that the sampling and analysis procedures were appropriate to detect normal elemental concentrations in the oil sands.. Accuracy was shown by a number of techniques:

- statistical analysis of the data,
- chemical balance of input and output streams,
- trend plots that require accurate data to work,
- agreement between duplicate analyses
- agreement between geophysical logs and elemental concentration,

6. Concentrations of the elements were determined - overall and as a function of geology. Ranges and statistical averages were determined for each element and for each facies.

7. It was not practical to explore elemental relationships with organic compounds in oil sand using samples recovered from core. That aspect is a function of extraction processes and their respective tailings.

8. Depositional environments that existed at the time the formations were developing were excellent sorting mechanisms. Geological facies reflect the different depositional environments. The sorting accorded to each facies is reflected in the chemical analysis.

Facies that reflect high energy depositional environments tend to be coarse grained, have a high bitumen content, have a high silica content and are low in the concentration of most other elements.

Facies that formed in low energy depositional environments tend to be fine grained, have a low bitumen content, have a lower silica content and higher concentrations of most other elements.

9. There appears to be a positive relationship between the amount of clay sized material (amount finer than two microns) and the aluminum content.. As the amount of clay sized material increases so does the aluminum content.

10 There also appears to be a positive relationship between aluminum and the other elements. As the aluminum content increases so does the concentration of most elements. Exceptions include silica and cobalt which decrease with aluminum content, and chlorine, cobalt and the precious metals that appear to be randomly distributed.

11. There is a good relationship between the gamma count, and:

- the amount of clay sized material
- aluminum and other elements that are concentrated in fine grained materials,
- methylene blue index - an indicator of the amount of clay sized material,

This relationship can be used to predict the following from gamma logs:

- the amount of clay sized material and in turn
    - the processability of feed in extraction,
    - the amount of potential sludge forming material.

12. Physical characteristics of the main facies were determined:

- grain size distribution,
- amount of clay sized material,
- methylene blue index

13. Tailings were found to follow the trend of element concentrations observed in progressing from high grade to low grade ore. Fine tails contain even higher concentrations of aluminum and the other elements. Aluminum is a good descriptor to characterize fine tails.

14. Acid leaching usually removes metal components. The pilot process reviewed in this study was found to selectively remove aluminum, chlorine and iron from fine tails.

15. The concentration of titanium and zirconium appears to increase considerably in fine grained facies. This suggests that there may not be as much of these minerals in recoverable heavy minerals as has been believed.

16. The concentration of nickel and vanadium , (and for that matter most elements) also appears to increase in fine grained materials. This raises questions about theories that link nickel and vanadium to bitumen (which tends to decrease in fine grained materials).

17. The concentration of precious metals was generally only a few parts per billion. These detections represent extremely small, widely and apparently randomly distributed deposits. The presence of more extensive placer deposits of precious metals was not detected, but neither was their absence proven. Other approaches that analyze large masses of material would probably be needed to determine if placer deposits of precious metals are present.

Overall we believe that the study was worthwhile and that the goals of the study have been achieved. Many of the findings are new. Spin-off applications should benefit the industry.

Results are available on a floppy disk so students may further evaluate the data if interested.

Suggestions are offered to guide further studies.

D. W. Devenny Ph.D. P Eng. P Geol.
Principal Investigator

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

FIGURES PRESENTED IN THE MAIN REPORT

CHAPTER 1 INTRODUCTION

1. 1 The program

This study of potential mineral and metal co products in the Athabasca oil sands was undertaken as a cost sharing arrangement between Gulf Canada Resources and the Canada/Alberta Partnership on Mineral Development administered through the Alberta Department of Energy.

A proposal was submitted as a multi phase program in May 1992. Phase I became the basis of the current study. It was activated after the Alberta/Canada Partnership was executed in the fall of 1992. Funding for the current study extended from the time of signing until March 31 1993.

The focus of the work was to determine the extent (concentration and distribution) of potential co product minerals and metals present in the Athabasca from a geological perspective.

Details about the proposed study are outlined in Appendix A.

Specifics for Stage I were as follows:

- select a site that is representative, on which the oil sand geology is well documented, and that can serve as the basis of later studies,
- explore the potential of co products in a profile represented by two core holes.,
- develop procedures to obtain representative samples from each geological facies
- develop analytical procedures to reveal the main elements present in each facies and identify the different associations (associated with solid, bitumen or organic phases),
- determine if the elements can be extracted by leaching with strong acid.

1.2 Justification for Undertaking the Study

The Athabasca oil sands of northern Alberta contain vast reserves of bitumen. Commercial development of these reserves offers significant social benefit to Alberta. Unfortunately, the economics of extracting bitumen alone are marginal and development is not proceeding.

Little is known about the extent, distribution, or potential value of other resources in the oil sands. Heavy minerals, base metals, precious metals and rare earths are known to be present as minor constituents.

It is doubtful if commercial extraction of the mineral or metal component of the oil sands will be economical on a stand alone basis. However, the economics change drastically if recovery is considered in conjunction with activities associated with bitumen recovery. Synergy between the two operations can help the economics of both operations. If economic synergies are found between bitumen recovery and the extraction of co products the implications to commercial development and to the Alberta economy would be immense.

To date, studies of the potential of co products have had limited scope. No public domain studies of a comprehensive nature have looked at the whole picture - starting with the geological resource base, and identify what is potentially recoverable under a variety of synergistic operating conditions. In view of the importance of the topic to Alberta, the current study was proposed and supported.

Further information on the potential associated with co product recovery is contained in Appendix B.

1.3 Report layout

The study involves a lot of data - over 10,000 analyses - and their interpretation.

Key information is highlighted in the body of the report. Supporting data and more detailed assessments are contained in the appendices.

The layout of the information is self evident from the report index.

1 4 Study team and methodology

The study team consisted of the following:

Principal Investigator	Dr. D. W. Devenny P. Eng., P. Geol
Gulf Professional Staff	Dr. A. Szlachcic G. Gray
Consultant	R. McCosh P. Eng of McCosh Resource Consultants Limited

The study team continued:

Analytical Laboratories	Activation Laboratories Ltd. Ancaster, Ont. Gulf Canada Laboratories, Calgary, Alberta, The University of Alberta, Edmonton, Alberta
Project Advisors	Dr. F. Goodarzi, ISPG, Calgary, Alberta Dr. D. Taplin P. Eng. Komex International Ltd. Calgary, Alberta.
Other support services	as needed

The Gulf team, assisted by R. McCosh planned and managed the program.

Key steps in executing the work:

- identifying options to be covered,
- defining work programs with their associated schedule and costs,
- selecting facilities for analytical work,
- managing sampling, sample preparation and expediting,
- receiving data and interpreting results,
- documenting results.

A trial program was undertaken at the start of the program. This involved preparing reference samples and submitting duplicate samples to the different laboratories for trial analyses. This approach proved to be invaluable because it:

- allowed refinement in the approach to:
    - sampling,
    - sample preparation,
    - analysis
    - data handling
- demonstrated that the planned approach was reasonable.

More detail about the trial program is contained in Appendix C.

The schedule for the main program was dictated by the time to perform chemical analyses. The primary method of analysis involved scheduling work to obtain access to a nuclear reactor. This was followed by a period to allow cooling before measurements could be taken. As a result two to three months was required for turn-around-time. There was little time for repeat testing or interpretation of results. Work was concluded by the principal investigator after the funding period.

CHAPTER 2 - THE PROGRAM

2.1 Sampling procedures

The goal of the sampling program was to obtain representative uncontaminated samples of each facies of the oil sand.

Considerations for the sampling program:

1. Site selection.
2. Drilling program to avoid introduction of contaminants.
3. Extracting representative uncontaminated samples from core:
    - avoid contamination by drilling mud,
    - avoid contamination from sloughed material in the hole,
    - sample all horizons,
    - represent facies present,
    - detect variations within a facies,
    - avoid contamination from sampling equipment,

Procedures used to meet the above goals are outlined in Appendix D.

Two core holes were selected from the Sandalta mineable oil sands lease (Lease 30 located 40 km north of Fort McMurray on the east side of the Athabasca river. Geological control on that lease is quite good with core holes drilled at 100 m centres on east west cross sections and at 400 m centres in the north south direction. Major facies are known to be present.

Hole 209 represents a rich oil sand profile. Hole 215 represents low grade oil sand with reject zones. Together the two core holes contain adequate material for testing the major facies.

Logs for the core holes are presented as Figures B.1 and B.2 in appendix B

A description of the overall geology in the area is contained in Appendix B.

Descriptions of the samples are contained in Appendix D.

2.2 Preparing samples for analysis

Preparation for analysis involved sub sampling to reduce the size of sample without altering the composition and without introducing contaminants.

Procedures adopted to meet those goals are outlined in Appendix D.

2.3 Laboratory Analysis

In the main program 200 samples were tested to determine the presence and concentration of elements present in each facies. The elements studied are grouped as follows:

Primary elements:	Al, Ca, Fe, K, Mg, Mn, Na, P, Si, and Ti.
Minor elements	As, B, Ba, Cl, Cr, Cs, Ga, Hf, Nb, Rb, S, Se, Sr, and Y.
Metallic elements	Co, Cu, Mo, Ni, Pb, Sn, V and W.
Precious metals	Ag, Au, Pd and Pt.
Rare earths	Ce, Dy, Eu, Gd, La, Lu, Nd, Sc, Sm, Tb, Th, U, Yb.
Trace elements	Bi, Br, Cd, Hg, Ir, Sb and Ta.

The goal in laboratory analysis is to accurately determine what is there and how much of it is present without altering the composition or without introducing contaminants.

Over 10,000 analyses were performed to determine the presence and extent of elements present.

Three analytical techniques were selected for the program:

- induced neutron activation analysis (INAA or INA)
- induced coupled plasma analysis (ICP)
- fire assay analysis

Each method of analysis has its good and bad points. A summary of the characteristics is contained in Appendix D. Together the three analytical procedures meet the overall needs of the subject program for detection limits and reliability of results.

The INAA offers some specific advantages over other methods. Consequently INAA methods of analysis were used preferentially. When they did not work well ICP was used. Fire assay was used to test the extent of precious metal present.

The only uncertainty in the sampling program was the required size of sample to ensure a representative analysis. The size of samples required by the different analytical procedures was roughly as follows:

Method of analysis	Size of sample
INAA	0.5 grams
ICP	5 grams
Fire assay	50 grams

The size of sample used would be adequate if elements are uniformly distributed in the oil sand. However the sample size could be inadequate if anomalies of chemical concentrations are present. This aspect will be addressed later.

Results of the analytical testing program are contained in Appendix E.

2.4 Miscellaneous testing program

Miscellaneous tests were performed to characterize:

- whole oil sand as a function of grade,
-. fine tailings,
- the effect of leaching,
- different ways of characterizing oil sand:
    - grain size analysis,
    - methylene blue index.

A description of these miscellaneous tests and results is provided in Appendix F.

CHAPTER 3 - ANALYSIS OF RESULTS

3.1 Data

Analytical data from the main program are contained in Tables E.1 and E.2 Appendix E. The data are also contained on a floppy disk - in Excel 4.0 format.

Over 10,000 analyses are present.

3.2 Statistical analysis of the data

Element concentrations cover eight orders of magnitude - from one part per billion to 500,000,000 parts per billion. This range in concentrations poses a challenge to statistical analysis.

Statistical analyses are provided in Appendix G.

Formats used to display statistical trends are described by the following description of the figures in Appendix G.

Figure G.1 shows the statistical distribution of each element considering all data. For each element the figure shows:

- a histogram of the distribution of measured concentrations,
- statistics of the concentrations -max, min, mean, median, standard deviation,

Figure G.2 shows the mean concentration of each element by facies. Confidence limits in the data are also indicated.

Figure G.3 also shows the concentration of selected elements by facies. The data is presented in the same format as Figure G.1. The histograms show significantly different concentrations of some elements in coarse vs. fine grained environments. Most elements appear to be more concentrated in fine grained facies. Bitumen, cobalt and silicon appear to be more concentrated in coarse grained facies.

Figure G.4 plots the distribution of the concentration of each element by facies. Fine grained facies such as Salt Marsh, pro Delta Mud and Delta Marsh Mud have much higher concentrations of most elements as noted above. Figure 3.1 illustrates part of Figure G.4.

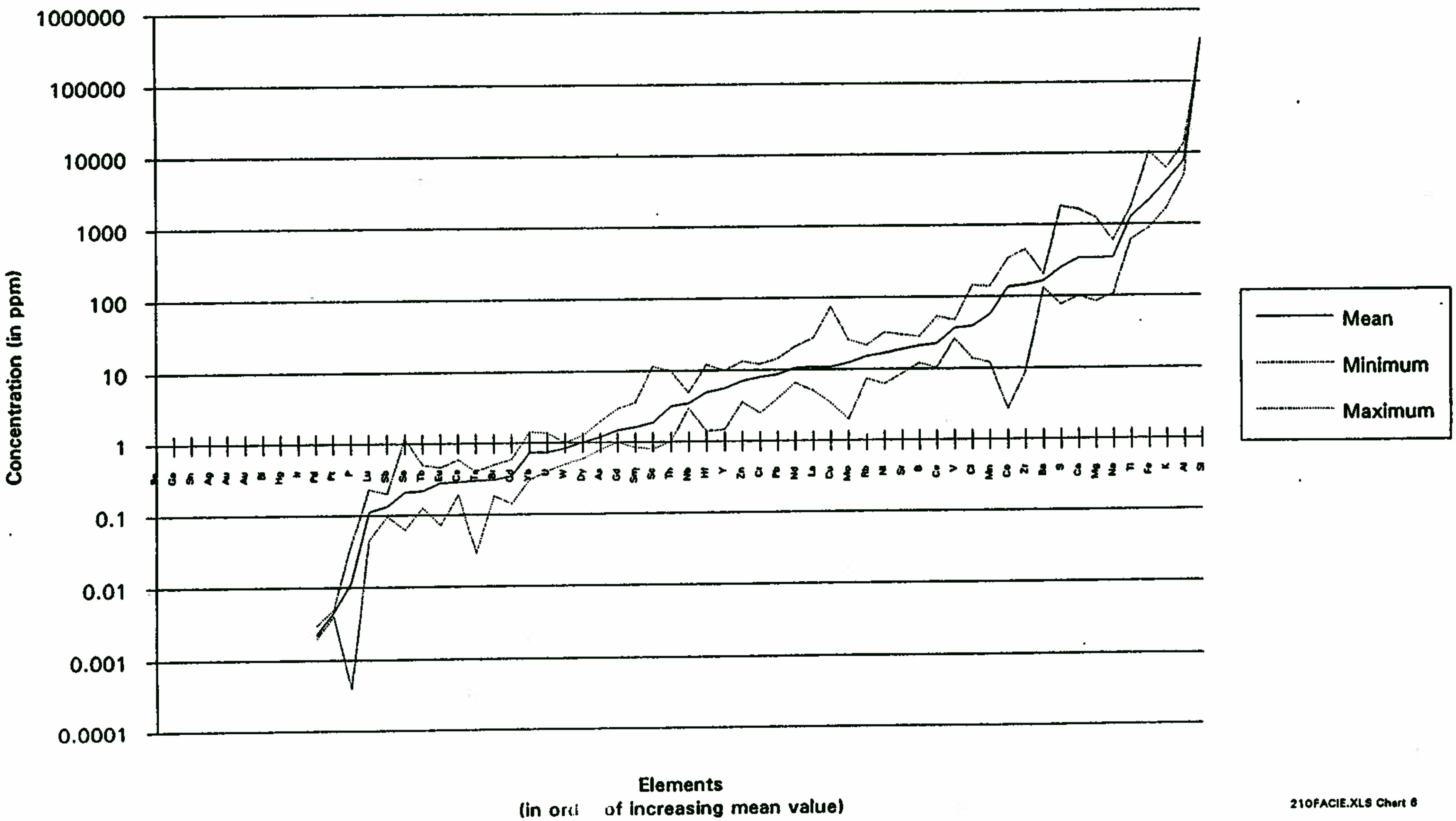
Figure G.5 shows the mean concentration of each element in all facies. The same spread between fine and coarse grained facies is evident.

3.3 Trend Analysis

Trend plots contained in Appendix H are used to show relationships that are difficult to detect through statistical analysis. The principal plots are described below:

Figure H.1 shows a cross plot of the concentration of each element vs. the concentration of aluminum. Data is shown for each hole separately as well as combined.

Figure 3.1 Mean and Range of Elemental Concentrations
Tidal Channel Facies



210FACIE.XLS Chart 6

Figure H.2 shows miscellaneous cross plots created to explore relationships between various elements. The cross plots include: V vs. Ni, Cl vs. Na, U vs. Th, Lu vs. La, K and Zr vs. Ti. Figure 3.2 illustrates some of the miscellaneous cross plots.

Figures H.3 and H.4 show plots of various concentrations against the Gamma count and against the Methylene Blue Index. The gamma count data was obtained at the time the holes were drilled and is summarized on Table E.7. Data plotted includes clay content, aluminum content bitumen content and key elements. The data plotted in Figure H.3 was restricted to samples that were also subjected to Methylene Blue Index testing. The data plotted in Figure H.4 represents the entire data base. Figure 3.3 illustrates the gamma cross plots.

Figure H.5 plots the concentration of various elements vs. the bitumen content. These plots were made to appraise conclusions by others that some of the elements should show different degrees of organic bonding.

Figure H.6 plots the concentration of key elements vs. depth that were appraised by both INA and ICP analysis. The plots were made to determine if the two methods of analysis agree with one another. Figure 3.4 illustrates part of Figure H.6.

Figure H.7 shows bore hole plots showing all data vs. depth:

- facies and geological descriptions,
- bitumen content,
- geophysical logs,
- concentration of all elements appraised in this program.

CHAPTER 4 - INTERPRETATION OF RESULTS

A detailed analysis of the cross plots for each element is provided in Table I.1 and I.2 in Appendix I. General observations are outlined below.

4.1 Are the results accurate ?

Most of the analyses are believed to be reasonably accurate for the following reasons:

1. Chemical balances (Appendix E - Table E.3 and E.4) indicate that the results are credible for the elements that are present in quantity. This approach does not verify data for elements present as minor constituents.

Figure 3.2 Miscellaneous Cross Plots

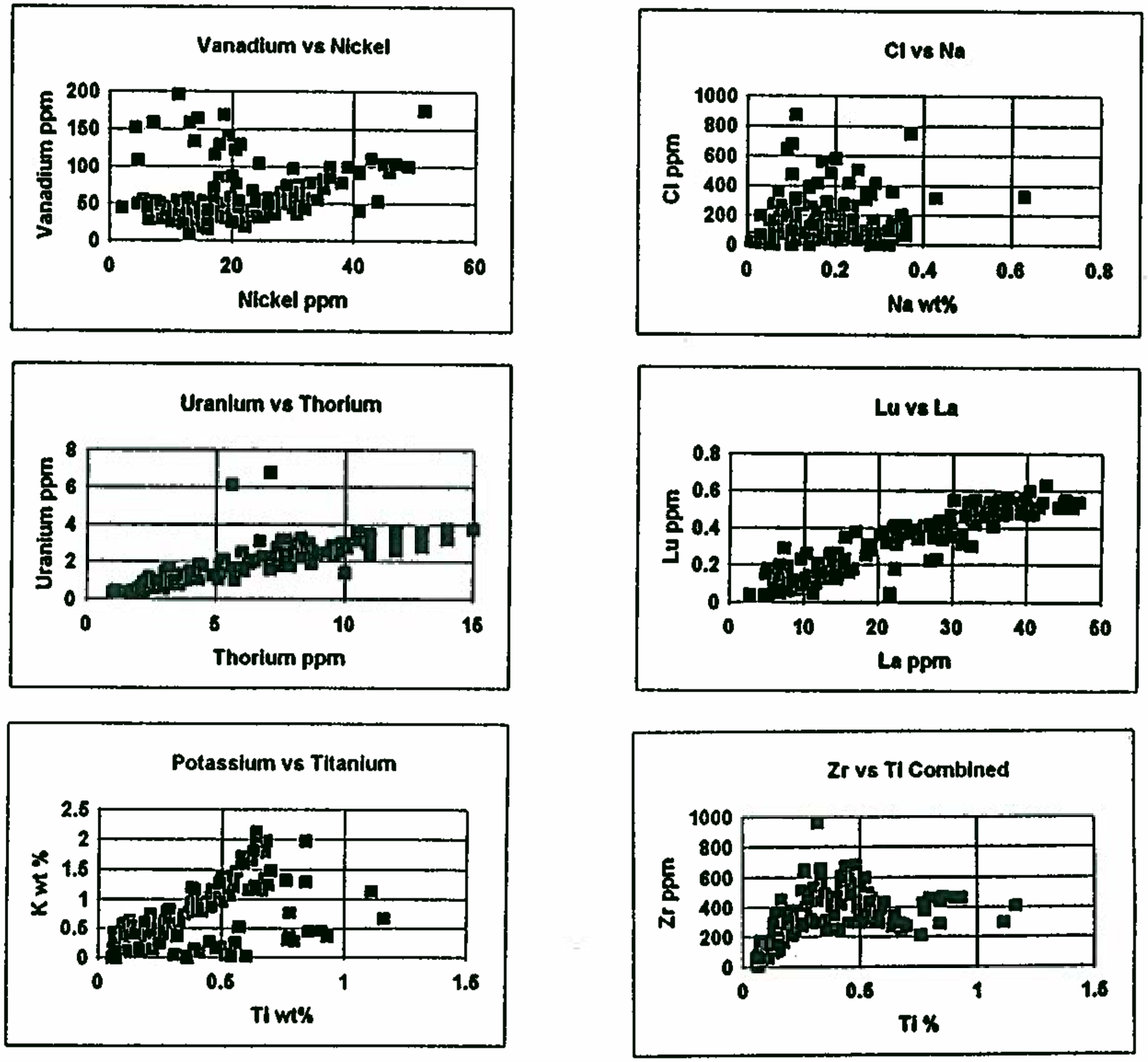
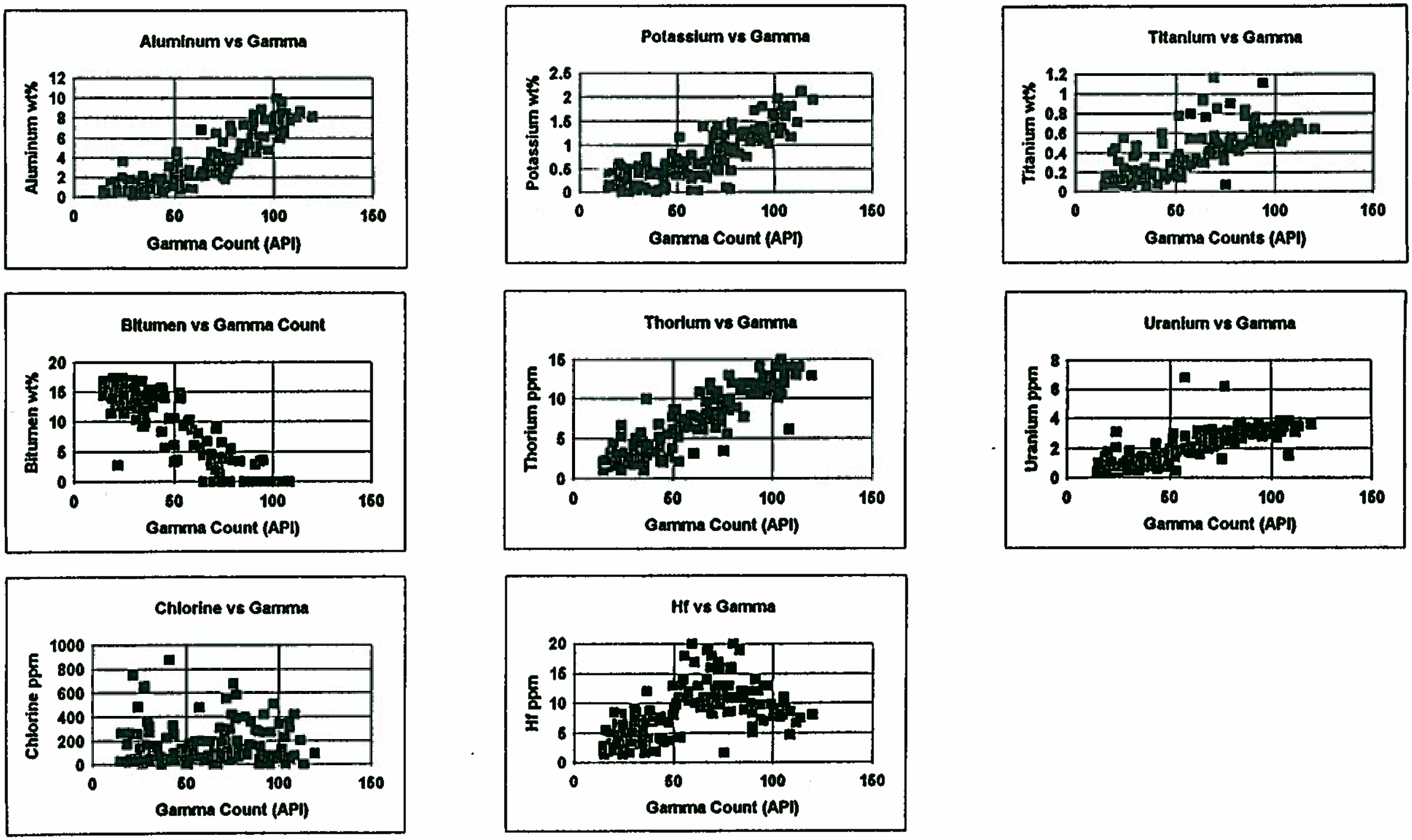


Figure 3.3 Gamma Cross Plots - Various Elements



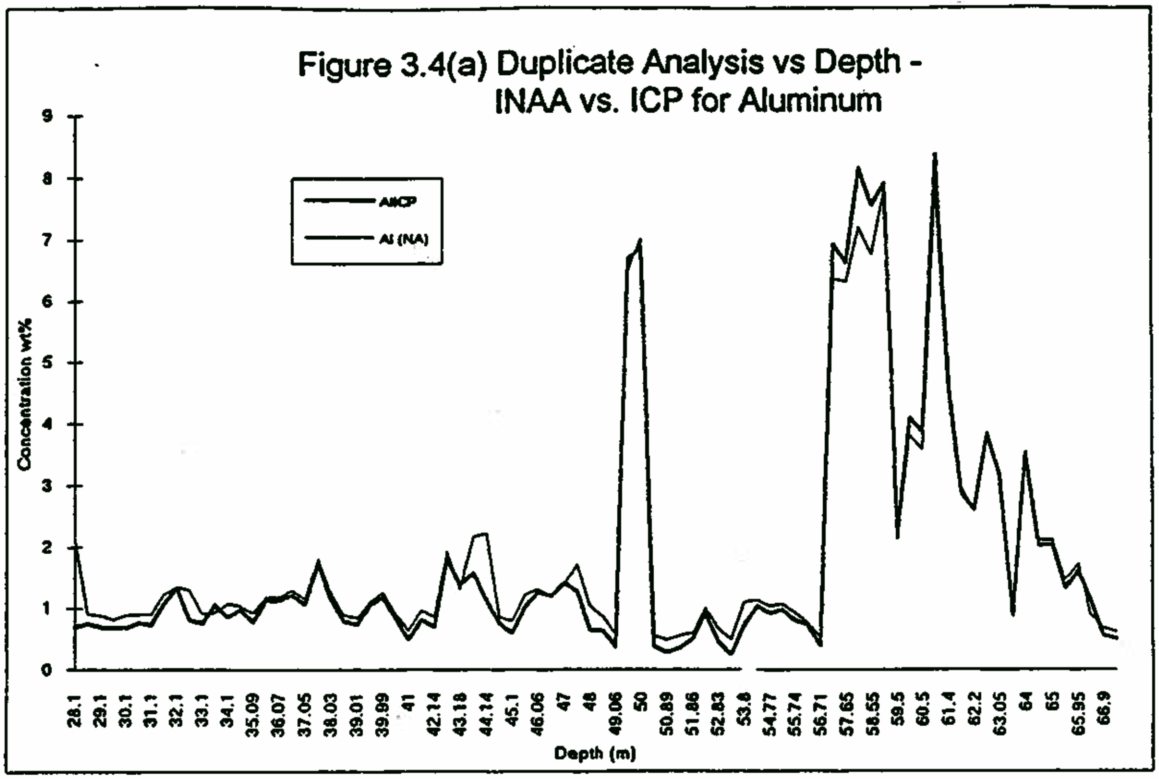


Figure 3.4(a) Duplicate Analysis vs Depth - INAA vs. ICP for Aluminum
Al(ICP)
Al (NA)
Concentration wt%
Depth (m)

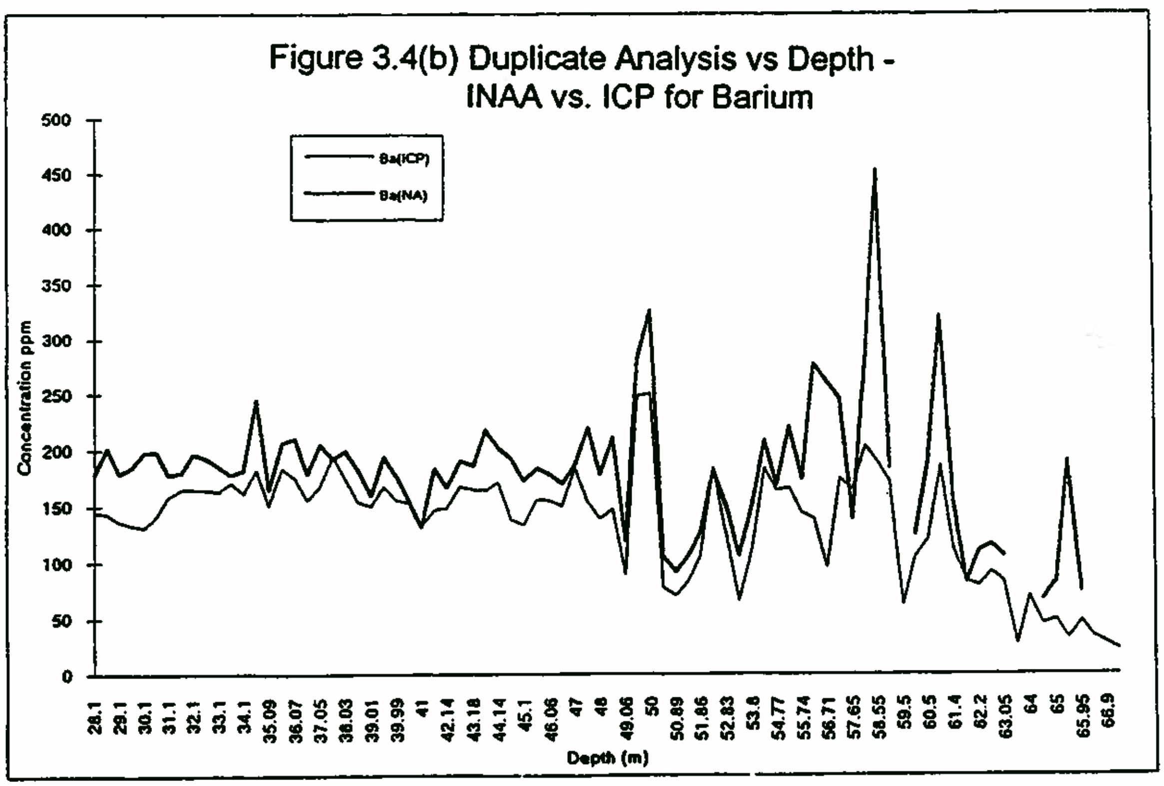


Figure 3.4(b) Duplicate Analysis vs Depth - INAA vs. ICP for Barium
Ba(ICP)
Ba(NA)
Concentration ppm
Depth (m)

2. Statistical analyses showed consistent trends for all elements. This would not be possible if the measurements were not correct.

3. The cross plots show consistent trends. Samples were selected on the basis of geology. The cross plots represent totally different relationships. The trends shown would not be possible if there the analyses were not consistent.

4. Plots of duplicate analyses vs. depth show the same trends (Figure H.7). That would not be possible if the analyses were not consistent.

5. The plot of element concentrations vs. depth on the bore holes (Figure H.8) show remarkable consistency that would not be possible if the results were not accurate.

6. Plots of element concentration vs. aluminum content was repeated in the two core holes. This would not have been possible if the results were not reliable. For those few cases where the trends in each bore hole did not agree errors are suspected.(suspect that Al affected some ICP analyses).

4.2 Linkage of elemental concentrations to geology

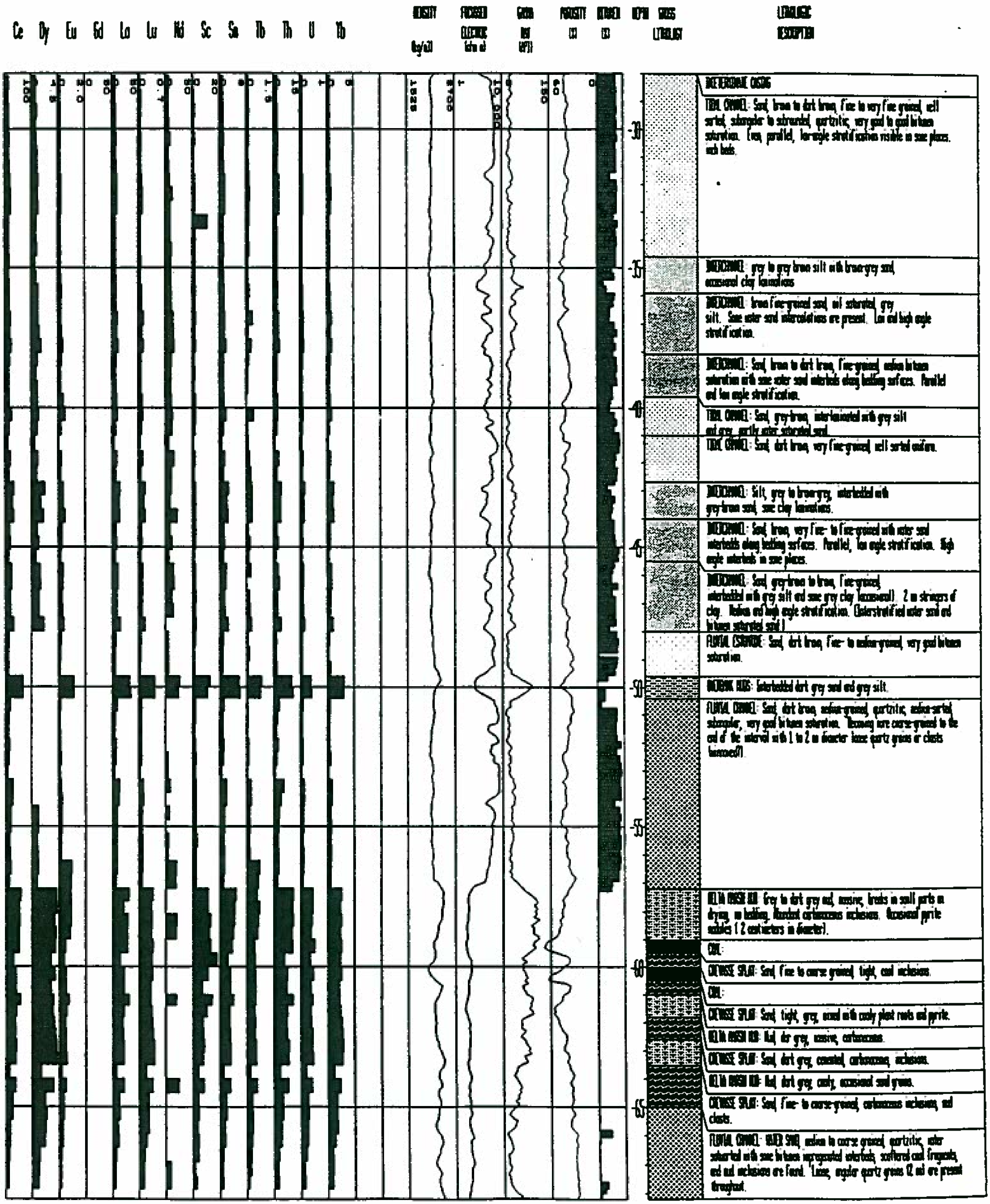
The depositional environments at the time the formations were deposited were excellent sorting mechanisms. They sorted the sediments according to grain size - sand, silt and clay. The sorting accorded to each facies is reflected in the chemical analysis.

Facies that formed in higher energy environments consist mostly of coarse grained material and little clay. These facies are rich in silica and low in most other elements. They are characterized by low gamma counts a low Methylene Blue Index and a high bitumen content. Facies that reflect these environments include: fluvial channel, fluvial estuarine, inter channel and, tidal channel and lower tidal flats.

Facies that formed in still water conditions contain fine grained material, a reduced sand content and more clay. These facies contain less silica and more of most other elements. They are characterized by high gamma counts, a high Methylene Blue Index and a low bitumen content. Facies that reflect these conditions include: delta marsh mud, overbank mud, pro delta mud and salt marsh.

The close link between geology and elemental concentrations is illustrated by the bore hole logs. Figure 4.1 is part of the bore hole logs provided by Figure H.8 in Appendix 8.

Figure 4.1 Gulf - Sandalta Drill Hole
Concentration of Rare Earths (ppm)



4. 3 Linkage of elements to aluminum

Many elements show a positive relationship to aluminum. As the aluminum content increases so does the concentration of these elements. The same relationship extends to the amount of clay sized material.

Figure 4.2 shows the different types of relationship with Aluminum and offers a possible explanation for the trend.

The linkage between the amount of clay sized material and aluminum is shown by Figure H.3 on page H.25. It shows identical relationships between the Methylene Blue Index, % clay sized material and aluminum content when plotted against the gamma count.

The aluminum content should be used as a descriptor of fine tails - to indicate the amount of clay sized material present.

4.4 Some anomalies in the cross plots with aluminum

Some cross plots for metals reveal different relationships for each bore hole. The differences vary from different trends to different concentrations. (e.g. Cd, Mo, Pb, V) The difference is attributed to errors in the ICP analysis (believe ICP analysis of those elements was affected by aluminum).In those cases the INAA concentration is believed to be correct.

The plot for barium shows a distinct bilinear relationship with aluminum. The plots are attributed to two modes of origin for barium.

Figure 4.3 illustrates the anomalous plots.

4.5 Some unexpected trends

Titanium and Zirconium concentrations are greatest in fine grained clay rich zones. The association with fine grained material (waste zones for bitumen extraction) could mean that the extent of these elements in heavy minerals is less than was once believed.

Nickel and Vanadium concentrations also appear to be greatest in fine grained clay rich zones. This challenges theories about their association with bitumen.

Most elements (with the exception of chlorine, cobalt and silica) appear to be more concentrated in the fine grained facies.

Rare earth concentrations plotted vs. depth closely resemble each other as well as the gamma log.

Figure 4.2 Cross Plot Trends With Possible Explanation

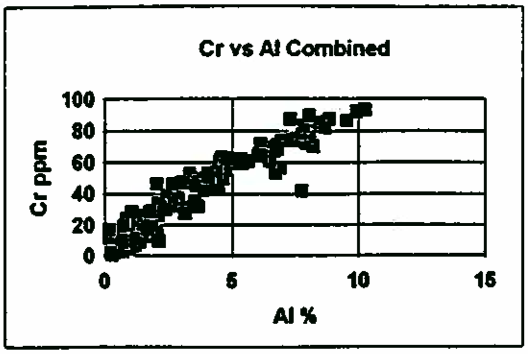


Figure 4.2(a) Positive Linear Trend
Suggests close association with clay minerals
Possible Present as a Consistent Imputiry

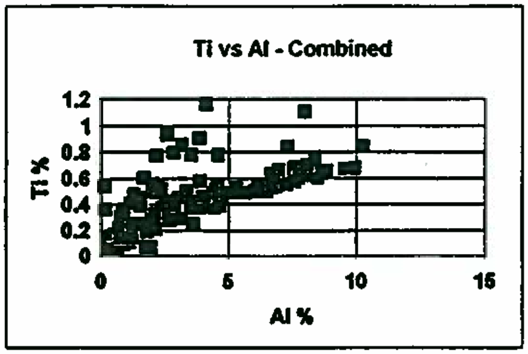


Figure 4.2(b) Positive Linear Trend + Scatter
Suggests present in two modes
- one form associated with clays
- one form independent of clays

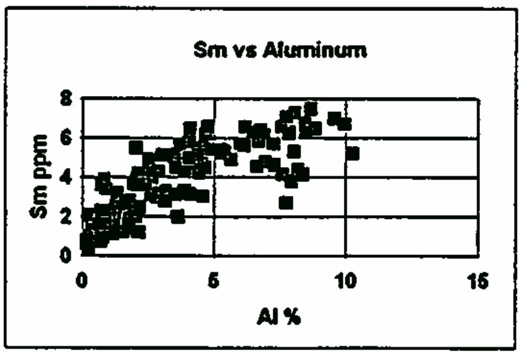


Figure 4.2(c) Scattered Positive Trend
Loosly associated with clays

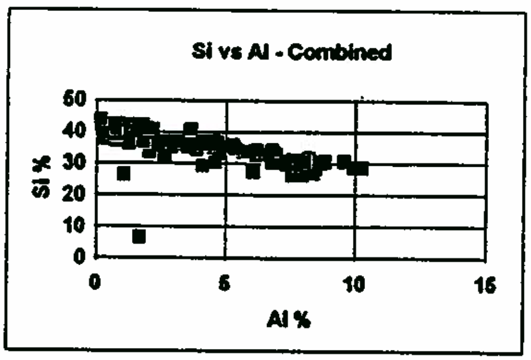


Figure 4.2(d) Negative Linear Trend
Inversely related to clays
Favour high energy edepositional environment

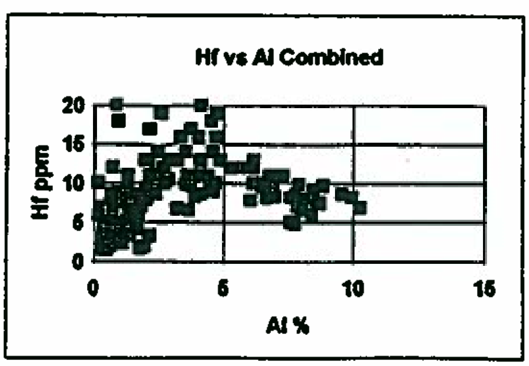
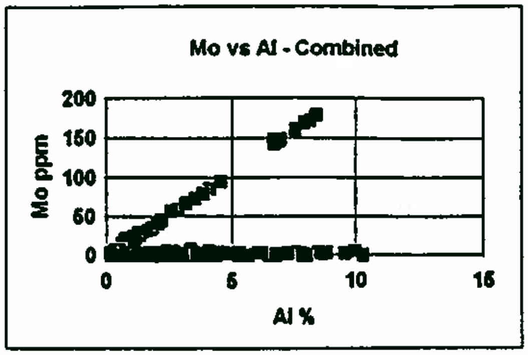
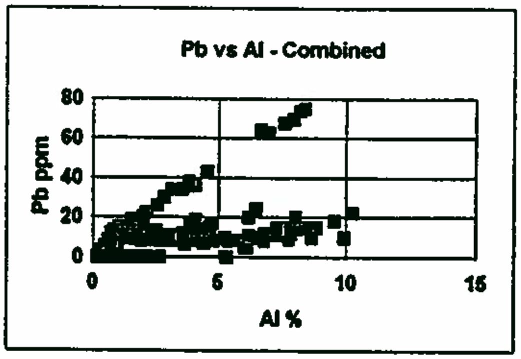


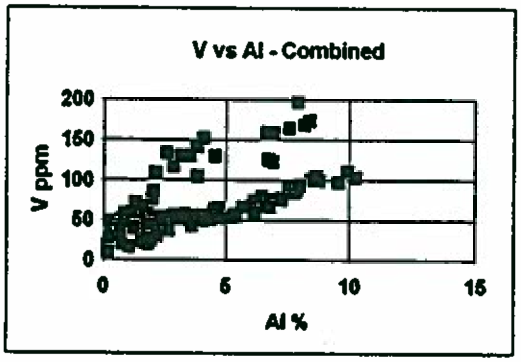
Figure 4.2(e) Scatter - no trend
Different origin and distribution from clay.



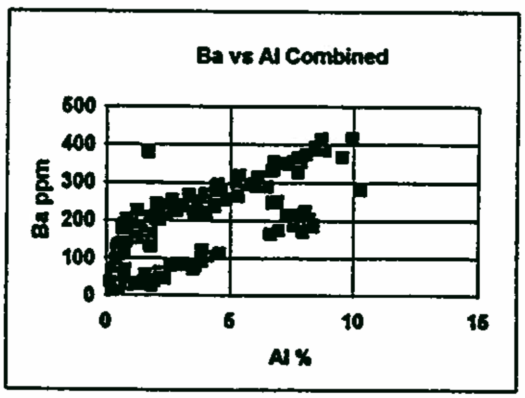
Upper trend by ICP
Believe result affected by Al
Use lower trend line (INAA)



Upper trend by ICP
Believe result affected by Al
Use lower trend line (INAA)



Divergent data
Suspect scaling difference is the cause



Divergent data
Present with both ICP and INAA
Believe it is real
Represents two modes of origin

Figure 4.3 Anomalous Cross Plots

Cross plots for U vs. Th and Lu vs. La show strong positive linear relationships. The trend is attributed to their presence as consistent impurities in the clay minerals.

Detectable amounts of precious metals are widespread. Their distribution does not show any consistent pattern. Some high concentrations were encountered (one part per million for gold). However, usually the concentration of precious metals was low.

Sodium vs. Chlorine relationship is scattered. This suggests that they do not exist in the ground as NaCl. Indeed Cl appears to be somewhat randomly distributed in the profile.

4.6 Results from the miscellaneous testing program

Figure F.1 shows that low grade ore contains more aluminum and its associated complex of other elements than high grade ore.

Fine tails contain even more of the aluminum related elements.

The leaching pilot selectively removes Al, Cl and Fe.

Hydrometer based grain size analysis is much more accurate in detecting the extent of clay sized material present. Figure 4.4 shows that commonly used traditional methods can seriously underestimate the amount of clay sized material present.

Figure H.3 shows that there is a close relationship between the Methylene Blue Index and the clay content.

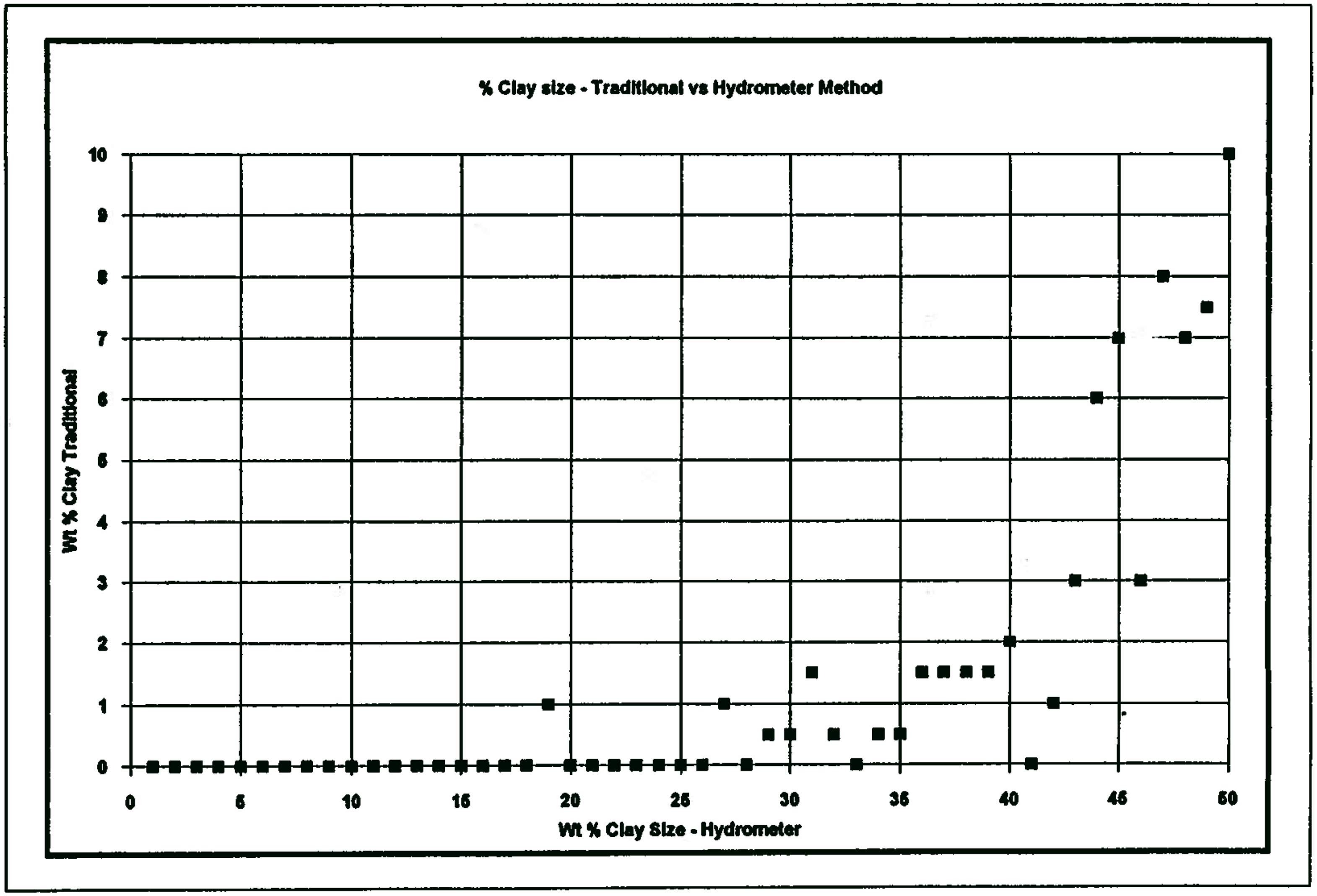
4.7 Linkage to gamma count

A Linkage to gamma count is apparent from Figure H.4. The linear relationship indicates that the gamma count can be used to indicate the potential bitumen content, the clay content and the presence of the complex of elements related to clay. The linear relationship with potassium, thorium and uranium suggests the origin of the gamma radiation.

4.8 Bitumen cross plots (Figure H.5)

The bitumen cross plots were constructed to determine if there was any difference in the trend indicated by elements expected to be totally organically bound, predominantly organically bound, and those with no organic bonding.

Figure 4.4 Clay Content by Various Methods



The plots involve the analysis of whole oil sand. No attempt has been made to determine the organic content.

In general the plots show a negative relationship between the concentration of the various elements and the bitumen content. Cobalt is the exception. It shows a scattered positive relationship.

From Figure H.5 it is concluded that the elements identified show a stronger relationship to clay or aluminum than to bitumen.

CHAPTER 5 POSSIBLE SPIN-OFF APPLICATIONS

Possible side benefits from the current study are outlined below.

5.1 Background information of elements present.

The study reveals that most elements are present in oil sands.

Information on the concentration of elements and their chemical form is needed to appraise reclamation needs.

Some of the measured concentrations exceed limits suggested by regulators. This is not surprising as it is natural ground that is being examined. Table E.6 shows the natural concentration of each element in the earth's crust. The natural concentrations also exceed limits suggested by the regulators. The natural occurrence of elements in the earth's crust is summarized in Table E.6. It is interesting to note that the natural concentrations frequently exceed limits suggested by regulators.

In reclamation studies the stability of elements under long term weathering conditions is more important than the concentration.

5.2 Interpreting performance from gamma logs

The study showed a strong relationship between the gamma count and other data.

This relationship has been used for many years by geophysicists to predict the clay content of formations penetrated by a bore hole. The geophysicists assume that the radiation comes from radioactive impurities that are present in the clay minerals in consistent amounts. This allows calibration and use of the phenomenon.

Plots in Appendix H show a number of relationships that support the use of gamma logs in oil sand work. These include:

- the strong relationship between gamma count and:
  - clay content
  - aluminum content
  - potential radioactive source elements
- strong relationships between aluminum and potential radioactive sources
  - K, U, and Th
- a positive relationship between the Methylene Blue Index and
  - clay content
  - aluminum content.

With this information it should be possible to predict the following from gamma logs:

- clay content
- potential bitumen content of the oil sand (potential if saturated)
- processability of oil sand feed (related to clay content)
- extent of sludge formers in the feed
- extent of potential fine tails make.

The path to predicting performance from gamma logs is illustrated by Figure 5.1.

It is noted that operators currently use a coarse size to describe the fines present in oil sand feed (minus 44 microns or minus 22 microns rather than the minus-2 microns proposed herein). However, the minus 2 micron size more accurately reflects the size of particle that affects performance.

CHAPTER 6 RECOMMENDATIONS FOR FUTURE WORK

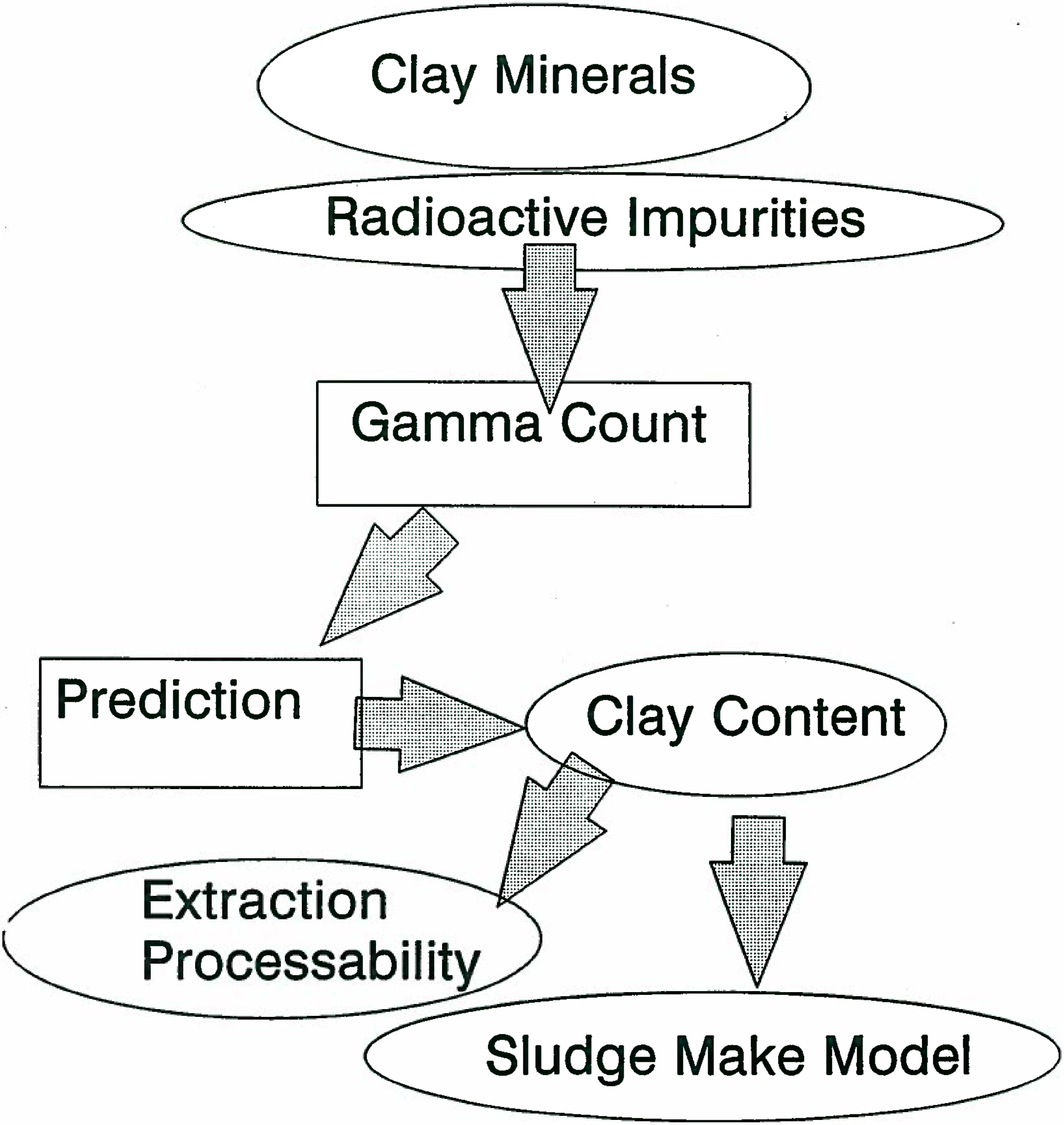
The current study identified the concentration of elements in the various facies.

Other linkages:

1. Elements linked to the different extraction processes

Some extraction processes extract bitumen alone. Others extract organic materials along with the bitumen.

Figure 5.1 Prediction from Gamma Log



It would be instructive to examine the bitumen recovered by each process to determine the related elements and their concentrations.

6.2 Mineralogy associated with the different element concentrations

The current study identified elements and their concentrations. The next step is to determine mineralogy that the elements are associated with. This information will be needed to appraise chemical stability relative to extraction and to reclamation.

6.3 Concentration of elements in process streams

It would be instructive to determine the concentration of elements in the various process streams of a commercial plant. Factors that should accompany the study:

- a material balance for all process streams that shows the distribution of all fine and coarse grained materials,
- a chemical balance for all process streams,
- mineralogy associated with elements of interest.

6.5 Carry out stages 2 and 3 of the current proposal

Stage 2 appraise the co product potential of a large block of oil sand

Stage 3 appraise the co product potential of Alberta's oil sands deposits.

The work could be undertaken by others as long as the criteria for a suitable site outlined on page B.4 are met.

6.6 Determine the size of sample needed to appraise the extent of precious metals

The current program identified precious metals that are inherently present in the oil sand. Due to the erratic nature of the precious metal concentrations it cannot be stated with certainty that attractive placer deposits do not exist.

If placer concentrations of precious metals exist it is suspected that they will be extremely fine grained (much finer than in traditional deposits.

Methods of exploring the potential of placer deposits being present include:

- an extended run of concentrating options (e.g. by centrifuge)
- test the content of very large samples

CHAPTER 7 - GOALS AND ACCOMPLISHMENTS OF THIS PROGRAM

The original goals of the current study and the progress against them is summarized in Table 7.1

Table 7.1 Progress against original goals:

Task	Status
1. Select a site suitable for the appraisal	Done
2. Develop an appropriate procedure to take representative, uncontaminated samples.	Done
3. Develop an appropriate procedure to prepare samples for testing. to obtain representative, uncontaminated samples.	Done
4. Develop appropriate procedures to determine the concentration of elements present.	Done
5. Determine the elemental concentration s in two core holes.	Done
6. Determine the association between elemental concentrations and geology	Done
7. Determine the association of elements with: - solid constituents, - bitumen - organic material	Because of the persistent relationship between many elements and aluminum it is believed that most elements are related to solid material Plans to appraise linkages to bitumen or organic material were dropped because this requires an extraction process. It is not practical to do it on core.
8. Appraise the potential to extract co products by leaching with strong acid.	Done
9. Determine index properties of oil sand: - grain size analysis, - methylene blue index	Done
Determine cross correlations	Done

Most of the goals of the program have been accomplished.

8. ACKNOWLEDGMENTS

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The study is indebted to a number of persons who contributed to success of the project.

K Cochrane capably handled business matters on behalf of Alberta.

The project consultant R. McCosh of McCosh Resource Consultants played a key role in coordinating work plans, analyzing data and interpreting the results.

Gulf staff willingly took this project on as an overload to their regular duties. Key members were Dr. A. Szlachcic and G. Gray.

The commercial laboratories made extra efforts to process the work assigned to them on a timely basis.

The project advisors (Dr. F. Goodarzi of the ISPG and Dr. D. Taplin of Komex International) provided valuable insight and guidance.

The views expressed in the report are the author's, and do not reflect the views of the sponsoring organizations.

D. W. Devenny Ph.D., P. Eng. P. Geol.
Principal Investigator

APPENDIX A

THE STUDY PROGRAM

A.1 The overall proposed program

Stages of the proposed study were as follows:

Stage 1 - select a site that is representative ,on which oil sand geology is well documented and that can serve as the basis of later studies,
- explore the potential of co products in a profile represented by two core holes.,
- develop procedures to obtain representative samples from each geological facies
- develop analytical procedures to reveal the main elements present in each facies
- determine association of the elements with different phases (solid, bitumen or organic phases)
- determine if products can be extracted by chemical leaching

Stage two was to build on stage one by appraising the potential in a 200 hectare representative block of oil sand.

Stage three was to extend the data further and appraise the potential of co product potential in Alberta's oil sand deposits.

The three phases outlined did not address the development of extraction processes to jointly recover bitumen and minerals/metals. Nor did they address the overall economics of co production of bitumen and minerals/metals. Those studies would be carried out if the early phases show promise.

A.2 Details of Stage 1

The goal of phase one was to develop appropriate procedures to sample and to analyze oil sand to determine:

- what metals are there (essentially all elements - even trace amounts)
- how those present are tied to the different phases (bitumen, organic, or solids)
- what is extractable by acid leaching,
- how the elements are distributed by geological facies.

Specific steps:

Determine the extent (concentration and distribution) of potential co products present in the Athabasca oil sand from a geological perspective.

1a. Select a representative area that has been drilled in detail and for which the geology is well documented in three dimensions,
1b Develop procedures to obtain representative samples from each facies,
1c Develop analytical techniques to reveal the major elements present and how they are present in the oil sands:
- determine the presence in parts per billion if necessary
- determine how it is present:
  - in the bitumen phase
  - in the organic phase
  - in the solid mineral phase
  - amount extractable by chemical leaching
1d Evaluate the concentrations according to geological facies and other charactersticks such as particle size, clay content, bitumen content etc.,
1e Determine the related mineralogy if pertinent.

The goal of identifying the concentration of elements associated with the organic phase was dropped when it became apparent that this distinction is linked to specific extraction processes and cannot practically be determined from elemental analysis of core samples.

The study concentrated on elemental analysis so did not address mineralization.

APPENDIX B

B.1 The potential associated with co product recovery

The Athabasca oil sands of northern Alberta are well known for their vast reserves of bitumen. However, little is known about the extent, distribution, or potential value of other resources. Heavy minerals, base metals, precious metals and rare earths may also be present.

Commercial development of the oil sands offers significant benefit to Alberta. Unfortunately the economics of extracting bitumen alone are marginal. As a result there have not been any new developments in the mineable portion of the Athabasca deposits since Syncrude started operations in 1978.

It is doubtful if commercial extraction of the mineral and metal component of the Athabasca deposit will be economical on a stand alone basis. However the economics change drastically when recovery is considered in conjunction with mining activities to extract bitumen. Activities to recover bitumen cover the mining cost. Some of the extraction activities concentrate heavy minerals and metals. Together these factors should greatly reduce the cost of recovering co products. In addition some of the steps taken to extract metals could offer solutions to environmental challenges associated with the reclamation of oil sand operations.

Costs associated with the recovery of minerals and metals as co products will be much lower than costs associated with recovery of minerals and metals alone. As a result the grade of deposit needed for economic recovery of co products will be much lower than the break-even grade of a deposit considered for traditional stand alone recovery.

The net effect of the above is that there is a high potential for synergy between bitumen recovery and mineral/metal recovery. The use of such synergy is compatible with today's outlook on maximizing value in resource extraction. Identification of favourable synergies would allow commercial recovery of both bitumen and mineral/metal reserves. The scale of development that would follow if oil sand development became viable is immense - as are the associated benefits to Alberta.

Co product recovery has been considered with the existing commercial oil sand operations but has not proceeded because:

- the extent and distribution of co products in the ground is not known,
- the grades of potential co products are much lower than those required for traditional mineral or metal recovery,

- studies of co product recovery have concentrated on part of the minerals and metals present and has never addressed the full potential.
- studies which have focused on the recovery of heavy minerals in their natural state have been dealing with a product of marginal value,
- owners and operators of the commercial plants are not knowledgeable about mineral or metal recovery. Their focus has been toward oil recovery alone.

B.2 What is known about co products and previous work

Preliminary work by others has identified interesting accumulations of heavy minerals, base metals, precious metals and even rare earths. The heavy minerals of greatest interest include titanium and zirconium based minerals that are believed to be concentrated in some horizons. Base metals include aluminum that is probably concentrated in the clay sized fractions. Precious metals and rare earths are believed to be present in small quantities that may be extractable in conjunction with other operations.

Concentration of some of the heavy minerals have been studied in process streams in the existing commercial plants. Little if any work has been done to determine the distribution and concentration of heavy minerals and metals in different geological facies of the Athabasca Oil Sands. Similarly little if any work gas been done to appraise the extent of metals that can be removed by acid leaching. Both of the foregoing aspects must be determined and possible approaches to recovering co products appraised before the full economic potential can be appraised.

The presence of heavy minerals in the Athabasca oil sands is well documented. The Alberta Research Council (Carrigy, 1963) examined heavy minerals of coarser fractions of the McMurray Formation. Since then several studies have been completed in the public domain and within private sources. One of the most complete was undertaken by the Alberta Research Council (Kramers and Brown 1978). In that study heavy minerals were extracted from samples obtained from selected drill holes from several locations.

The elemental concentration in oil and bitumen has been researched by many. Curials (1974) and Parnell (1988) investigated trace elements in crude oil and bitumen as a possible tool for mineral exploration. Jarvis et. al. (1982) investigated trace impurities in various petroleum products including Athabasca oil sands to determine their fate during extraction and upgrading. Hitcheon and Filby (1984) attempted to determine the origin of Alberta crude oils through the extent of 11 trace elements in the oil. Majid and Ripmeester (1987) investigated humic matter associated with heavy minerals in oil sands. Reynolds (1989) characterized the nickel and vanadium components of sands from Athabasca and the United States.

Possible beneficiation and recovery of heavy minerals has also been studied by a number of researchers. Trevoy et. al. (1977, 1981) describes Syncrude's studies into recovering heavy minerals from oil sand tailings streams. Robertson Research (1981) undertook an extensive evaluation of the potential to extract titanium and zirconium minerals from tailings streams in commercial processing of the Athabasca oil sands. Trevoy reports specific techniques considered to recover and to beneficiate the heavy minerals. Sirianni and Ripmeester (1981) report on the feasibility of selective concentration of heavy minerals using an oil phase agglomeration method. Majid and Ripmeester (1985) showed that it is possible to recover heavy minerals from oil sand and from tailings at Suncor using oil agglomeration techniques.

Jacobs(1982) and Jacobs and Filby (1982a, 1982b 1983) investigated the extent of trace elements in oil sand, bitumen and coke from the Syncrude and Suncor operations. Trace elements in cores from Peace River and Cold Lake deposits were also evaluated. His focus was to use trace elements in oil to determine its origin. Jacobs identified elements that should show organic linkages as follows:

- elements totally organically bound -Mo Ni, Rb, Se, V.
- elements predominantly organically bound As, Co, Cr, Fe, Ga, Na, Sb, Sc, Th.
- elements totally inorganically bound: Al, Ce, Cs, K, La.

The origin of the source material, either geographically or geologically, is usually missing from the foregoing studies. In many cases the samples were obtained from partial process streams so are not traceable to a specific geologic facies.

The elements evaluated in the preceding studies varied but were generally limited in number and were related to specific study goals. Analytical techniques were also varied, although neutron activation has been the predominant procedure employed.

B.3 Sources of material tested in this program

The Sandalta site (Lease 30) was chosen for the test program because it offers the following:

- the site has been well explored using up-to-date exploration techniques:
    - full profile coring (8.5 cm diameter) with good core recovery,
    - geophysical logs (electrical, gamma and neutron density)
    - geological facies have been mapped in detail
    - bitumen contents determined
- most of the geological facies are present (marine facies at the top of the deposit have been eroded away at this location)
- the density of exploration holes is quite high in the study area
    - 100 m spacing on E - W cross sections,
    - 400 m spacing in the N - S direction between cross sections,
- cores are still available for testing,
- geological data is represented in a three dimensional computerized block model that permits modeling of the geology in three dimensions:
    - block size in the core area is 25 m X 25 m X 0.5 m,
- the block model follows detailed facies -(i.e. facies are not averaged).
- a colour photo record of the cores is available.

Lease 30 is located 40 km north of Fort McMurray, east of Fort McKay.

Core holes 209 and 215 were chosen from the densely investigated area for the current program. Core hole 209 represents a section of high grade oil sand with few waste bands. Core hole 215 represents a section of lower grade oil sand with many waste bands.

The cores were originally taken during a program undertaken in 1985. The drilling contractor was selected on the basis of competence and was paid for high core recovery. As a result core recovery was quite good.

The cores have been stored in a warehouse since the 1985 program. In the warehouse storage the cores have dried out but there is no reason to suspect changes that would affect this program.

B.4 Geology of the Athabasca Oil Sand Deposit

The Athabasca oil sands of northern Alberta contain immense reserves of bitumen. The deposits cover an area of 46,800 square kilometers. Approximately 10% of the area is covered by 50 metres or less of overburden so is considered amenable to surface mining.. Two surface mining operations, Syncrude Canada limited and Suncor Inc. extract bitumen from the oil sands and upgrade it to synthetic oil. Their combined production of over 200,000 barrels of synthetic oil per day represents 15% of Canada's oil production.

Depositional History

Most of the bitumen is contained in the McMurray formation of Cretaceous age.

The McMurray formation is a basin fill sequence of clastic sediment - sand and clay. The sands are quartzose and are believed to be erosion products from the Canadian Shield area to the northeast and from Jurassic sandstones to the south.

The McMurray formation was deposited in an irregular north-trending basin that developed on top of eroding Devonian strata. The topography of the basin, which tended to control the deposition of the McMurray, was shaped by regional down dropping. It was aided locally by karst collapse structures caused by dissolution of the deeper Middle Devonian salt beds. An eroding drainage system modified the area.

During the Cretaceous period, the Boreal Sea, located north of the present day Athabasca deposit migrated southward, transforming the fluvial environment into an estuary setting which was strongly controlled by tidal currents. Eventually the sea covered the area, resulting in the deposition of marine shales (Clearwater Formation) which overly the McMurray.

There are a number of theories concerning the origin of the bitumen. The most probable is that oil migrated from the Alberta Basin into the sand reservoir of the McMurray in post Cretaceous times. The oil may have migrated as light oil or as fairly mature oil.

Bitumen frequently occupies the pore space in the sandy phases of the McMurray Formation. It is not uniformly distributed . At some locations the basal sands are saturated with water. The interface between the bitumen and water varies from sharp to gradational. Occlusions also exist in the upper McMurray that are free of bitumen.

Since entrapment, the oil has been in contact with fresh water containing bacteria. The water can remove light hydrocarbons and the bacteria can transform mature oil to bitumen.

The McMurray Formation

The McMurray Formation consists of a series of predominantly uncemented sands, silts and clays that were deposited in successive environments as the sea invaded. On the Sandalta Lease the first deposits were deposited in a fluvial environment. These were followed by coastal plain and then by estuarine environments. Sediments representing a marine environment (absent at Sandalta) are sometimes found at the top of the McMurray.

The depositional environments offered different sorting capabilities that characterizes the sediments that accumulated. Geologists are able to recognize the different depositional environments on the basis of grain size, sedimentary structures and stratigraphic position. Facies boundaries are often indistinct and the depositional sequences can repeat. "Upward fining" sequences are also found that represent gradually weaker currents (and hence finer grained material) with time.

Geological facies, named after the depositional environment in which deposition occurred have been mapped as outlined in the Table B.1. The extent of each facies on the Sandalta lease is indicated. Typical bitumen contents for each facies are also shown.

B. 5 General Characteristics of Oil sands

The material to be evaluated in this study consist of oil sand core taken to obtain a continuous sample of the McMurray Formation. In general the core utilized in this project has the following physical characteristics:

- consists of a heterogeneous mixture of sand, silt and clay, sorted by the forces active at the time of deposition,

- the coarse grained facies contain approximately 83% solids, 12% bitumen and up to 5% water.

- the coarse grained fraction is mostly equidimensional quartz sand with rounded to sub angular grains. The sand is well sorted and tends to be fine grained.

- the coarse grained facies may contain thin bands of silt and clay that may also be dispersed within the sand fraction.

- some facies, such as abandoned channels may contain a mix of all grain sizes,

- fine grained facies were deposited in quiet conditions and consist predominantly of silt and clay. The silts are probably composed of quartz. The clays are predominantly kaolinite and illite.

- the oil sand is generally uncemented. Grains exist in an extremely tight packing with some degree of interlock between the sand grains.

- bitumen is found in the pore space of the coarse grained deposits. The bitumen content is roughly inversely proportional to the grain size. Thin fine grained facies found within coarser facies may be barren of bitumen. Fine grained facies with a high clay content (e.g. delta marsh muds) are often barren of bitumen.

- quartz grains are normally "water wet", i.e. they are surrounded by an envelope of water such that the bitumen does not directly contact the mineral solid. Non quartz minerals such as clays and heavy minerals may be "oil wet".

Table B.1 Geological facies present at the Sandalta site.

Depositional Environment	Facies	Sub Facies	Gross Lithology	% of Total	Typical Percent Bitumen
Estuarine	Pro Delta Mud		Silt and Clay	4.0%	0 - 3%
	Salt Marsh		Clay	3.7%	0 - 3%
	Abandoned Channel		Sand, Silt and Mud		1 - 14%
	Inter Channel		Sand with some Silt and Clay	14.2 %	12 - 16%
	Tidal Channel	Tidal Channel	Sand	17.0 %	13 - 16%
		Tidal Channel with Breccia	Sand with silt and clay breccia.	0.3%	6 - 14%
	Channel Breccia		Clay clasts in sand	0.2%	2 - 16%
	Upper Tidal Flat	Burrowed	Silt and Sand	10.7 %	1 - 7%
		Bedded (layered)	Silt and Sand	1.8%	3 - 13%
		Burrowed and Bedded	Sand and Silt	10.8 %	2 - 9%
	Lower Tidal Flat	Burrowed	Sand and Silt	4.5%	5 - 11%
		Bedded (layered)	Sand and Silt	5.8%	9 - 15%
		Burrowed and Bedded	Sand and Silt	5.8%	5 - 13%
		Tidal Mud	Clay	0.1%	5 - 13%
Coastal Plain	Fluvial Estuarine		Sand	0.9%	11 - 16%
	Delta Marsh Mud		Clay	0.5%	0 - 1%
	Overbank Mud		Silt and Clay	1.0%	0 - 13%
	Crevasse Splay		Sand, Mud Debris	1.2%	0 - 4%
	Coal		Coal	0.4%	0%
	Fluvial Channel	Oil - Bearing	Sand	10.7 %	8 - 17%
		Water - Bearing	Sand	1.1%	1 - 7%
		Mixed oil and water	Sand	1.7%	1 - 11%
		Fluvial Channel Breccia	Sand and Breccia	0.5%	6 - 14%
	Fluvial Breccia		Clay Clasts in Sand	0.1%	Not Present
	Abandoned Channel		Sand, Silt Mud	0.3%	1 - 14%

Figure B.1 Gulf - Sandalta Drill Hole 209

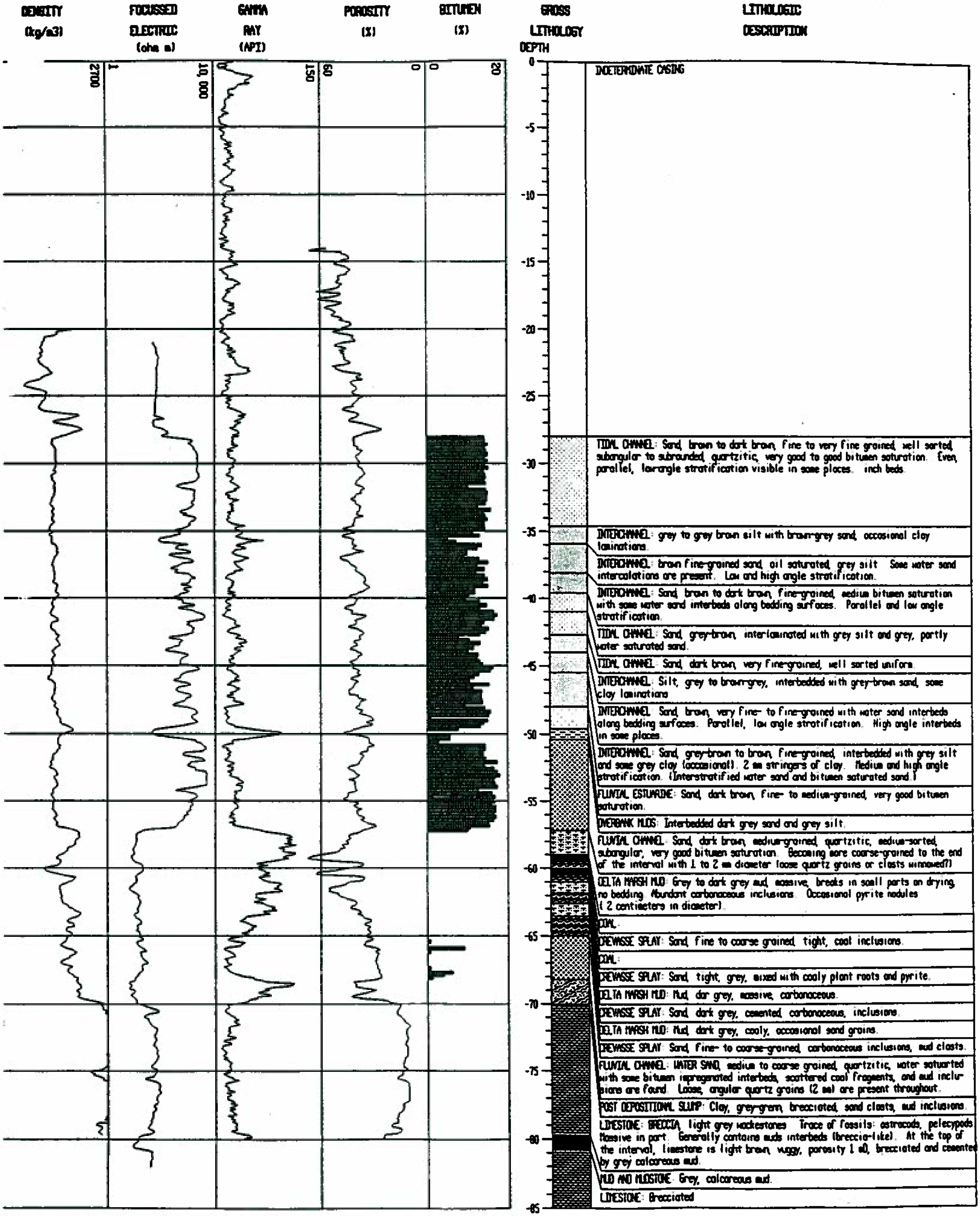
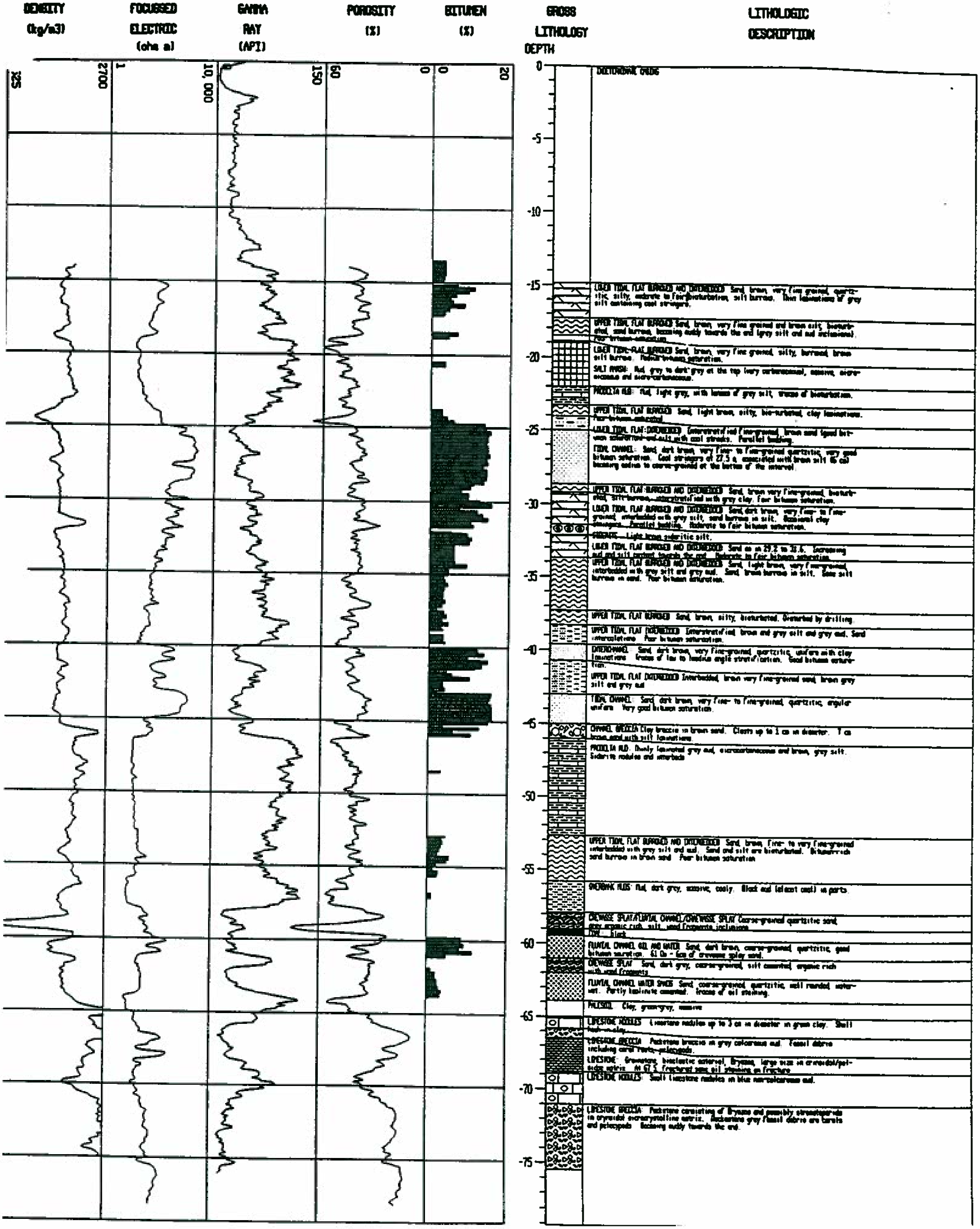


Figure B.2 Gulf - Sandalta Drill Hole 215



Appendix C

THE TRIAL PROGRAM

C.1 Reference samples

Reference samples were created to evaluate proposed sampling and evaluation procedures. Three 10 kg samples of representative material were developed as follows:

- a composite sample representing all facies,
- a sample representing fine grained facies that contain little bitumen
- a sample representing coarse grained facies that contain bitumen,

The samples were derived from core other than that planned for the core program in this study.

C.2 Trial Sampling and Analysis

The reference samples were subdivided to provide duplicate samples for detailed analysis.

Four duplicate sets of seven samples each were prepared and sent to analytical laboratories.

From these results it was concluded that the approach to sampling and analysis to determine the concentration of the various elements was adequate for this project.

The reference program was invaluable in allowing the development of appropriate procedures for the main program.

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

D.1 SAMPLING - THEORY AND PRACTICE

Factors to consider when taking representative samples and the steps to meet the project goals of representative sampling are outlined in Table D.1.

Descriptions of samples are provided at the rear of this appendix.

D.2 Analytical Procedures

The goal in analytical testing is to obtain accurate representative information on the concentration of elements present.

Key considerations:

- sample size must be large enough to allow representative sampling,
- sample preparation should not alter the chemical composition or introduce contaminants,
- confidence limits in the indicated concentrations for each element should be acceptable,
- detection limits should allow detection at low concentrations,

D.3 Analytical methods adopted

Analytical methods were reviewed. Three were adopted for the current program. A general description of each method follows.

Induced Neutron Activation Analysis (INAA or INA)

- samples are exposed to radiation which excites all matter present,
- each element emits characteristic radiation,
- the presence and extent of each element is determined from:
    - radiation unique to each element,
    - intensity of the unique radiation Vs time identifies the concentration,

Induced Coupled Plasma (ICP)

- sample preparation involves heating to 500 degrees to remove bitumen and organic material,
- sample is then dissolved in acid,
- the dissolved sample is atomized in a hot plasma flame,
- elements are detected by noting characteristic wave lengths emitted by the atomized sample.
- concentration is determined from the intensity of the radiation.

Fire Assay

- sample is heated in the presence of fluxes until it fuses,
- light elements are driven off,
- precious metals can then be selectively removed.
- the analysis is good for measuring small concentrations of precious metals.

Each method of analysis has its good and bad points. Together the three analytical procedures meet the overall needs of the subject program for detection limits and for accuracy.

D.4 Specific advantages of INAA

The INAA offers some specific advantages over other methods:

- tests whole samples,
- non destructive testing,
- samples can be retested if desired,
- limited opportunity to introduce contaminants because nothing is added,
- process minimizes systematic errors,
- confidence limits can be computed for each element analyzed,
- result is not affected by particle size or the chemical state of the elements present.

In the current program INAA methods of analysis were used preferentially. When INAA methods of analysis did not work ICP was used. Fire assay was used to test the extent of precious metal present.

Table D.1 Considerations for sampling and steps taken to meet the study goals.

Area	Concerns	Steps Taken
Drilling	Representative geology present	Selected core holes from a well defined area that are known to have the major facies present.
	Cores sample all pertinent formations	Use a competent drilling contractor and offer a bonus for good core recovery.
	Possible depth errors due to uncertainty over where core losses might occur.	a) Seek high core recovery b) Correct recorded depth against marker beds identified by the geophysical logs.
Extracting representative samples from cores	Foreign material from: - sloughed material in the hole	- seek high core recovery
	- introduced by drilling mud	- avoid sampling zones that suggest invasion by drilling mud
		- extract sample from the centre of the core where invasion by drilling mud is unlikely - sampled by cutting a cores in half and then cutting a V notch from the centre of the half core.
	- introduced by sampling procedure	- used steel saw blade of known composition
		- clean saw blade between sample points
		- place sampled section in a sealed plastic bag
		- avoid hand contact to minimize introduction of contaminants
	- sample all horizons	- use continuous sampling to sample all horizons
	- represent facies present	- identify facies on core and select sample intervals to avoid crossing boundaries
		- take continuous samples across each facies
	detect variation within a facies	- take several samples (max length of sample 0.5m)
Sampling for analysis	keep a representative sample while reducing the sample size for analysis	- thoroughly chop and mix the sample by hand to create a uniform sample
		- use a mild steel knife to avoid introducing unwanted elements
		- grind sample using a chemically clean mortar and pestle to reduce particle size if the sample does not contain bitumen (most did)
		- quarter the sample repeatedly on a clean flat surface using the mild steel knife until a sample of the size desired remains. Put in a clean container.

D.5 Required Sample Size

The size of samples required to determine representative concentrations of the elements present depends on the size of individual anomalies present.

It is believed that the sample size was adequate to determine the concentration of elements that form an inherent part of the oil sands. This is borne out by the data trends.

Supportable argument can be made that much larger samples and more of them are needed to appraise anomalies - such as those associated with placer deposits. For this reason sampling programs to appraise gold placer deposits often involve large sized samples - of a tonne or more.

In the current program INAA samples weighed approximately 0.5 grams. The weight of the whole INAA sampling program - for 200 samples was only 100 grams. This is not a statistically relevant sample size to appraise a zone comprising many tonnes of material.

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-1 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-2 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-3 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-4 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-5 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-6 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-7 (TC)	Sand, fine- to medium-grained	non-apparent	quartzitic, 0.5 cm pyrite nodule	well sorted	high bitumen saturation
209-8 (TC)	Sand, fine- to medium-grained	4 cm light brown silt band with low bitumen saturation	quartzitic	well sorted	high bitumen saturation
209-9 (TC)	Sand, fine- to medium-grained	4 cm light grey to brown silt band at top of sample	quartzitic	well sorted	high bitumen saturation
209-10 (TC)	Sand, very fine- to fine-grained	non-apparent	quartzitic	well sorted	high bitumen saturation
209-11 (TC)	Sand, very fine- to fine-grained	structureless	quartzitic	well sorted	high bitumen saturation

Drill Hole 209-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-12 (TC)	Sand, very fine- to fine-grained	45 degree fracture infilled with silt, 3 cm irregular clast of strongly weathered micaceous schist (?)	several 1 cm clasts of weathered phyllite	well sorted	high bitumen saturation
209-13 (TC)	Sand, very fine- to fine-grained	2-3 cm wide band of 1 mm thick flakes of weathered silty material	quartzitic	well sorted	high bitumen saturation. Lower contact is gradational
209-14 (ICH)	Sand, very fine- to fine-grained	structureless	quartzitic	well sorted	Medium to high bitumen saturation
209-15 (ICH)	Sand, very fine- to fine-grained	two - 1 cm square clasts of weathered siltstone, light brown	quartzitic	well sorted	Medium to high bitumen saturation
209-16 (ICH)	Sand, very fine- to fine-grained	two - 3 cm irregular clasts of light brown weathered siltstone	quartzitic	well sorted	Medium to high bitumen saturation
209-17 (ICH)	Sand, very fine- to fine-grained	minor irregular clasts of light brown silt in middle of sample	quartzitic, 1 cm blocky pyrite nodule, 4 cm long clast of quartzite or siltstone	well sorted	Medium to high bitumen saturation
209-18 (ICH)	Sand, with increasing silt laminations to bottom of sample	low angle cross-bedding in lower half of sample, bedding of 1 mm scale	quartzitic	moderately sorted	Medium to high bitumen saturation in sand, low to moderate in silty lenses

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-19	Sand, very fine- to fine-grained, occasional silty lenses < 1 mm thick	vague high angle (20-30 degree) bedding in middle of sample	quartzitic	well to moderately sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation
20920 (ICH)	Sand, fine- to very fine-grained	wavy, irregular, subparallel bedding, occasional silty lenses, 1 cm thick barren silt lense in middle of sample	quartzitic	well to moderately sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation
209-21 (ICH)	Sand, fine- to very fine-grained with coarse silt lenses	wavy, subhorizontal, parallel and planar, parallel bedding, 10-20 degrees, 0.5 cm barren silt lense at top of sample	quartzitic	moderately sorted	medium to high bitumen saturation, lower saturation in silt lenses
209-22 (ICH)	Sand, fine- to very fine-grained with silt interbeds	planar, parallel, low angle bedding, 0.5 to 1.0 cm thick	quartzitic, light brown irregular clast of cemented siltstone	moderately to well sorted	variable bitumen saturation
209-23 (ICH)	Sand, fine- to very fine-grained	top 5 cm subrounded clasts of light brown siltstone in wavy, subparallel bedding, lower part of sample has parallel bedding at 5-10 degrees	quartzitic, 1 cm irregular light grey silt layer at bottom	moderately to well sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation

Drill Hole 209-85
Sample Descriptions

ample umber 'acies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-24 (ICH)	Sand, fine- to very fine-grained	low angle (5 degree) and horizontal planar bedding, 1 cm thick	quartzitic	moderately to well sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation .
209-25 (ICH)	Sand, fine- to very fine-grained. Thin silty sand laminations in top and bottom of sample	low (0 to 5 degrees) angle bedding in top half of sample, high angle, thick (0.5 cm) bedding in middle of sample and horizontal, thin (1 mm) planar bedding at bottom of sample.	quartzitic	moderately to well sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation
209-26 (ICH)	Sand, fine- to very fine-grained, some silty sand laminations in lower part of sample	high angle (20-30 degrees) bedding at top flattening to 0-3 degrees near bottom	quartzitic, 0.5 mm thin coal laminations in silty sand matrix in middle of sample.	moderately to well sorted	thin silt lenses have low bitumen saturation elsewhere high bitumen saturation, lower contact gradational
209-27 (TC)	Sand, fine- to very fine-grained	vague, steep (25-35 degrees) parallel bedding	quartzitic	moderately to well sorted	high bitumen saturation
209-28 (TC)	Sand, fine- to very fine-grained	vague, parallel, subhorizontal bedding, 1 cm siltstone clasts and wavy subhorizontal silt laminations in middle of sample	quartzitic	moderately to well sorted	high bitumen saturation

Drill Hole 209-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-29 (TC)	Sand, fine- to very fine-grained	vague, parallel high angle (20-30 degree) bedding	quartzitic, 2-3 mm siltstone clasts	moderately to well sorted	variable laminations of high and low bitumen saturation. Lower contact is gradational.
209-30 (ICH)	Sand, fine- to very fine-grained	pseudo-bedding, horizontal, planar, parallel. 8 cm of interbedded grey silt and sand, 1-2 cm thick, laminations in silt 1-2 mm thick	quartzitic	moderately to well sorted	medium to high bitumen saturation in sand. Occasional thin (0.1 mm) laminations in silt.
209-31 (ICH)	Sand, fine- to very fine-grained. Silt layers increasing to bottom of sample.	vague cross-bedding, wavy irregular, silt laminations thickening to 1-2 cm thick flat silt units in lower part of sample	quartzitic	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-32 (ICH)	Sand, fine- to very fine-grained	Planar, parallel bedding which increases to 20 degrees in lower part of sample	quartzitic	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-33 (ICH)	Sand, fine- to very fine-grained	Planar, parallel, pseudo-bedding, flat to low angle (0-5 degrees)	quartzitic	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-34 (ICH)	Sand, fine- to very fine-grained	Planar, parallel, pseudo-bedding, flat to low angle (0-5 degrees), increasing to 20 degrees in bottom of sample	quartzitic	well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-35 (ICH)	Sand, fine- to very fine-grained	Planar, parallel bedding at 20 degrees decreasing to 0 degrees at bottom of sample	quartzitic	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-36 (ICH)	Sand, fine- to very fine-grained	Parallel, planar, pseudo-bedding at 0 - 20 degrees, flattening to 0 degrees at bottom of sample	quartzitic	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-37 (ICH)	Sand, fine- to very fine-grained, increasing silt laminations toward bottom of sample.	Low angle (0-5 degrees) parallel bedding, slightly disturbed by drilling	quartzitic, 2-3 mm coal lamination	moderately to well sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-38 (ICH)	Sand, fine- to very fine-grained, silt laminations 0.5 to 0.1 cm thick are common	Bedding disturbed by drilling	quartzitic	moderately sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-39 (ICH)	Sand, fine- to very fine-grained	Even, parallel, medium angle (15-25 degrees) bedding, flattening to 5 degrees at bottom	quartzitic	moderately sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer
209-40 (ICH)	Sand, fine- to very fine-grained	Bedding at 5-10 degrees, 1-10 mm thick, silt laminations common at top of sample	quartzitic	moderately sorted	variable bitumen saturation from high to low in sand giving appearance of pseudo-bedding. Thin irregular (0.1 mm) bitumen laminations in silt layer. Lower contact is gradational

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-41 (FE)	Sand fine-grained	Large-scale cross-bedding at 0-15 degrees.	quartzitic	well sorted	moderate to high bitumen saturation, variable in layers
209-42 (FE)	Sand, fine-grained	Planar, parallel bedding at 20-30 degrees, 5 mm thick	quartzitic, single 4 mm silt clast	well sorted	moderate to high bitumen saturation, variable in layers
209-43 (ICH)	Sand, fine- to coarse-grained	Planar, parallel bedding at 15 degrees, flattening to 0 degrees at the bottom	quartzitic, 0.5 by 2 cm clasts of bitumen free siltstone, 1 cm pyrite nodule	moderate to poorly sorted	moderate to high bitumen saturation, variable in layers. Lower contact is sharp.
209-44 (OV)	Silt and very fine-grained sand	1 mm thick planar, parallel bedding dipping at 30-40 degrees!!!. Fine-grained sand in thin white laminations or slightly bitumen stained	quartzitic	poorly sorted	trace of bitumen saturation in some sand laminations
209-45 (OV)	Silt and very-fine grained sand	1 mm thick planar, parallel bedding dipping at 30-40 degrees!!!. Fine-grained sand in thin white laminations or slightly bitumen stained. The bedding dip flattens to 0 degrees at bottom of sample.	quartzitic	poorly sorted	trace of bitumen saturation in some sand laminations. Lower contact is sharp.
209-46 (FC)	Sand, fine- to coarse-grained	Parallel, planar bedding,0.5 to 2 cm thick, minor 1 -3 mm bitumen free silt clasts	quartzitic	moderately to poorly sorted	high to very high bitumen saturation, variable in layers

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-47 (FC)	Sand, fine- to coarse-grained	Parallel, planar bedding	quartzitic, occasional thin (1 mm) clasts of bitumen free silt	moderately to poorly sorted	high to very high bitumen saturation, variable in layers
209-48 (FC)	Sand, fine- to very coarse-grained	Some cross-bedding at top of sample, otherwise bedding is obscured	quartzitic, rare 0.5-1.0 cm siltstone, common 0.5 cm irregularly oriented clasts of coal (washed in?), some pyrite associated with the coal	poorly sorted	high to very high bitumen saturation, variable in layers
209-49 (FC)	Sand, fine- to medium-grained	vague bedding at 0-5 degrees	quartzitic, minor irregular silt clasts 1-5 mm	well sorted	high bitumen saturation
209-50 (FC)	Sand, fine- to medium-grained	vague bedding at 0-5 degrees	quartzitic, 0.5 to 3 cm lenticular clasts of bitumen free silt are common	well sorted	high bitumen saturation
209-51 (FC)	Sand, fine to very fine-grained	structureless	quartzitic	well sorted	high bitumen saturation

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-52 (FC)	Sand, fine to very fine-grained	structureless	quartzitic, two clayey silt clasts (0.5 -2 cm) in middle of sample	well sorted	high bitumen saturation
209-53 (FC)	Sand, fine to very fine-grained	4 cm of interbedded and burrowed grey silt and sand, single lense, 2-4 mm thick, of very coarse sand and granules	quartzitic	well sorted	high bitumen saturation
209-54 (FC)	Sand, very fine-grained	structureless	quartzitic	well sorted	high bitumen saturation
209-55 (FC)	Sand, very fine-grained	structureless	quartzitic	well sorted	high bitumen saturation
209-56 (FC)	Sand, very fine-grained	structureless	quartzitic	well sorted	high bitumen saturation
209-57 (FC)	Sand, very fine-grained	structureless	quartzitic	well sorted	high bitumen saturation
209-58 (FC)	Sand, very fine-grained	vague bedding at 5-10 degrees, single layer of coarse-grained sand (lag?) at bottom of channel	quartzitic	well sorted	high bitumen saturation
209-59 (FC)	Sand, very fine-grained	4 cm thick lense of fine-grained sand with 10% coarse to granules size particles (lag?)	quartzitic	well sorted	high bitumen saturation. Lower contact is sharp.

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-60 (DMM)	Silt, grey, clayey, 10-15% very fine-grained sand, 1-2 mm thick stringers of very fine-grained, white sand,	dried and desiccated, no apparent bedding	quartzitic, slightly micaceous, 4 cm pyrite nodule in middle of sample, black (organic matter?) disseminated through out, one brown siltstone nodule	poorly sorted	Thick droplets of bitumen
209-61 (DMM)	Silt, some clay, 10-15% very fine-grained sand	dried and desiccated, no apparent bedding, 2 cm thick fine-grained sand lense, rounded clasts of fine-grained sand	quartzitic, slightly micaceous, black organic specks are common	poorly sorted	Trace bitumen content
209-62 (DMM)	Silt, some clay, 10-15% very fine-grained sand	desiccation tends to accentuate thin, flat, parallel bedding, 1 mm in thickness, occasional small vugs of fine-grained sand	quartzitic, slightly micaceous, black organic specks are common, organic content increases with depth	poorly sorted	Trace bitumen content
209-63 (DMM)	Silt, some clay, 10-15% very fine-grained sand	desiccation tends to accentuate thin, flat, parallel bedding, 1 mm in thickness, occasional small vugs of fine-grained sand	strongly organic	poorly sorted	Trace bitumen content. Lower contact gradational.

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-64 (COAL)	Shale increasing to shaley coal towards the bottom	Thin (1 mm), wavy discontinuous bedding	Strongly carbonaceous	poorly sorted	No bitumen
209-65 (CS)	Silt, grey, sandy, trace medium-grained sand	Wavy, discontinuous bedding, 0.5 cm thick, thin (<1 mm thick) discontinuous white silt laminations	quartzitic, carbonaceous	very poorly sorted	No visible bitumen
209-66 (COAL)	Shale, black, trace very fine- to fine-grained disseminated sand	1-2 mm thick, wavy, irregular bedding	quartzitic, highly carbonaceous, occasional 1-3 mm thick coal stringers	poorly sorted	No visible bitumen. Lower contact is sharp.
209-67 (CS)	Silt, grey	Structureless, vertical 0.5 mm thick pyrite stringers and occasional pyrite nodules	carbonaceous	poorly sorted	No visible bitumen. Lower contact is gradational.
209-68 (DMM)	Silt, dark grey, clayey	thin (1 mm), slightly curved, non-parallel bedding	quartzitic	moderately sorted	No visible bitumen.
209-69 (DMM)	Shale, grey, black	vague to structureless	quartzitic, carbonaceous decreasing with depth, finely disseminated	moderately sorted	No visible bitumen. Lower contact is gradational.

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-70 (CS)	Silt, dark grey, clayey	wavy, parallel bedding	quartzitic, carbonaceous, pyritic, isolated white sand grains	moderately to poorly sorted	No visible bitumen.
209-71 (CS)	Silt, grey, with trace fine- to coarse-grained sand as isolated grains	wavy, irregular bedding, 5-10 mm thick	quartzitic, decreasing organic content with depth but very carbonaceous at bottom of sample	very poorly sorted	No visible bitumen. Lower contact is gradational
209-72 (DMM)	Silt, grey, with fine- to coarse-grained sand	discontinuous, wavy, parallel bedding, 3-5 mm thick	quartzitic, organic	poorly to very poorly sorted	trace bitumen
209-73 (DMM)	Silt, grey, with fine- to coarse-grained sand	chaotic, wavy, discontinuous, non-parallel bedding	quartzitic, organic	very poorly sorted	trace bitumen
209-74 (CS)	Silt, grey and fine- to coarse-grained sand, interbedded. Sand content increasing with depth.	wavy, irregular bedding, 1-2 cm thick	quartzitic,	very poorly sorted	low bitumen saturation in sand
209-75 (CS)	Silt, dark grey with fine- to coarse-grained sand	vague, wavy, irregular bedding	quartzitic, carbonaceous	very poorly sorted	no visible bitumen

Drill Hole 209-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-76 (CS)	Sand, fine- to coarse-grained, slightly silty, 1 cm interbeds of medium- to coarse-grained sand	wavy, irregular, discontinuous bedding, 0.5 cm thick	quartzitic,	very poorly sorted	Slight bitumen saturation in sand. Lower contact is sharp.
209-77 (FC)	Sand, fine- to medium-coarse-grained in grey silty matrix, white quartz grains or thin stringers	no apparent structure	quartzitic, coaly blebs common	very poorly sorted	Traces of bitumen in blebs.
209-78 (FC)	Sand, fine- to medium-coarse-grained in grey silty matrix, white quartz grains or thin stringers. Changing to fine- to coarse-grained sand at bottom.	no apparent structure	quartzitic, coaly blebs in upper part of sample	poorly to very poorly sorted	Thick sand unit is bitumen free. Thinner sand interbeds have moderate bitumen saturations
209-79 (FC)	Sand, fine- to medium-coarse-grained in grey silty matrix, white quartz grains or thin stringers	no apparent structure	quartzitic, coaly blebs in upper part of sample	poorly to very poorly sorted	Thick sand unit is bitumen free. Thinner sand interbeds have moderate bitumen saturations
209-80 (FC)	Sand, fine- to medium-coarse-grained in grey silty matrix, white quartz grains or thin stringers.	vague, irregular, wavy, bedding in silty unit	quartzitic, coaly blebs common	poorly to very poorly sorted	Thick sand unit is bitumen free. Thinner sand interbeds have moderate bitumen saturations

Drill Hole 209-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
209-81 (FC)	Sand, fine- to medium-coarse-grained in grey silty matrix, white quartz grains or thin stringers	wavy, irregular, discontinuous, bedding in top 7 cm; remainder is structureless	quartzitic, carbonaceous in top 7 cm of sample	poorly to very poorly sorted	Trace bitumen saturation increasing to moderate bitumen saturation at bottom of sample
209-82 (FC)	Sand, fine- to medium-grained, 2-4 mm granules at bottom	structureless	quartzitic	moderately to very poorly sorted at bottom	

Drill Hole 215-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-1 (LTF)	Sand, grey, 0.5mm bitumen saturated laminations at bottom of sample	thin, rippled bedding, cracks open parallel to bedding, irregular dessication fractures	thin, black flakes	moderately sorted	distinctly different than remaining lower tidal flat unit
215-2 (LTF)	Sand, low bitumen saturation	Sand and occasional silt filled burrows, some ripple trough cross stratification alternating with churned layers	quartzitic	medium to well sorted	low bitumen saturation at top of sample
215-3 (LTF)	Sand with some silt	strongly bioturbated	quartzitic	medium to well sorted	medium to low bitumen saturation, which is irregular to mottled in distribution
215-4 (LTF)	Sand	Bioturbated at top and bottom of sample. Remainder is thinly bedded < 0.1mm in thickness	quartzitic	medium to well sorted	increasing bitumen content towards bottom of sample

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-5 (LTF)	Sand, very fine-grained and silt, brown to grey	strongly bioturbated, circular burrows common	quartzitic	medium to poorly sorted	irregular bitumen saturation (mottled) decreasing to bottom, some drilling disturbance of outer core at bottom,
215-6 (UTF)	Sand, very fine-grained and grey silt	strongly bioturbated, churned	quartzitic	moderately to poorly sorted	sand, light brown with minor bitumen staying
215-7 (UTF)	Sand, very fine grained and grey silt	strongly bioturbated (churned), 4 cm thinly bedded laminantions near bottom of unit	quartzitic	moderately to poorly sorted	minor bitumen saturation
215-8 (SM?)	Sand, fine-grained	moderately to well bioturbated	carbonaceous and quartzitic	moderately sorted	decreasin bitumen saturation with depth, very fine grained to silty, wavy laminations, bitumen free, contact sharp
215-9 (SM)	Silt, black, carbonaceous	very thinly bedded (<0.1mm)	1 mm thick coaly laminantions in lower 1/3 of sample		sample is desiccated
215-10	Silt, grey	1 cm coal clast in to 10 cms. Occasional 1 mm thick coal stringers	black specs of carbonaceous material (<0.1 mm)		desiccated from drying
215-11 (SM)	Silt, grey	very thin (<1mm) subparallel bedding, fracture @ 45 and 90 degrees to core axis	occasional clay laminations, some < 0.1 mm specks of organic matter		desiccated
215-12 (SM)	Silt, grey	no bedding distinguishable	minor organic specks (<0.1mm)		desiccated

Drill Hole 215-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-13 (SM)	Silt, grey	no bedding distinguishable	light brown iron-stained layer 20 cm from top of sample, minor organic specks throughout		desiccated
215-14 (SM)	Silt, grey	no distinguishable bedding	minor 0.1 mm organic specks		desiccated, core badly crumbled at top of sample
215-15 (PDM)	Silt, grey, clayey	alternating silt and clay laminations 1 -2 mm thick	1-2 cm pyrite nodules		some desiccation
215-16 (PDM)	Silt, grey, clayey	1 cm thick slightly bitumen-stained irregular sand lamination and filled burrows			some desiccation
215-17 (PDM)	Silt, grey, clayey	2-3 cm thick interbands of subvertical sand filled burrows		poorly sorted	some desiccation, light bitumen saturation in sand-filled burrows. Lower contact gradational
215-18 (UTF)	Silt, grey, clayey, grading to very fine grained sand with depth	1-2 cm thick interbands of subvertical and horizontal circular burrows		poorly sorted	transition from prodelta mud, increasing bitumen saturation with depth. (fining upward sequence)
215-19 (PDM)	Silt, grey, interbedded with silty sand			poorly sorted	low bitumen saturation in sand interbeds, realtively sharp but irregular lower contact

Drill Hole 215-85 Sample Descriptions					
Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-20 (LTF)	Sand, very fine-grained	very thinly bedded (1 mm) with bitumen-rich laminations	quartzitic	well sorted	up to 13 cm with no visible bedding, low bitumen saturation
215-21 (LTF)	Sand, fine- to very fine-grained sand		well sorted	well sorted	good bitumen satuartion, lower contact defined by bitumen saturation, relatively sharp
215-22 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 10 degrees	quartzitic	well sorted	
215-23 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 20 degrees	quartzitic	well sorted	pseudo-bedding resulting from alternating rich and moderate bitumen saturations
215-24 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 0 -10 degrees due to variable bitumen saturation	quartzitic	well sorted	
215-25 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 0 -10 degrees due to variable bitumen saturation	quartzitic, minor pyrite	well sorted	
215-26 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 0 -10 degrees due to variable bitumen saturation	quartzitic, minor pyrite	well sorted	slightly lower bitumen saturation in middle of sample, alternating layers of bitumen irregularly distributed but occurrig in stringers about 1 mm thick

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-27 (TC)	Sand, fine- to very fine-grained, uniform	faint bedding at 0 -10 degrees due to variable bitumen saturation	quartzitic	well sorted	
215-28 (TC)	Sand, very fine-grained to coarse-grained (lag?) at bottom	faint bedding at 0 -10 degrees due to variable bitumen saturation	quartzitic	well sorted	lower contact shart with lower clay band 2 cm thick, load cast
215-29 (UTF)	Sand, very fine-grained with alternating zones of sand and 1 mm thick silt laminations	clay laminations horizontal, burrows, undulating load casts			Clay laminations of 2 cm towards bottom of sample
215-30 (LTF)	Sand, very fine-grained	1 cm thick wavy burrowed silt laminatons, load clasts, interbedded with oil sand	quartzitic	well sorted	medium bitumen saturation
215-31 (LTF)	Sand, very fine-grained	several intervals thinly bedded (1mm) grey silt and fine-grained sand, some burrows	quartzitic	well sorted	medium bitumen saturation in sand, silt layers have trace bitumen
215-32 (LTF)	Sand, very fine-grained	1-2 mm stringers of wavy discontinous grey silt in middle of sample, bedding at 0 to 5 degrees	quartztic	well sorted	medium bitumen saturation
215-33 (LTF)	Sand, very fine-grained	occassional zones of interbedded grey silt and very fine-grained sand	quartzitic	well sorted	lower contact is sharp
215-34 (SIDERITE)	Siltstone, light brown, cemented	grey, faint, wavy, subhorizontal, thin bedding	quartzitic	well sorted	hard, partially impregnated with bitumen, lower contact is sharp

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-35 (LTF)	Sand and light grey silt	alternating band of very fine-grained sand and intrbedded light grey silt and sand, sand filled burrows	quartzitic	well sorted	low to medium bitumen saturation
215-36 (LTF)	Interbedded brown to black sand and grey brown silt	subhorizontal, even, parallel, wavy bedding, minor clasts(?), burrows sand filled	quartzitic	well sorted	slightly disturbed by drilling, medium to low bitumen saturation
215-37 (LTF)	Interbedded brown to black sand and grey brown silt	subhorizontal, even, parallel, wavy bedding, minor clasts(?), well burrowed, semi-circular horizontal sand filled burrows	quartiztic	well sorted	one clean sand interval, low to medium bitumen saturation, lower contact gradational
215-39 (UTF)	brown to black, fine-grained sand with light grey silt lenses	silt lenses burrowed (sand filled) and bedded (1 mm thick)	quartzitic	moderately sorted	low bitumen saturation
215-40 (UTF)	Silt, light grey with some very fine-grained sand	burrowed and bedded silt with minor discontinuous sand lenses	quartzitic	well sorted	low bitumen saturation
215-41 (UTF)	Silt, light grey with some very fine-grained sand	burrowed and bedded silt with minor discontinuous sand lenses	quartzitic	well sorted	low bitumen saturation
215-42 (UTF)	Silt, light grey with some very fine-grained sand	burrowed and bedded silt with minor discontinuous sand lenses	quartzitic	well sorted	low bitumen saturation

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-43 (UTF)	Silt, light grey with some very fine-grained sand, occasional sand lenses 3-6 cm thick	burrowed and bedded silt with minor discontinuous sand lenses	quartzitic	well sorted	low bitumen saturation
215-44 (UTF)	Silt, light grey with some very fine-grained sand	burrowed and bedded silt with minor discontinuous sand lenses	quartzitic	well sorted	low bitumen saturation
215-45 (UTF)	Silt, light grey to brown	sand filled burrows, occasional 0.5 cm thick sand interbeds, bedding subhorizontal	quartzitic	moderately to well sorted	low to no bitumen saturation except in sands
215-46 (UTF)	Silt, light grey to brown with minor sand lenses	sand filled burrows, bedding subhorizontal, burrowed and bedded	quartzitic	moderately sorted	low bitumen saturation except in sands
215-47 (UTF)	Silt, light grey	Sand filled burrows and occasional, wavy subhorizontal sand lenses	quartzitic	monerately sorted	low to no bitumen saturation, moderate to high saturation in sand lenses
215-48 (UTF)	Silt, light grey and minor light brown sand	appears to have been saturated by drilling fluid	quartzitic	poorly sorted	low to no bitumen saturation
215-49 (UTF)	Silt, light grey, with interbedded sand lenses	Silt in flat, even, parallel beds approx. 1 mm thick. Sand lenses wavy, 1-10 mm	quartzitic	well sorted in individual lenses	no bitumen saturation in silt. Bitumen saturation in sand increasing with thickenss of indivdaul units.
215-50 (ICH)	Sand, very fine-grained	Vague, low to high angle bedding	quartzitic	well sorted	moderate bitumen saturation
215-51 (ICH)	Sand, very fine-grained	Frequent light grey silt laminations at low to high	quartzitic	moderately sorted	low to moderate bitumen saturation

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-52 (ICH)	Sand, very fine-grained	Isolated 2 mm clay drapes at bottom of sample	quartzitic	well sorted	moderate bitumen saturation
215-53 (UTF)	Silt and fine-grained sand, interbedded	Irregular bedding dips, may be due to drill action, occassional burrows, bedding 2 - 3 mm thick	quartzitic	moderately sorted	low to high bitumen saturation
215-54 (UTF)	Sand, very fine-grained	Thinly laminanted grey silt at top and bottom	quartzitic	poorly sorted	very variable unit with silt and sand interbedded irregularly for top 1/3 of sample, clean sand saturated with bitumen in middle 1/3 and thinly bedded (<1mm) silt and sand in lower 1/3
215-55 (UTF)	Silt, grey, interbedded with very fine-grained sand	Thingly bedded at top and thickly bedded (>2mm) at bottoem	quartzitic	poorly sorted	variable, lower contact sharp and unconformable
215-56 (TC)	Silt, fine- to very fine-grained	Non-distinguishable	quartzitic	well sorted	good bitumen saturation
215-57 (TC)	Silt, fine- to very fine-grained	Non-distinguishable	quartzitic	well sorted	good bitumen saturation
215-58 (TC)	Silt, fine- to very fine-grained	Non-distinguishable	quartzitic	well sorted	good bitumen saturation
215-59 (TC)	Silt, fine- to very fine-grained	Non-distinguishable	quartzitic	well sorted	good bitumen saturation
215-60 (CB)	Sand, fine- to very fine-grained with silt clasts	Irregular clay silt clast several centimeters in length	quartzitic	poorly sorted	12 cm of clean oil sand at bottom

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-61 (CB)	Sand, fine- to very fine-grained	Wavy, discontinuous silt laminations at top of sample	quartzitic, green (glauconitic?) siltstone, possible cave in hole		block of breccia, disturbed by drilling at very top of sample
215-62 (PDM)	Silt, grey	Even, parallel bedding, 3-5 mm thick, bitumen stained fracture, occasional 0.1mm laminations of very fine-grained sand sometimes containing bitumen, some steeply dipping to vertical fractures	0.01 mm black particles (1-3%), mica?	well sorted	15 cm thick siderite cemented, subhorizontal shrinkage cracks along bedding planes
215-63 (PDM)	Silt, grey	Even, parallel bedding, 3-5 mm thick, bitumen stained fracture, occasional 0.1mm laminations of very fine-grained sand sometimes containing bitumen, some steeply dipping to vertical fractures	1 cm thick light brown cemented layerr	well sorted	light yellow discoloration infrequently in core
215-64 (PDM)	Silt, grey	Even, parallel bedding, 3-5 mm thick, bitumen stained fracture, occasional 0.1mm laminations of very fine-grained sand sometimes containing bitumen, some steeply dipping to vertical fractures. 0.5 cm sandy silt layer about 20 cm from top of sample.	quartzitic, 1-3 percent black specks	well sorted	

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-65 (PDM)	Silt, grey	< 1mm, brown, rust stained, coarse silt or fine-grained sand laminations just above pyrite	1 cm pyrite pebble with silt beds folded around pebble	well sorted	
215-66 (PDM)	Silt, grey	thinly bedded dark brown coarse silt to fine-grained sand lenses and 1 cm light brown cemented laminations	quartzitic	well sorted	
215-67 (PDM)	Silt, grey	6 cm ironstone lense located 10 centimeters from bottom, several 1-2 mm brown, uncemented layers near bottom of sample	quartzitic	well sorted	
215-68 (PDM)	Silt, grey	1-2 cm thick light brown ironstone lense, bedding < 1mm thick	quartzitic	well sorted	
215-69 (PDM)	Silt, grey	brown lenses common	quartzitic	well sorted	
215-70 (PDM)	Silt, grey with sand, interbedded 1-10 mm	irregular very fine-grained sand intervals, visible bitumen staining	quartzitic	moderatley sorted	
215-71 (PDM)	Silt, grey with sand, interbedded 1-10 mm	brown sand lenses, + 15 mm thick	quartzitic	poorly sorted	
215-72 (PDM)	Sand and silt, sand content increasing with depth		quartzitic	poorly sorted	

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-73 (PDM)	Sand and silt, sand content increasing with depth		quartzitic	poorly sorted	
215-74 (PDM)	Sand and silt, sand content increasing with depth		quartzitic	poorly sorted	lower contact is gradational, is related to increased bitumen content in very fine-grained sand lense.
215-75 (UTF)	Sand, brown with grey silt interbedded	bedding commonly churned, burrows sand filled	quartzitic	poorly sorted	bitumen saturation low to moderate in sand. Silt is barren of bitumen
215-76 (UTF)	Sand, brown, interbedded with grey silt	Sand lenses 1-5 cm thick, sharp contact with silt but sometimes irregular. Silt is thinly bedded (< 1mm). Burrows filled with sand	quartzitic, silt lenses contain mica and black, glassy(?) specks	poorly sorted	some bitumen saturation
215-77 (UTF)	Sand, brown, interbedded with grey silt	Sand lenses 1-5 cm thick, sharp contact with silt but sometimes irregular. Silt is thinly bedded (< 1mm). Burrows filled with sand	quartzitic	poorly sorted	some bitumen saturation
215-78 (UTF)	Silt, grey, with 1-10 cm thick sand lenses	Silt is thinly bedded. Some burrowing, sand filled. Siderite cemented, brown silt lense in sand layer in top 10 cm of sample	quartzitic	poorly sorted	thicker sand lenses have high bitumen saturation, otherwise low to medium saturation
215-79 (UTF)	Silt, coarse-grained and Sand very fine-grained, some grey silt lenses	Silt is thinly bedded. Some burrowing, sand filled.	quartzitic	poorly sorted	bitumen saturation low in sand. Silt is barren of bitumen

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-80 (UTF)	Sand, brown with grey silt interbedded	bedding commonly churned, burrows sand filled	quartzitic	porrly sorted	bitumen saturation low to moderate in sand. Silt is barren of bitumen
215-81 (OV)	Silt, clayey, grey	Silt lenses, frequent 0.01 to 0.1 mm thick, occasional brown 5mm lenses with 0.01mm thick laminations of black flacky mineral	quartzitc with 0.01 mm black specks, 2 cm pyrite pebble		
215-82 (OV)	Silt, grey	thinly bedded, iron stained nodule 2 cm in size			
215-83 (OV)	Clay, dark organic	thinly bedded (<1mm)			
215-84 (OV)	Mud, dark, carbonaceous	thinly bedded (<1 mm)			lower contact sharp and irregulat
215-85 (CS/FC)	Sand fine- to very fine-grained with silt and clay	thin stringers of clean quartz sand, subhorizontal, irregular silty lenses 1-3 cm	quartzitic	poorly sorted	moderate bitumen saturation, very variable
215-86 (CS/FC)	Sand, very fine- to coarse-grained with silt and clay	irregular clasts of silt and coarse sand ripup clasts		very poorly sorted	lower contact is scoured
215-87 (COAL)	Coal, black		contains 10 percent fine-grained sand		lower contact is sharp
215-88 FC(O+W))	Sand, fine- to coarse-grained, some silt. Lower 13 cms of sample is coarse-grained sand	3 cm and 0.5 cm thick brown, fine-grained, cemented sand laminations.	top 20 cm seems to have high fines content (white powder?)	very poorly sorted	May be seat for overlying coal. Trace bitumen content increasing with depth, lower 13 cm high bitumen concentration.

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-89 (FC(O+W))	Sand, medium- to coarse-grained. Very coarse grained at top. Middle of sample contains 10-15 cm of silt and fine-grained gravel with some coal at bottom of unit			moderately sorted	high bitumen saturation
215-90 (FC(O+W))	Sand, fine- to coarse-grained		quartzitic, minor coal fragments	poorly sorted	high bitumen saturation. Lower contact is sharp.
215-91 (CS)	Salt and pepper texture. Medium to coarse grained sand in dark grey silt matrix	subhorizontal bedding	quartzitic, frequent coal fragments	very poorly sorted	low bitumen saturation
215-92 (CS)	Silt to coarse-grained sand, light grey to white	structureless	quartzitic, carbonaceous, trace black, glassy (?) specks, black, feldspathic, irregular zones	very poorly sorted	trace bitumen saturation, low bitumen saturation at bottom of sample. Lower contact is irregular but sharp.
215-93 (FCWS)	Sand, some silt, white to light brown, medium- to coarse-grained	structureless	quartzitic, minor, black, glassy particles,	very poorly sorted	irregular bitumen saturations
215-94 (FCWS)	Sand, some silt, light to dark brown, medium- to coarse-grained	structureless, pseudo-banding of bitumen saturated zones near bottom,	quartz grains coated with fines, some graules	very poorly sorted	occasional patches of medium grade bitumen
215-95 (FCWS)	Sand, medium- to coarse-grained	pseudo-bedding of variable bitumen saturation	quartzitic	moderately to poorly sorted	low bitumen saturation
215-96 (FCWS)	Sand, medium- to coarse-grained	pseudo-bedding of variable bitumen saturation	quartzitic	moderately to poorly sorted	low bitumen saturation. Lower contact is irregular but sharp.

Drill Hole 215-85
Sample Descriptions

Sample Number (Facies)	Gross Lithology	Structures	Constituents	Sorting	Comments
215-97 (?)	Siltstone, grey	wavy, irregular bands of white grey to light brown beds, subhorizontal	quartzitic, well cemented, 5-20 % black glassy particles	poorly to very poorly sorted	

Appendix E
Analytical Data

Results of 10,000 chemical analyses from the main program are summarized in Tables E.1 and E.2.

Table E.1 - data from Bore Hole 209
Table E.2 - data from Bore Hole 215

The data show the origin of each sample, the bore hole, the depth, the facies present and the concentration of each element. Plotted results show the concentration of the individual elements - not of the equivalent oxide.

The data are grouped as follows:

- Major elements:	Al,Ca,Fe,K,Mg,Mn,Na,P,Si and Ti.
- Minor Elements:	As,B,Ba,Cl,Cr,Cs,Ga,Hf,Nb,Rb,S,Se,Sr and Y.
- Metallic Elements:	Co,Cu,Mo,Ni,Pb,Sn,V, and W
- Precious Metals:	Ag, Au, Pd, and Pt.
- Rare Earths:	Ce,Dy,Eu,Gd,La,Lu,Nd,Sc,Sm,Tb,Th,U,Yb.
- Trace Elements:	Bi,Br,Cd,Hg,Ir,Sb,Ta,

Blank columns in Table E.1 represent analyses that were not performed. Individual blank boxes usually represent concentrations that were below detection limits.

Testing facilities are reported by number.

Lab 1 employed neutron activation, ICP and fire assay in their analysis.
Lab 2 employed only neutron activation analysis.
Lab 3 employed ICP analysis.

Supplementary information includes the bitumen content (determined in earlier testing programs) and the results of 6 samples that were subjected to analysis by both neutron activation and to ICP analysis.

Tables E.3 through E.6 are self explanatory.

Table E.7 lists gamma logs for each core hole determined at the time the holes were drilled. Results have been averaged over the corresponding sample interval.

Appendix E
Analytical Data

Table of Contents

Table E.1`

Analytical Data

					Minor Elements															Bitumen
Test Lab					2	3	3	3	2	3	2		2		2	3	2	3	3	Gulf
Unit of measurement					ppm	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm	(ug/g)	ppm	(ug/g)	(ug/g)	wt%
Sample #	From (m)	To (m)	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	S	Se	Sr	Y	Bitumen
209-1	28.1	28.6	0.5	TC	0.8	ND	145	ND	143	4.1	0.19		3.02		14.4	185	0.093	11.8	1.5	14.4
209-2	28.6	29.1	0.5	TC	0.98	ND	143	ND	25	4	0.26		2.89		17.9	85	0.069	10.8	1.8	14.8
209-3	29.1	29.6	0.5	TC	0.95	ND	136	ND	16	2.5	0.19		3.79		17.7	82	0.132	8.7	2.2	14.8
209-4	29.6	30.1	0.5	TC	0.95	ND	134	ND	14	6.1	0.26		3.8		17.5	77	0.105	8.7	1.8	15.1
209-5	30.1	30.6	0.5	TC	1	ND	131	ND	16	5.4	0.23		4.36		14.9	78	0.065	10.8	2.2	14.7
209-6	30.6	31.1	0.5	TC	1.04	ND	142	ND	35	5.4	0.2		3.62		16.3	90	0.071	12.3	3.3	14.6
209-7	31.1	31.6	0.5	TC	0.81	ND	159	ND	23	7.7	0.22		3.67		15.5	87	0.1	20.4	3.8	14.6
209-8	31.6	32.1	0.5	TC	0.83	ND	165	ND	37	10.6	0.42		4.78		18.2	132	0.144	27.2	5.5	12.5
209-9	32.1	32.6	0.5	TC	0.86	ND	165	ND	30	11.9	0.59		4.66		19.8	198	0.128	28.9	6.8	15.2
209-10	32.6	33.1	0.5	TC	0.89	ND	165	ND	33	8.5	0.52		4.31		18.9	127	0.112	22.1	3	14.9
209-11	33.1	33.6	0.5	TC	1.04	ND	163	ND	55	7.7	0.24		2.83		15.2	91	0.063	21.3	3.4	14.3
209-12	33.6	34.1	0.5	TC	0.98	ND	171	ND	41	6	0.21		3.06		21.6	168	0.097	23.8	4.7	14.5
209-13	34.1	34.6	0.5	TC	1.01	ND	162	ND	45	6.8	0.35		2.92		17.6	128	0.079	22.1	4.7	14.4
209-14	34.6	35.09	0.49	ICH	0.99	ND	183	ND	29	12.3	0.27		3.13		20.8	132	< 0.05	24.7	3	14.5
209-15	35.09	35.58	0.49	ICH	1.52	ND	151	ND	63	4.3	0.21		3.24		16.1	196	0.067	18.7	3	9.9
209-16	35.58	36.07	0.49	ICH	1.42	ND	184	ND	25	14.5	0.33		3.77		20	216	0.082	24.7	6	10.5
209-17	36.07	36.56	0.49	ICH	1.44	ND	175	ND	32	14	0.38		3.73		17.5	292	0.082	23.8	5.5	11.3
209-18	36.56	37.05	0.49	ICH	1.92	ND	156	ND	45	11.1	0.54		5.28		14.4	237	< 0.05	22.1	7.2	9.3
209-19	37.05	37.54	0.49	ICH	1.13	ND	168	ND	32	7.7	0.3		4.36		18.3	294	0.099	20.4	6.4	14.1
209-20	37.54	38.03	0.49	ICH	1.23	ND	195	ND	23	15.7	0.72		5.52		23.1	813	0.152	28.9	8.5	13.4
209-21	38.03	38.52	0.49	ICH	1.07	ND	175	ND	46	13.6	0.45		3.33		17.9	309	0.092	24.7	5.5	13.3
209-22	38.52	39.01	0.49	ICH	1.03	ND	154	ND	30	10.2	0.27		3.39		14.1	303	0.059	22.1	4.7	14.6
209-23	39.01	39.5	0.49	ICH	1.76	ND	150	ND	30	11.1	0.27		2.78		15.2	343	< 0.05	24.7	5.1	13.6
209-24	39.5	39.99	0.49	ICH	1.22	ND	168	ND	27	6.8	0.44		3.53		17.2	2756	< 0.05	27.2	6.4	11.3
209-25	39.99	40.48	0.49	ICH	1.58	ND	156	ND	26	11.1	0.53		3.36		19.5	2678	< 0.05	28.9	7.2	11.4
209-26	40.48	41	0.52	ICH	1.5	ND	153	ND	31	8.1	0.33		2.98		7.1	1193	0.061	25.5	5.5	14.1
209-27	41	41.57	0.57	TC	0.88	ND	133	ND	28		0.2		1.42		7.4	88	< 0.05	18.7	2.1	17
209-28	41.57	42.14	0.57	TC	0.96	ND	147	ND	26	8.9	0.36		5.23		11.2	1809	0.094	23.8	7.2	13.9
209-29	42.14	42.7	0.56	TC	0.99	ND	149	ND	45	6.4	0.23		3.37		14.3	498	0.091	22.1	5.1	15
209-30	42.7	43.18	0.48	ICH	1.15	ND	168	ND	19	21.3	0.82		7.22		25.4	521	0.164	20.4	11.9	9.2
209-31	43.18	43.66	0.48	ICH	1.36	ND	165	ND	31	12.3	0.45		6.98		20.2	462	0.111	26.4	9.4	12.4
209-32	43.66	44.14	0.48	ICH	1.72	ND	164	ND	28	12.3	1		6.9		26.8	581	0.157	27.2	12.8	10.3
209-33	44.14	44.62	0.48	ICH	2	ND	172	ND	32	7.2	0.43		2.31		15.1	779	0.106	27.2	5.5	12.6
209-34	44.62	45.1	0.48	ICH	1.05	ND	138	ND	21	10.6	0.36		4.06		14.9	309	< 0.05	20.4	6	13.5
209-35	45.1	45.58	0.48	ICH	1.01	ND	134	ND	29	3	0.22		2.15		15	250	0.073	19.6	3	16.1
209-36	45.58	46.06	0.48	ICH	2.11	ND	156	ND	33	6.8	0.35		3.7		15.8	597	0.099	24.7	7.7	12.3

Table E.1`

Analytical Data

										Minor Elements										Bitumen
Test Lab					2	3	3	3	2	3	2		2		2	3	2	3	3	Gulf
Unit of measurement					ppm	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm	(ug/g)	ppm	(ug/g)	(ug/g)	wt%
Sample #	From (m)	To (m)	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	S	Se	Sr	Y	Bitumen
209-37	46.06	46.54	0.48	ICH	1.6	ND	155	ND	44	11.9	0.38		4.54		17.2	594	0.126	24.7	7.2	13
209-38	46.54	47	0.462	ICH	1.21	ND	150	ND	31	6.8	0.43		3.64		17.2	368	0.116	23	7.7	12.5
209-39	47	47.5	0.498	ICH	1.29	ND	184	ND	33	9.4	0.37		3.28		20.3	626	0.144	27.2	7.2	13.6
209-40	47.5	48	0.5	ICH	1.45	ND	154	ND	50	11.9	0.69		7.57		23.5	322	0.122	23.8	9.4	12.6
209-41	48	48.53	0.53	FE	1.22	ND	139	ND		3.8	0.23		2.04		14.4	444	0.065	19.6	3.8	15.1
209-42	48.53	49.06	0.53	FE	1.15	ND	148	ND		9.8	0.21		1.83		15.2	570	< 0.05	20.4	3	15.3
209-43	49.06	49.6	0.54	FE	1.07	ND	89	0.43			0.18		2.32		9.3	701	< 0.05	13.6	2.6	15.1
209-44	49.6	50	0.4	OV	2.4	ND	248	0.28		53.5	4.2		8.7		81	4070	0.33	71.6	27.9	4
209-45	50	50.4	0.4	OV	2.46	ND	251	ND		56.7	4.34		9.36		85	1893	0.38	68.8	27.9	5.7
209-46	50.4	50.89	0.49	FC	1	ND	77	ND		4.3	0.14		4.42			92	< 0.05	13.6	4.3	2.8
209-47	50.89	51.37	0.48	FC	0.62	ND	70	ND		1	0.12		2.92		5.1	49	< 0.05	11.9	3.4	14.42
209-48	51.37	51.86	0.49	FC	2.83	ND	83	ND		1.7	0.15		2.04		8.6	125	< 0.05	14.9	3.3	13.9
209-49	51.86	52.34	0.48	FC	1.07	ND	106	ND		5	0.13		2.73		10	173	0.122	16.6	4.6	17.4
209-50	52.34	52.83	0.49	FC	1	ND	184	ND		5.8	0.31		2.88		17.1	199	< 0.05	24.1	3.7	16.6
209-51	52.83	53.31	0.48	FC	1.11	ND	125	ND			0.18		1.4		12.2	120	0.058	14.9	1.7	17.5
209-52	53.31	53.8	0.49	FC	0.8	ND	66	ND			0.09		6.87		7.2	41	0.146	10	2.9	16.8
209-53	53.8	54.28	0.48	FC	1.18	ND	111	ND			0.41		6.8		14.5	92	0.094	14.9	7.5	15
209-54	54.28	54.77	0.49	FC	1.11	ND	184	ND			0.31		4.65		17.9	122	0.122	18.4	3.2	16.5
209-55	54.77	55.25	0.48	FC	1.02	ND	164	ND	20		0.26		5.07		17.3	106	0.069	15.8	5.8	16.4
209-56	55.25	55.74	0.49	FC	1.27	ND	166	ND	37	8.3	0.27		3.89		19.4	117	0.151	14.9	6.2	17.1
209-57	55.74	56.22	0.48	FC	0.82	ND	144	ND	25		0.27		4.97		15.6	202	0.084	14.9	6.2	16.8
209-58	56.22	56.71	0.49	FC	0.77	ND	139	ND	27		4.8		5.49		89	87	0.39	14.1	5.8	15.9
209-59	56.71	57.2	0.49	FC	0.69	ND	95	ND	25		1.7		4.06		86	62	0.385	10.8	6.2	15.5
209-60	57.2	57.65	0.45	DMM	1.79	ND	175	0.09	49	73.9	5.9		8.41		110	1481	0.451	57.7	24.2	0
209-61	57.65	58.1	0.45	DMM	1.95	ND	165	0.09	60	69.3	4.9		8.11		83	682	0.462	55.8	22.3	0
209-62	58.1	58.55	0.45	DMM	2.62	ND	203	0.37	41	70.2	6.1		7.78		117	1332	0.373	76.3	23.3	0
209-63	58.55	59	0.45	DMM	3.31	ND	189	0.27	46	73.4	5.6		8.18		101	1320	0.422	75.6	21.6	0
209-64	59	59.5	0.5	COAL	4.64	ND	172	0.32	79	72.1	1.66		7.21		20.3	2010	0.45	98	22.7	0
209-65	59.5	60	0.5	CS	2.17	ND	62	ND	140		1.62		11		23.2	1590	0.484	46.8	20.4	Not
209-66	60	60.5	0.5	COAL	1.6	ND	105	ND	144	52.8	4.04		8.61		39.6	2498	0.553	87.4	22.8	Bitumen
209-67	60.5	61	0.5	CS	1.38	ND	121	ND	128	44.2	3.3		8.29		60.3	2404	0.334	45.1	18.8	Saturated
209-68	61	61.4	0.4	DMM	2.42	ND	186	ND	151	82.6	5.6		6.1		97	4922	0.407	88.6	19.8	Below
209-69	61.4	61.8	0.4	DMM	1.53	ND	112	ND	166	53.7	4.9		8 97		70.6	3722	0.413	70.5	20.5	Here
209-70	61.8	62.2	0.4	CS	1.12	ND	83	ND	200	37.4	3.1		10.4		41	2448	0.449	53.3	22.4	
209-71	62.2	62.6	0.4	CS		ND	79	ND	195	35.3	3		10.2		31.1	1546	0.5	53.3	24.9	
209-72	62.6	63.05	0.45	DMM		ND	92	ND	201	41.8	3.11		11		42.9	2107	0.545	59.8	24.6	
209-73	63.05	63.5	0.45	DMM	1.42	ND	83	ND	224	31.5	2.49		12.9		30.4	1521	0.487	45.9	24.3	

Table E.1`
Analytical Data

					Minor Elements															Bitumen
Test Lab					2	3	3	3	2	3	2		2		2	3	2	3	3	Gulf
Unit of measurement					ppm	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm	(ug/g)	ppm	(ug/g)	(ug/g)	wt%
Sample #	From (m)	To (m)	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	S	Se	Sr	Y	Bitumen
209-74	63.5	64	0.5	CS	0.95	ND	27	ND	226	12.2	0.41		7.73			1400	0.255	21.6	9.9	
209-75	64	64.5	0.5	CS	1.09	ND	70	ND	182	35.1	2.24		9.89		19.5	1887	0.486	52.2	21.6	
209-76	64.5	65	0.5	CS	0.94	ND	45	ND	254	13.2	1.25		7.88		16.8	1447	0.404	32	11.3	
209-77	65	65.47	0.47	FC		ND	49	ND	261	14.4	1.4		8.28		19.3	1277	0.386	36	12.6	
209-78	65.47	65.95	0.48	FC		ND	32	ND	272	9.5	0.62		9.11			932	0.453	22.8	9.5	
209-79	65.95	66.42	0.47	FC	1.49	ND	48	ND	264	16.7	1.37		8.57		18.7	1434	0.355	30.6	10.8	
209-80	66.42	66.9	0.48	FC		ND	33	ND	173	9.5	0.62		5.29		14.3	1236	0.246	32.4	9.9	
209-81	66.9	67.37	0.47	FC		ND	28	ND	274	2.4	0.34		5.33			1135	< 0.05	13.2	4.7	
209-82	67.37	67.85	0.48	FC		ND	22	ND	269	2.3	0.19		5.52			1046	0.122	18	5.4	

Table E.1
Analytical Data

				Metallic Elements										Primary Elements									
				3	3	3	3	3		3	2	3	3	3	3	3	3	3	3	3	3	3	3
				(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	(ug/g)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)
Sample #	From (m	To (m)	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
209-1	28.1	28.6	TC	100	22.2	11.8	6.3	7.4		30	< 1	13.3	108	0.69	0.166	0.171	0.453	0.037	0.002	0.053	0.004	38.89	0.106
209-2	28.6	29.1	TC	147	5.8	11.6	6.5	5.4		29	< 1	5.2	86	0.75	0.022	0.09	0.529	0.02	0.001	0.047	0.004	39.39	0.108
209-3	29.1	29.6	TC	171	4.6	12.3	8.7	6.7		30	< 1	5.1	124	0.69	0.017	0.093	0.412	0.019	0.001	0.037	0.004	36.36	0.112
209-4	29.6	30.1	TC	183	3.8	11.6	10.1	8.7		29	< 1	4.3	125	0.68	0.014	0.112	0.447	0.012	0.002	0.027	0.006	36.77	0.116
209-5	30.1	30.6	TC	161	5.1	10.8	10.1	6.5		26	0.5	4.8	128	0.68	0.016	0.109	0.318	0.018	0.002	0.029	0.004	36.54	0.122
209-6	30.6	31.1	TC	171	5.6	13	11.6	10.8		32	< 1	4.9	124	0.76	0.013	0.094	0.477	0.012	0.001	0.02	0.005	37.4	0.112
209-7	31.1	31.6	TC	208	3.4	12.8	10.2	8.5		37	0.6	5.4	144	0.72	0.014	0.133	0.254	0.016	0.002	0.022	0.008	41.35	0.121
209-8	31.6	32.1	TC	219	5	20.4	9.4	12.8		43	< 1	8.1	164	1.08	0.036	0.132	0.453	0.03	0.002	0.029	0.009	40.37	0.149
209-9	32.1	32.6	TC	194	4.8	25.5	6.4	14.5		45	< 1	11.1	204	1.32	0.065	0.16	0.4	0.047	0.002	0.025	0.011	40.86	0.173
209-10	32.6	33.1	TC	252	4.9	16.2	11.9	10.2		41	< 1	5.2	96	0.8	0.026	0.212	0.477	0.015	0.002	0.022	0.006	41.26	0.11
209-11	33.1	33.6	TC	270	7.1	15.3	10.2	10.2		37	0.9	5.3	92	0.75	0.02	0.094	0.477	0.014	0.002	0.04	0.012	40.87	0.112
209-12	33.6	34.1	TC	289	6.5	20.4	11.9	12.8		39	< 1	8.5	98	1.06	0.027	0.121	0.623	0.028	0.002	0.025	0.009	40.85	0.128
209-13	34.1	34.6	TC	274	74.8	16.2	10.2	12.8		41	< 1	6.9	91	0.85	0.021	0.099	0.359	0.019	0.002	0.025	0.011	41.74	0.114
209-14	34.6	35.09	ICH	299	9.4	18.7	15.3	13.6		41	0.9	6.9	108	0.98	0.022	0.102	0.529	0.019	0.002	0.028	0.011	40.91	0.122
209-15	35.09	35.58	ICH	277	6	21.3	13.6	11.9		41	0.6	6.5	115	0.77	0.038	0.233	0.377	0.018	0.002	0.028	0.013	41.23	0.11
209-16	35.58	36.07	ICH	265	5.8	22.1	15.3	13.6		47	0.5	10.2	149	1.13	0.031	0.184	0.518	0.027	0.003	0.032	0.012	41.79	0.145
209-17	36.07	36.56	ICH	282	6.6	23	13.6	11.1		47	< 1	9.4	120	1.12	0.041	0.252	0.483	0.033	0.003	0.027	0.014	39.99	0.141
209-18	36.56	37.05	ICH	292	5.7	23.8	8.5	13.6		48	0.7	9.4	182	1.21	0.03	0.375	0.348	0.037	0.004	0.023	0.013	39.69	0.178
209-19	37.05	37.54	ICH	249	5.9	20.4	10.2	11.1		46	< 1	7.7	167	1.06	0.025	0.246	0.506	0.034	0.005	0.021	0.01	40.16	0.152
209-20	37.54	38.03	ICH	194	8.2	33.2	11.1	18.7		54	< 1	13.6	204	1.73	0.129	0.455	0.588	0.073	0.011	0.029	0.015	39.54	0.197
209-21	38.03	38.52	ICH	279	4.7	23	15.3	11.9		46	0.7	8.5	107	1.14	0.03	0.259	0.565	0.034	0.005	0.027	0.012	40.79	0.14
209-22	38.52	39.01	ICH	329	6.8	16.2	12.8	8.5		40	0.6	5.8	108	0.78	0.028	0.234	0.277	0.029	0.006	0.017	0.011	40.95	0.11
209-23	39.01	39.5	ICH	340	6.1	15.3	15.3	6.9		43	< 1	8.5	89	0.72	0.084	0.229	0.459	0.022	0.006	0.017	0.014	41.55	0.093
209-24	39.5	39.99	ICH	260	5.3	20.4	13.6	14.5		43	0.6	9.4	112	1.05	0.153	1.533	0.395	0.192	0.02	0.023	0.014	38.92	0.126
209-25	39.99	40.48	ICH	225	7.2	23	18.7	15.3		47	< 1	11.9	108	1.17	0.162	1.445	0.324	0.179	0.022	0.028	0.015	38.98	0.132
209-26	40.48	41	ICH	270	6.3	16.2	15.3	11.9		45	< 1	10.2	94	0.83	0.088	0.708	0.301	0.079	0.011	0.023	0.012	40.86	0.111
209-27	41	41.57	TC	337	11.9	6.5	30.6	5.6		36	< 1	3.6	9	0.49	0.017	0.088	0.166	0.009	0.001	0.011	0.008	41.14	0.061
209-28	41.57	42.14	TC	267	6.5	16.2	15.3	13.6		48	< 1	7	219	0.81	0.105	1.042	0.324	0.127	0.014	0.024	0.013	40.31	0.151
209-29	42.14	42.7	TC	312	8.5	13.6	13.6	8		43	< 1	5.5	117	0.69	0.043	0.317	0.336	0.041	0.005	0.015	0.012	40.74	0.118
209-30	42.7	43.18	ICH	210	17	35.7	12.8	17.9		58	1.1	12.8	297	1.8	0.115	0.412	0.629	0.078	0.01	0.029	0.014	39.08	0.249
209-31	43.18	43.66	ICH	230	11.1	28.1	17	15.3		54	1.5	11.1	309	1.37	0.11	0.369	0.441	0.057	0.01	0.029	0.012	39.47	0.206
209-32	43.66	44.14	ICH	260	11.9	31.5	15.3	18.7		54	0.7	11.1	232	1.57	0.14	0.379	0.406	0.065	0.009	0.02	0.014	38.91	0.213
209-33	44.14	44.62	ICH	337	34	23.8	15.3	11.9		45	< 1	10.2	61	1.12	0.086	0.567	0.518	0.05	0.016	0.023	0.019	39.38	0.106
209-34	44.62	45.1	ICH	315	8	15.3	18.7	7.8		45	0.5	6.7	138	0.75	0.041	0.248	0.377	0.028	0.007	0.016	0.014	38.06	0.114
209-35	45.1	45.58	ICH	360	12.8	8.3	12.8	8		37	< 1	4.5	45	0.6	0.076	0.123	0.201	0.018	0.003	0.011	0.012	39.06	0.078
209-36	45.58	46.06	ICH	297	8.5	21.3	14.5	12.8		44	0.8	13.6	139	1.02	0.085	0.385	0.395	0.038	0.011	0.016	0.013	38.98	0.132

Table E.1
Analytical Data

				Metallic Elements										Primary Elements									
				3	3	3	3	3		3	2	3	3	3	3	3	3	3	3	3	3	3	3
				(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	(ug/g)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)
Sample #	From (m	To (m)	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
209-37	46.06	46.54	ICH	315	19.6	27.2	15.3	13.6		54	< 1	16.2	128	1.25	0.069	0.436	0.483	0.048	0.012	0.014	0.013	37.97	0.156
209-38	46.54	47	ICH	326	7.7	24.7	17	12.8		53	< 1	10.2	116	1.2	0.044	0.304	0.16	0.043	0.007	0.013	0.012	38.58	0.154
209-39	47	47.5	ICH	251	7.1	29.8	17.9	15.3		51	< 1	12.8	113	1.4	0.055	0.462	0.359	0.049	0.012	0.02	0.011	38.18	0.132
209-40	47.5	48	ICH	299	8.1	28.1	16.2	13.6		52	1	9.4	233	1.27	0.036	0.339	0.559	0.045	0.007	0.013	0.011	38.44	0.184
209-41	48	48.53	FE	350	10.2	14.5	17	6.7		42	< 1	3.7	59	0.64	0.028	0.131	0.4	0.014	0.003	0.016	0.011	38.85	0.08
209-42	48.53	49.06	FE	379	17.9	8.5	14.5	6.9		36	< 1	3.2	44	0.63	0.016	0.138	0.436	0.008	0.003	0.013	0.008	37.68	0.064
209-43	49.06	49.6	FE	365	7.2	5.6	14.5	3.1		31	< 1	3.2	23	0.37	0.023	0.168	0	0.007	0.003	0.003	0.012	39.02	0.055
209-44	49.6	50	OV	100	17.7	142.3	20.5	62.3		126	2.6	41.9	303	6.69	0.39	2.605	1.309	0.436	0.066	0.058	0.04	32.14	0.531
209-45	50	50.4	OV	117	18.6	145.1	20.5	63.2		123	2.1	48.4	332	6.87	0.173	1.499	1.385	0.335	0.039	0.053	0.036	33.19	0.539
209-46	50.4	50.89	FC	435	11.9	6.5	15.3	1.6		35	< 1	3.1	177	0.38	0.013	0.11	0.002	0.011	0.002	0.002	0.013	39.52	0.075
209-47	50.89	51.37	FC	372	10.2	4.3	13.6	0.9		35	< 1	2	91	0.28	0.006	0.085	0.072	0.006	0.002		0.01	39.43	0.069
209-48	51.37	51.86	FC	342	6.6	5.6	14.9	1.6		37	< 1	2.2	92	0.36	0.019	0.11	0.231	0.01	0.002	0.005	0.011	38.1	0.077
209-49	51.86	52.34	FC	324	7	8.2	16.6	2.8		47	< 1	4.7	101	0.5	0.02	0.126	0.172	0.01	0.003	0.004	0.011	38.46	0.097
209-50	52.34	52.83	FC	291	5.6	19.1	14.9	7.8		43	< 1	4.2	79	0.92	0.022	0.254	0.57	0.021	0.007	0.017	0.011	38.62	0.1
209-51	52.83	53.31	FC	314	5.2	6.9	9.1	2.7		41	0.7	1.9	29	0.46	0.095	0.062	0.266	0.003	0.002	0.01	0.009	38.57	0.066
209-52	53.31	53.8	FC	323	2.8	4.2	7.1	1.7		48	0.9	2.2	191	0.24	0.006	0.077	0.096	0.003	0.002	0.003	0.007	38.07	0.136
209-53	53.8	54.28	FC	305	5.2	14.1	8.3	3		51	< 1	4.4	280	0.73	0.01	0.151	0.359	0.021	0.004	0.008	0.009	37.5	0.149
209-54	54.28	54.77	FC	334	4.7	23	5.5	6.8		55	< 1	6	121	1.04	0.014	0.146	0.389	0.015	0.004	0.022	0.007	42.36	0.134
209-55	54.77	55.25	FC	318	4.9	18.3	5.4	6.9		51	< 1	5.1	167	0.92	0.011	0.158	0.354	0.005	0.004	0.02	0.005	38.49	0.139
209-56	55.25	55.74	FC	319	5.6	20.8	7.5	5.1		53	< 1	5.9	173	0.98	0.014	0.194	0.529	0.007	0.005	0.025	0.008	38.55	0.145
209-57	55.74	56.22	FC	326	3	15.8	4.6	2.7		50	< 1	4.2	204	0.79	0.064	0.115	0.324	0.005	0.003	0.015	0.006	36.54	0.132
209-58	56.22	56.71	FC	339	2.7	17.4	2.1	4.4		45	< 1	4.6	179	0.73	0.014	0.098	0.471	0.003	0.002	0.018	0.005	37.11	0.121
209-59	56.71	57.2	FC	354	4.2	6.8	6.2	0.9		44	< 1	2.9	197	0.39	0.012	0.085	0.119	8E-04	0.002	0.008	0.008	37.42	0.126
209-60	57.2	57.65	DMM	86	19.5	148.8	13	62.3		158	2.6	40	282	6.94	0.134	1.404	1.151	0.386	0.02	0.166	0.014	32.69	0.666
209-61	57.65	58.1	DMM	98	19.5	147.9	7	64.2		159	2.8	36.3	269	6.64	0.089	0.868	1.233	0.371	0.005	0.163	0.033	33.13	0.636
209-62	58.1	58.55	DMM	87	19.5	172.1	18.6	73.5		169	2.9	50.2	260	8.18	0.133	1.287	1.35	0.487	0.009	0.213	0.032	31.6	0.675
209-63	58.55	59	DMM	79	17.1	160.2	14.4	67.5		165	4.1	47.7	278	7.57	0.144	1.167	1.239	0.481	0.006	0.237	0.012	31.43	0.686
209-64	59	59.5	COAL	69	21.1	169.3	11.3	69.7		197	4.7	29.2	300	7.93	0.254	1.253	1.139	0.51	0.005	0.316	0.034	26.64	1.111
209-65	59.5	60	CS	173	11.9	45.1	4.7	22.1		109	2.2	17.9	431	2.14	0.144	0.863	0.307	0.141	0.002	0.149	0.008	36.49	0.769
209-66	60	60.5	COAL	106	19	85.1	4.2	36.5		152	3.5	20.5	409	4.08	0.081	0.941	0.664	0.282	0.003	0.217	0.01	29.37	1.164
209-67	60.5	61	CS	96	12.2	80.8	24.4	35.7		105	15.5	26.3	320	3.85	0.079	1.011	0.518	0.224	0.004	0.144	0.018	37.28	0.572
209-68	61	61.4	DMM	87	18.9	178	51.6	74.8		175	15.8	49	213	8.38	0.201	2.265	1.326	0.591	0.008	0.361	0.026	27.08	0.76
209-69	61.4	61.8	DMM	82	14.8	95.1	21.3	42.6		130	9.8	34.4	379	4.55	0.215	1.44	0.758	0.345	0.005	0.285	0.016	30.22	0.775
209-70	61.8	62.2	CS	122	12.9	59.3	17.2	30.1		117	17.7	17.2	465	2.85	0.152	1.68	0.277	0.183	0.003	0.208	0.016	35.13	0.797
209-71	62.2	62.6	CS	108	12	56.8	13.8	25.8		134	66.7	16.3	467	2.59	0.154	0.481	0.365	0.162	0.002	0.179	0.017	34.67	0.931
209-72	62.6	63.05	DMM	93	12.3	79.2	19.4	37.8		141	34.5	22	467	3.83	0.159	0.992	0.459	0.21	0.004	0.193	0.016	34.35	0.905
209-73	63.05	63.5	DMM	127	11.7	66.6	18	34.2		130	15.8	15.3	473	3.16	0.105	0.845	0.441	0.159	0.004	0.155	0.028	36.73	0.852

Table E.1
Analytical Data

				Metallic Elements										Primary Elements									
				3	3	3	3	3		3	2	3	3	3	3	3	3	3	3	3	3	3	3
				(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	ppm	(ug/g)	(ug/g)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)	(wt%)
Sample #	From (m	To (m)	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
209-74	63.5	64	CS	240	9	18.9	17.1	9		58	166	5.5	314	0.87	0.082	2.282	0.002	0.048	0.003	0.072	0.012	39	0.361
209-75	64	64.5	CS	185	15.3	72.9	18	34.2		130	258	16.2	402	3.52	0.144	0.877	0.342	0.19	0.005	0.165	0.022	35.9	0.779
209-76	64.5	65	CS	263	11.3	40.4	20.7	17.9		77	108	7.9	294	2.01	0.058	0.783	0.188	0.087	0.003	0.119	0.017	40.17	0.493
209-77	65	65.47	FC	286	14.4	40.5	18	17.1		86	245	11.7	314	2.03	0.077	0.551	0.249	0.104	0.002	0.145	0.017	38.54	0.556
209-78	65.47	65.95	FC	315	16.2	25.7	17.1	11.4		72	56.6	4.7	292	1.31	0.042	0.719	0.169	0.054	0.002	0.087	0.015	42.21	0.477
209-79	65.95	66.42	FC	350	14.4	31.5	23.4	13.5		68	913	7.7	295	1.6	0.063	0.773	0.273	0.091	0.002	0.126	0.015	39.6	0.451
209-80	66.42	66.9	FC	345	13.5	21.6	19.8	9		59	238	4.5	252	1.14	0.08	0.489	0.09	0.067	0.002	0.107	0.018	40.38	0.41
209-81	66.9	67.37	FC	411	14.1	8.5	24.4	4.2		31	383	5.8	166	0.55	0.03	2.116	0.096	0.025	0.002	0.06	0.014	42.08	0.175
209-82	67.37	67.85	FC	456	18.9	7.7	18	3.2		32	317	2.9	186	0.5	0.043	0.677	0.169	0.037	0.002	0.078	0.014	41.49	0.168

										Table E.1											
										Analytical Data											
					Precious Metals							Rare Earths									
					3	2			2	2	2	2	2	2	2	3	2	2	2	2	2
					(ug/g)	ppb	ppb	ppb	ppm	ppm	ppm		ppm	ppm	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm
Sample #	From (m	To (m)	Interval	Facies	Ag	Au	Pd	Pt	Ce	Dy	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb
209-1	28.1	28.6	0.5	TC		< 2			16	0.9	0.191		7.86	0.061	7.8	1	1.26	0.13	2.45	0.54	0.53
209-2	28.6	29.1	0.5	TC		< 2	ND		14.5	0.86	0.203		7.52	0.079	7.3	1.5	1.18	0.15	2.34	0.52	0.48
209-3	29.1	29.6	0.5	TC		< 2	ND		17.8	1.02	0.227		9.14	0.081	7.1	2	1.33	0.17	2.52	0.56	0.57
209-4	29.6	30.1	0.5	TC		< 2	ND		16.7	0.9	0.212		9.05	0.072	7.6	1.5	1.39	0.16	2.47	0.6	0.5
209-5	30.1	30.6	0.5	TC		< 2	ND		19.4	0.96	0.24		10.1	0.085	10.4	2	1.53	0.18	2.96	0.58	0.53
209-6	30.6	31.1	0.5	TC		< 2	ND		17.8	1.14	0.214		9.04	0.082	6.7	1.5	1.41	0.13	2.59	0.57	0.52
209-7	31.1	31.6	0.5	TC		< 2	ND		18.6	1.13	0.215		9.38	0.082	7.7	1.5	1.45	0.17	2,54	0.59	0.53
209-8	31.6	32.1	0.5	TC		< 2	ND		22.7	1.26	0.277		11.5	0.101	9.7	2	1.87	0.21	3.54	0.77	0.71
209-9	32.1	32.6	0.5	TC		< 2	ND		23.1	1.2	0.276		11.6	0.113	14.5	2.5	1.82	0.22	3.31	0.82	0.84
209-10	32.6	33.1	0.5	TC		< 2	ND		23.6	1.26	0.281		11.3	0.11	10.3	2	1.84	0.2	3.35	0.81	0.72
209-11	33.1	33.6	0.5	TC		< 2	ND		17.2	0.96	0.212		8.28	0.065	10.2	11.5	1.36	0.18	2.32	0.57	0.48
209-12	33.6	34.1	0.5	TC		< 2	ND		18	0.92	0.226		8.6	0.068	10.2	2.5	1.39	0.15	2.56	0.58	0.54
209-13	34.1	34.6	0.5	TC		< 2	ND		17.9	1.03	0.252		9.08	0.071	12.5	2	1.52	0.19	2.56	0.56	0.56
209-14	34.6	35.09	0.49	ICH		< 2	ND		18.1	0.76	0.23		8.91	0.081	11.2	2.5	1.41	0.13	2.4	0.52	0.54
209-15	35.09	35.58	0.49	ICH		< 2	ND		17.6	0.89	0.229		8.64	0.069	11.2	2	1.44	0.13	2.35	0.57	0.5
209-16	35.58	36.07	0.49	ICH		< 2	ND		19.6	1.26	0.292		9.86	0.092	11.9	2.5	1.68	0.21	2.66	0.72	0.64
209-17	36.07	36.56	0.49	ICH		< 2	ND		18.4	1.18	0.271		9.29	0.094	11.9	2	1.63	0.16	2.53	0.69	0.63
209-18	36.56	37.05	0.49	ICH		< 2	ND		22.2	1.17	0.223		11.1	0.144	14.9	2.5	1.88	0.38	3.26	0.95	0.91
209-19	37.05	37.54	0.49	ICH		< 2	ND		20.7	1.39	0.287		10.3	0.104	16	2	1.71	0.12	3.07	0.81	0.75
209-20	37.54	38.03	0.49	ICH		3	ND		25.1	1.77	0.38		12.9	0.131	16.5	2.5	2.18	0.31	3.67	1.01	0.95
209-21	38.03	38.52	0.49	ICH		4.9	ND		18.2	1.14	0.267		8.73	0.08	11.7	1.5	1.45	0.16	2.27	0.71	0.6
209-22	38.52	39.01	0.49	ICH		< 2	ND		15.9	0.86	0.213		8.25	0.071	10.9	2	1.35	0.11	2.11	0.59	0.59
209-23	39.01	39.5	0.49	ICH		< 2	ND		16.4	1.02	0.215		8.56	0.066	10.5	1.5	1.46	0.11	2.06	0.59	0.49
209-24	39.5	39.99	0.49	ICH		< 2	ND		17.9	1.16	0.391		9.65	0.099	11.9	2.5	1.58		2.67	0.63	0.63
209-25	39.99	40.48	0.49	ICH		1.4	ND		25.1	1.25	0.524		11.6	0.117	13.9	2.5	2.16	0.41	2.77	0.77	0.88
209-26	40.48	41	0.52	ICH		< 2	ND		16.6	1.07	0.236		8.35	0.083	12.4	2	1.37	0.11	2.29	0.54	0.5
209-27	41	41.57	0.57	TC		< 2	ND		10.3	0.59	0.072		5.13	0.045	7.1	1	0.85	0.13	1.02	0.4	0.3
209-28	41.57	42.14	0.57	TC		< 2	ND		21	1.11	0.272		10.6	0.115	15.8	2	1.74	0.19	3.11	0.74	0.7
209-29	42.14	42.7	0.56	TC		< 2	ND		16.2	0.97	0.194		8.3	0.068	12.2	1.5	1.34	0.27	2.19	0.62	0.5
209-30	42.7	43.18	0.48	ICH		< 2	ND		32.9	2.26	0.413		16.5	0.181	10.9	2.5	2.77	0.33	4.75	1.25	1.3
209-31	43.18	43.66	0.48	ICH		< 2	ND		29.2	1.66	0.4		14.6	0.147	9.1	2.5	2.34	0.32	4.2	1.06	1.08
209-32	43.66	44.14	0.48	ICH		< 2			32.1	2.1	0.518		15.5	0.174	22.2	2.5	2.64	0.33	4.32	1.18	1.24
209-33	44.14	44.62	0.48	ICH		< 2			16.5	1	0.299		8.5	0.083	9.2	2.5	1.49	0.12	2.06	0.55	0.61
209-34	44.62	45.1	0.48	ICH		< 2			19.9	1.24	0.273		10	0.094	13	2	1.67	0.23	2.68	0.71	0.67
209-35	45.1	45.58	0.48	ICH		< 2			14	0.73	0.202		6.89	0.059	6.9	1.5	1.16	0.15	1.58	0.45	0.42
209-36	45.58	46.06	0.48	ICH		< 2			24.1	1.48	0.357		11.7	0.116	15	2	2.11	0.26	2.79	0.79	0.79

Table E.1
Analytical Data

					Precious Metals				Rare Earths												
					3	2			2	2	2	2	2	2	2	3	2	2	2	2	2
					(ug/g)	ppb	ppb	ppb	ppm	ppm	ppm	issing 2	ppm	ppm	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm
Sample #	From (m	To (m)	Interval	Facies	Ag	Au	Pd	Pt	Ce	Dy	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb
209-37	46.06	46.54	0.48	ICH		9.9			23.3	1.58	0.336		11.7	0.106	15.6	2	2.05		3.31	0.83	0.85
209-38	46.54	47	0.462	ICH		< 2			18.8	1.24	0.266		9.69	0.101	12	2.5	1.67	0.17	2.29	0.73	0.7
209-39	47	47.5	0.498	ICH		< 2			20	1.26	0.306		9.63	0.093	14.4	2	1.73	0.22	2.58	0.74	0.65
209-40	47.5	48	0.5	ICH		< 2			31.3	2.06	0.42		16	0.165		2.5	2.67	0.31	4.35	1.18	1.13
209-41	48	48.53	0.53	FE		< 2			13.8		0.207		6.96	0.062	5.5	2	1.16	0.11	1.84	0.46	0.45
209-42	48.53	49.06	0.53	FE		< 2			12		0.174		6.28	0.053	5.2	1.5	1.01	0.17	1.48	0.43	0.35
209-43	49.06	49.6	0.54	FE		< 2			13		0.146		6.79	0.05	5.6	1.5	0.98	0.1	1.94	0.44	0.67
209-44	49.6	50	0.4	OV		< 2			66.8		1.14		33.1	0.419	26.2	13	5.83	0.83	10.1	2.73	3.1
209-45	50	50.4	0.4	OV		< 2			69.4		1.16		35.4	0.412	23.8	11	6.17	0.78	10.9	2.93	3.04
209-46	50.4	50.89	0.49	FC		< 2			19.1		0.162		9.68	0.074		2	1.43	0.09	3.11	0.68	0.56
209-47	50.89	51.37	0.48	FC		< 2			13.3		0.121		6.71	0.062		2	0.97	0.1	2.18	0.47	0.45
209-48	51.37	51.86	0.49	FC		< 2			11.8		0.132		6.01	0.065		1.5	1	0.09	1.82	0.45	0.42
209-49	51.86	52.34	0.48	FC		< 2			16.3		0.181		8.38	0.066		2	1.33	0.16	2.65	0.62	0.46
209-50	52.34	52.83	0.49	FC		< 2			13.8		0.2		7.54	0.077	4.4	2.5	1.17	0.13	2.05	0.61	0.6
209-51	52.83	53.31	0.48	FC		< 2			9.8		0.14		4.8	0.038	4.4	2	0.74	0.08	1.12	0.32	0.29
209-52	53.31	53.8	0.49	FC		< 2			27.8		0.194		14.3	0.124	8.7	2.5	2.08	0.25	5.72	0.98	0.84
209-53	53.8	54.28	0.48	FC		< 2			26.2		0.277		13.9	0.13		2.5	2.13	0.24	4.33	1.02	0.84
209-54	54.28	54.77	0.49	FC		< 2			19.8	1.15	0.243		9.85	0.085	6.7	2.5	1.6	0.17	3.13	0.75	0.64
209-55	54.77	55.25	0.48	FC		< 2			20.5	1.16	0.242		9.98	0.086		2.5	1.6	0.19	2.9	0.77	0.71
209-56	55.25	55.74	0.49	FC		< 2			15.9	0.92	0.215		8.57	0.093	5.1	3	1.38	0.16	2.44	0.62	0.64
209-57	55.74	56.22	0.48	FC		< 2			17.4	1.06	0.206		9.43	0.104	5	2.5	1.49	0.18	2.69	0.76	0.68
209-58	56.22	56.71	0.49	FC		< 2			19.9	1.16	0.97		9.49	0.091	20.1	2.5	1.52	0.7	2.99	0.76	0.63
209-59	56.71	57.2	0.49	FC		< 2			13.6	0.93	0.95		7.53	0.083	19.2	2.5	1.2	0.64	2.21	0.62	0.62
209-60	57.2	57.65	0.45	DMM		< 2			57	4.14	0.91		31.2	0.368		11.5	4.79	0.58	10.8	3.14	2.57
209-61	57.65	58.1	0.45	DMM		< 2			53.3	4.25	0.93		21.9	0.338		11.5	4.53	0.7	10.5	3.13	2.39
209-62	58.1	58.55	0.45	DMM		< 2			54.6	3.77	0.93		29.9	0.352	20.7	13.5	4.4	0.67	10.9	2.91	2.53
209-63	58.55	59	0.45	DMM		< 2			51.6	4.02	0.85		28.7	0.334	19.3	12.5	4.19	0.6	10.1	2.72	2.39
209-64	59	59.5	0.5	COAL		< 2			50.8	3.98	0.485		29	0.374		13.5	3.81	0.41	10.5	3.66	2.6
209-65	59.5	60	0.5	CS		< 2			28.5	3.25	0.415		15.6	0.349		18	2.46	0.47	6.01	2.51	2.39
209-66	60	60.5	0.5	COAL		< 2			40.5	3.91	0.525		22.8	0.36		11.5	3.18	0.5	7.68	3.22	2.56
209-67	60.5	61	0.5	CS		15.1			40.2	3.26	0.555		22.5	0.313		7	3.33	0.52	7.4	2.54	2.16
209-68	61	61.4	0.4	DMM		5.7			56.1	3.57	0.747		31.2	0.314	20.1	14.5	4.19	0.52	10.6	3.14	2.25
209-69	61.4	61.8	0.4	DMM		< 2			40.6	3.48	0.576		22.3	0.34		10.5	3.06	0.44	7.69	2.67	2.38
209-70	61.8	62.2	0.4	CS		3.4			37.3	3.76	0.494		20.4	0.36		7.5	3.01	0.49	7.4	2.77	2.63
209-71	62.2	62.6	0.4	CS		< 2			37.3	3.92	0.529		20.8	0.378		8	3.13	0.47	7.53	3.17	2.83
209-72	62.6	63.05	0.45	DMM		86			39	4.17	0.541		22.2	0.409		8.5	3.26	0.53	8.61	3.02	2.86
209-73	63.05	63.5	0.45	DMM		< 2			38.2	4.22	0.594		22	0.408		7.5	3.3	0.53	8.31	3.26	2.74

										Table E.1											
										Analytical Data											
					Precious Metals							Rare Earths									
					3	2			2	2	2	2	2	2	2	3	2	2	2	2	2
					(ug/g)	ppb	ppb	ppb	ppm	ppm	ppm	issing 2(	ppm	ppm	ppm	(ug/g)	ppm	ppm	ppm	ppm	ppm
Sample #	From (m	To (m)	Interval	Facies	Ag	Au	Pd	Pt	Ce	Dy	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb
209-74	63.5	64	0.5	CS		14.4			14.6	1.53	0.212		7.69	0.189		4	1.19	0.2	3.57	1.37	1.22
209-75	64	64.5	0.5	CS		38.5			37.3	3.57	0.53		21.7	0.358	23.8	8	3.15	0.57	8.06	2.96	2.35
209-76	64.5	65	0.5	CS		15			25.2	2.24	0.36		13.6	0.257		4	2.02	0.31	5.2	1.87	1.73
209-77	65	65.47	0.47	FC		< 2			25.6	2.48	0.386		14.6	0.263		4.5	2.16	0.32	5.3	2.08	1.75
209-78	65.47	65.95	0.48	FC		9.6			17.3	2.31	0.303		10.4	0.257		3.5	1.57	0.34	4.37	1.86	1.83
209-79	65.95	66.42	0.47	FC		15.8			17.2	2.13	0.296		11.9	0.207		4.5	1.68	0.29	4.47	1.79	1.4
209-80	66.42	66.9	0.48	FC		14.2			13.9	1.32	0.181		7.47	0.152		4	1.13	0.24	3.05	1.48	0.98
209-81	66.9	67.37	0.47	FC		6			10.7	1.19	0.137		5.78	0.136	8.4	1.5	0.85	0.23	2.27	0.95	0.97
209-82	67.37	67.85	0.48	FC		< 2			10	1.03	0.128		5.93	0.131	8.6	2.5	0.91	0.14	2.35	1.04	0.85

									Table E.1								
									Analytical Data								
							Trace Elements								Duplicate		
Test Lab						2	3		2	2	2	2	2	2	2	2	2
Unit of measurement						ppm	(ug/g)		ppm	ppm	ppm	ppm	ppm	%	%	%	%
Sample #	From (m)	To (m)	Interval	Facies	Bi	Br	Cd	Hg	Ir	Sb	Ta	Ba	Cr	Al	Fe	Mn	Na
209-1	28.1	28.6	0.5	TC		0.18	0.15		< 2	0.13	0.235	179	8.2	2..15	0.12	0.0017	0.025
209-2	28.6	29.1	0.5	TC		0.5	0.29		< 2	0.13	0.268	201	6.4	0.91	0.06	0.001	0.027
209-3	29.1	29.6	0.5	TC		0.47	0.22		< 2	0.13	0.296	179	8.7	0.87	0.09	0.0012	0.026
209-4	29.6	30.1	0.5	TC		0.22	0.14		< 2	0.12	0.396	185	7.7	0.8	0.1	0.0015	0.024
209-5	30.1	30.6	0.5	TC		0.28	0.22		< 2	0.13	0.266	198	8.4	0.88	0.11	0.0016	0.025
209-6	30.6	31.1	0.5	TC		0.22	0.29		< 2	0.14	0.271	198	8.3	0.9	0.081	0.0012	0.027
209-7	31.1	31.6	0.5	TC		< 0.2	0.26		< 2	0.1	0.323	178	7.9	0.9	0.097	0.0017	0.026
209-8	31.6	32.1	0.5	TC		< 0.2	0.6		< 2	0.15	0.391	180	12.3	1.23	0.094	0.0017	0.031
209-9	32.1	32.6	0.5	TC		0.25	0.6		< 2	0.16	0.332	197	14.4	1.34	0.153	0.0017	0.029
209-10	32.6	33.1	0.5	TC		0.32	0.43		< 2	0.17	0.311	1933	13.9	1.29	0.13	0.0015	0.031
209-11	33.1	33.6	0.5	TC		0.37	0.26		< 2	0.18	0.211	185	6.6	0.91	0.209	0.0013	0.029
209-12	33.6	34.1	0.5	TC		0.25	0.51		< 2	0.15	0.262	178	7	0.93	0.086	0.0012	0.031
209-13	34.1	34.6	0.5	TC		0.26	0.43		< 2	0.17	0.316	183	10	1.07	0.105	0.0013	0.031
209-14	34.6	35.09	0.49	ICH		0.21	0.51		< 2	0.11	0.227	245	8.3	1.04	0.09	0.0012	0.025
209-15	35.09	35.58	0.49	ICH		0.33	0.51		< 2	0.13	0.211	165	7.5	0.92	0.206	0.0015	0.032
209-16	35.58	36.07	0.49	ICH		0.27	0.6		< 2	0.19	0.284	206	10.4	1.18	0.146	0.0024	0.032
209-17	36.07	36.56	0.49	ICH		0.34	0.6		< 2	0.2	0.313	210	10.8	1.17	0.288	0.0029	0.033
209-18	36.56	37.05	0.49	ICH		0.26	0.68		< 2	0.21	0.48	179	14	1.29	0.324	0.0032	0.038
209-19	37.05	37.54	0.49	ICH		0.26	0.51		< 2	0.19	0.376	205	11.1	1.15	0.212	0.0042	0.031
209-20	37.54	38.03	0.49	ICH		< 0.2	0.94		< 2	0.26	0.59	192	16.7	1.8	0.389	0.0096	0.038
209-21	38.03	38.52	0.49	ICH		< 0.2	0.6		< 2	0.2	0.323	199	11.6	1.24	0.244	0.0046	0.031
209-22	38.52	39.01	0.49	ICH		0.24	0.34		< 2	0.14	0.265	182	7.1	0.89	0.207	0.0055	0.023
209-23	39.01	39.5	0.49	ICH		0.26	0.34		< 2	0.14	0.202	160	7.4	0.83	0.178	0.0042	0.021
209-24	39.5	39.99	0.49	ICH		0.27	0.85		< 2	0.13	0.305	194	12	1.1	1.37	0.0165	0.027
209-25	39.99	40.48	0.49	ICH		0.26	0.85		< 2	0.18	0.305	177	15.9	1.25	1.37	0.0199	0.029
209-26	40.48	41	0.52	ICH		0.28	0.51		< 2	0.16	0.264	154	9.4	0.91	0.48	0.0069	0.024
209-27	41	41.57	0.57	TC		0.22	0.17		< 2	0.11	0.135	132	4	0.63	0.078	0.001	0.018
209-28	41.57	42.14	0.57	TC		0.36	0.51		< 2	0.17	0.378	184	9.2	0.96	0.82	0.0106	0.024
209-29	42.14	42.7	0.56	TC		< 0.2	0.43		< 2	0.14	0.029	167	7.3	0.85	0.313	0.0045	0.022
209-30	42.7	43.18	0.48	ICH		< 0.2	1.02		< 2	0.25	0.552	191	19.1	1.92	0.355	0.0091	0.033
209-31	43.18	43.66	0.48	ICH		< 0.2	0.77		< 2	0.19	0.393	186	16.9	1.3	0.266	0.0065	0.029
209-32	43.66	44.14	0.48	ICH		< 0.2	0.85		< 2	0.25	0.571	218	21	2.16	0.413	0.0098	0.035
209-33	44.14	44.62	0.48	ICH		< 0.2	0.68		< 2	0.17	0.237	202	11.2	2.21	0.438	0.0115	0.029
209-34	44.62	45.1	0.48	ICH		< 0.2	0.34		< 2	0.16	0.286	192	8.6	0.85	..187	0.0049	0.024
209-35	45.1	45.58	0.48	ICH		0.4	0.17		< 2	0.14	0.222	173	6.9	0.79	0.13	0.0027	0.023
209-36	45.58	46.06	0.48	ICH		0.4	0.51		< 2	0.2	0.28	184	14.4	1.22	0.376	0.0104	0.028

Table E.1
Analytical Data

							Trace Elements								Duplicate		
Test Lab						2	3		2	2	2	2	2	2	2	2	2
Unit of measurement						ppm	(ug/g)		ppm	ppm	ppm	ppm	ppm	%	%	%	%
Sample #	From (m)	To (m)	Interval	Facies	Bi	Br	Cd	Hg	Ir	Sb	Ta	Ba	Cr	Al	Fe	Mn	Na
209-37	46.06	46.54	0.48	ICH		< 0.2	0.6		< 2	0.17	0.415	178	16.1	1.31	0.33	0.009	0.026
209-38	46.54	47	0.462	ICH		0.32	0.6		< 2	0.18	0.38	170	13	1.21	0.212	0.0056	0.025
209-39	47	47.5	0.498	ICH		< 0.2	0.77		< 2	0.18	0.31	187	10	1.38	0.32	0.0089	0.031
209-40	47.5	48	0.5	ICH		0.38	0.68		< 2	0.23	0.537	219	18.9	1.71	0.322	0.0079	0.031
209-41	48	48.53	0.53	FE		0.39	0.26		< 2	0.13	0.155	178	6.7	1.03	0.126		0.025
209-42	48.53	49.06	0.53	FE		0.36	0.17		< 2	0.14	0.146	211	4.8	0.86	0.116		0.025
209-43	49.06	49.6	0.54	FE		0.29	0.09		< 2	0.11	0.159	119		0.58	0.121		0.018
209-44	49.6	50	0.4	OV		< 0.2	4.19		< 2	0.58	1.12	282	56.3	6.51	2.19		0.076
209-45	50	50.4	0.4	OV		< 0.2	4.09		< 2	0.63	1.21	326	60.4	7.02	1.44		0.076
209-46	50.4	50.89	0.49	FC		< 0.2			< 2	0.11	0.175	105	8.1	0.55	0.119		0.015
209-47	50.89	51.37	0.48	FC		0.27			< 2	0.06	0.151	91	4.6	0.48	0.051		0.014
209-48	51.37	51.86	0.49	FC		0.28			< 2	0.1	0.135	106	55.4	0.55	0.157		0.019
209-49	51.86	52.34	0.48	FC		< 0.2	0.08		< 2	0.12	0.174	127	4.8	0.6	0.082		0.017
209-50	52.34	52.83	0.49	FC		< 0.2	0.33		< 2	0.12	0.236	182	8.6	1.01	0.13		0.025
209-51	52.83	53.31	0.48	FC		0.34	0.06		< 2	0.12	0.125	150	3.4	0.68	0.056		0.02
209-52	53.31	53.8	0.49	FC		0.26			< 2	0.1	0.428	106	11.1	0.48	0.09		0.012
209-53	53.8	54.28	0.48	FC		0.41	0.17		< 2	0.17	0.411	150	12.2	1.09	0.175		0.023
209-54	54.28	54.77	0.49	FC		< 0.2	0.28		< 2	0.17	0.368	208	9.4	1.13	0.144	0.0034	0.031
209-55	54.77	55.25	0.48	FC		< 0.2	0.25		< 2	0.19	0.355	169	9.2	1.03	0.134	0.0034	0.028
209-56	55.25	55.74	0.49	FC		0.27	0.42		< 2	0.16	0.334	220	8.8	1.07	0.148	0.0034	0.035
209-57	55.74	56.22	0.48	FC		< 0.2	0.08		< 2	0.12	0.317	174	9.3	0.93	0.103	0.0026	0.032
209-58	56.22	56.71	0.49	FC		< 0.2	0.25		< 2	0.13	1.55	277	8.4	0.76	0.076	0.0018	0.024
209-59	56.71	57.2	0.49	FC		0.23			< 2	0.12	1.43	261	6.5	0.54	0.078	0.0015	0.021
209-60	57.2	57.65	0.45	DMM		< 0.2	4.09		< 2	0.57	1.51	245	71.2	6.38	1.3	0.0018	0.193
209-61	57.65	58.1	0.45	DMM		0.58	4		< 2	0.65	1.42	139	71.5	6.33	0.836	0.0052	0.199
209-62	58.1	58.55	0.45	DMM		< 0.2	4.56		< 2	0.51	1.45	278	80.9	7.21	1.21	0.0074	0.241
209-63	58.55	59	0.45	DMM		0.89	4.5		< 2	0.69	1.53	452	77.3	6.77	1.05	0.0055	0.244
209-64	59	59.5	0.5	COAL		< 0.2	4.46		< 2	0.81	1.35	184	79.1	7.81	1.07	0.0043	0.32
209-65	59.5	60	0.5	CS		0.61	1.28		< 2	0.57	1.82		33.4	2.11	0.691	0.0014	0.153
209-66	60	60.5	0.5	COAL		0.97	2.36		< 2	0.65	2.15	125	50.7	3.79	0.676	0.0022	0.242
209-67	60.5	61	0.5	CS		< 0.2	2.26		< 2	0.47	1.39	189	54.6	3.57	0.949	0.0034	0.17
209-68	61	61.4	0.4	DMM		< 0.2	4.99		< 2	0.63	1.6	320	89.9	7.84	1.96	0.0063	0.371
209-69	61.4	61.8	0.4	DMM		1.2	2.87		< 2	0.61	1.63	154	60.4	4.47	1.18	0.0041	0.286
209-70	61.8	62.2	0.4	CS		0.9	1.72		< 2	0.49	1.78	82	48.1	2.94	1.86	0.0024	0.208
209-71	62.2	62.6	0.4	CS		0.7	1.38		< 2	0.49	2.24	110	43.5	2.57	0.418	0.002	0.199
209-72	62.6	63.05	0.45	DMM		< 0.2	2.11		< 2	0.64	2.18	116	50.5	3.76	0.896	0.0039	0.21
209-73	63.05	63.5	0.45	DMM		< 0.2	1.71		< 2	0.61	2.06	106	47.5	3.15	0.797	0.0036	0.177

Table E.1
Analytical Data

					Trace Elements							Duplicate					
Test Lab						2	3		2	2	2	2	2	2	2	2	2
Unit of measurement						ppm	(ug/g)		ppm	ppm	ppm	ppm	ppm	%	%	%	%
Sample #	From (m)	To (m)	Interval	Facies	Bi	Br	Cd	Hg	Ir	Sb	Ta	Ba	Cr	Al	Fe	Mn	Na
209-74	63.5	64	0.5	CS		0.46	0.72		< 2	0.26	1.03		18.3	1.04	2.18	0.0028	0.082
209-75	64	64.5	0.5	CS		< 0.2	1.89		< 2	0.5	1.97		43.5	3.51	0.815	0.0047	0.188
209-76	64.5	65	0.5	CS		0.75	1.03		< 2	0.32	1.32	67	27	2.1	0.764	0.003	0.132
209-77	65	65.47	0.47	FC		0.77	0.99		< 2	0.38	1.45	83	29.7	2.1	0.539	0.0024	0.147
209-78	65.47	65.95	0.48	FC		0.78	0.48		< 2	0.4	1.35	190	23.7	1.45	0.693	0.002	0.107
209-79	65.95	66.42	0.47	FC		< 0.2	0.81		< 2	0.39	1.57	74	28.4	1.71	0.696	0.0022	0.125
209-80	66.42	66.9	0.48	FC		0.69	0.36		< 2	0.24	0.906		16.3	0.89	0.333	0.0012	0.079
209-81	66.9	67.37	0.47	FC		0.8	0.56		< 2	0.15	0.608		11.8	0.68	1.59	0.0015	0.064
209-82	67.37	67.85	0.48	FC		0.99	0.09		< 2	0.14	0.682		12.7	0.61	0.656	0.0014	0.078

									Table E.2									
									Analytical Data									
										Minor Elements								Bitumen
Test Lab					1	1	1	1	1	1	1	1	1	1	1	1	1	1	Gulf
Unit of Measurement					ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt%
Sample #	From (m)	To (m)	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	Se	Sr	Y	Bitumen
215-1	14.85	15.14	0.29	LTF	7	74	270	2	36	53	2.4	6	16.0	14	50	<0.5	63	33	1.4
215-2	15.14	15.76	0.62	LTF	4	60	237	<2	190	34	1.1	5	12.0	10	32	<0.5	36	24	8.9
215-3	15.76	16.28	0.52	LTF	4	84	268	<2	140	53	1.8	4	16.0	16	41	<0.5	46	32	5.4
215-4	16.28	16.75	0.47	LTF	10	68	237	<2	99	39	0.8	4	19.0	14	30	<0.5	35	32	6.8
215-5	16.75	17.30	0.55	LTF	4	82	236	<2	115	47	1.6	5	13.0	13	38	<0.5	42	29	3.8
215-6	17.30	17.90	0.60	UTF	4	93	282	2	86	63	2.7	9	14.0	17	63	2.9	54	33	2.9
215-7	17.90	18.50	0.60	UTF	4	93	294	2	100	61	2.4	7	10.0	15	63	<0.5	56	35	0
215-8	18.50	19.10	0.60	LTF	4	56	227	<2	80	31	1.2	3	13.0	9	32	2.9	34	19	6.5
215-9	19.10	19.41	0.31	SM	2	178	326	4	75	42	3.1	20	4.8	20	46	<0.5	147	32	0
215-10	19.41	19.96	0.55	SM	4	147	367	3	64	86	6.3	22	8.6	21	112	1.4	116	39	0
215-11	19.96	20.51	0.55	SM	6	135	394	3	54	83	5.1	19	9.2	20	101	<0.5	99	33	0
215-12	20.51	21.05	0.54	SM	4	132	385	3	54	87	5.4	21	9.7	22	104	2.6	95	37	3.5
215-13	21.05	21.59	0.54	SM	3	128	389	3	<30	85	5.2	21	9.2	19	105	<0.5	103	40	0
215-14	21.59	22.10	0.51	SM	3	153	416	3	136	92	6.1	24	8.2	22	122	2.0	111	38	0
215-15	22.10	22.50	0.40	PDM	7	120	356	2	79	77	4.6	19	9.9	20	93	1.7	80	37	0
215-16	22.50	22.90	0.40	PDM	4	111	350	2	65	74	3.9	16	11.0	18	87	2.9	87	35	0
215-17	22.90	23.30	0.40	PDM	3	102	314	2	280	72	3.8	13	10.0	15	85	<0.5	79	32	0
215-18	23.30	23.68	0.38	UTF	3	90	295	2	70	61	3.0	12	12.0	15	67	2.0	61	25	0
215-19	23.68	24.05	0.37	UTF	3	82	281	<2	160	58	2.5	21	18.0	15	55	1.4	53	29	2.7
215-20	24.05	24.53	0.48	LTF	12	68	243	<2	<30	46	1.0	4	9.4	5	31	<0.5	49	23	3.4
215-21	24.53	25.00	0.47	LTF	2	24	185	<2	30	7.8	0.4	<2	3.7	5	17	1.0	25	7	5.7
215-22	25.00	25.52	0.52	TC	2	17	184	<2	25	11	0.2	<2	6.0	3	13	<0.5	17	7	14.5
215-23	25.52	26.04	0.52	TC	1	25	170	<2	20	9	<0.2	<2	8.6	3	12	<0.5	20	10	14.4
215-24	26.04	26.56	0.52	TC	1	25	175	<2	29	8.8	<0.2	<2	7.8	4	11	<0.5	15	10	14.2
215-25	26.56	27.08	0.52	TC	1	22	188	<2	40	8.6	0.3	<2	4.3	5	11	<0.5	18	8	14.9
215-26	27.08	27.60	0.52	TC	2	23	201	<2	59	11	0.3	<2	4.2	3	18	<0.5	22	10	14.3
215-27	27.60	28.12	0.52	TC	2	18	178	<2	37	6.7	0.3	<2	3.6	4	16	<0.5	13	7	13.9
215-28	28.12	28.65	0.53	TC	1	28	163	<2	<30	12	0.5	<2	12.0	3	13	<0.5	17	7	13.7
215-29	28.65	29.20	0.55	UTF	2	57	203	<2	91	27	1.3	3	13.0	7	23	<0.5	31	17	10.4
215-30	29.20	29.75	0.55	LTF	1	43	159	<2	35	24	0.5	<2	20.0	7	11	<0.5	17	27	8.6

Table E.2

					Minor Elements														Bitumen
Sample	From	To	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	Se	Sr	Y	Bitumen
215-31	29.75	30.30	0.55	LTF	2	60	203	<2	111	34	1.6	3	13.0	9	39	<0.5	29	21	14
215-32	30.30	30.85	0.55	LTF	2	31	174	<2	60	20	0.5	<2	18.0	7	13	<0.5	18	17	9.6
215-33	30.85	31.40	0.55	LTF	2	51	184	<2	133	23	0.9	<2	11.0	7	25	1.3	20	17	13.9
215-34	31.40	32.10	0.70	SID	1	29	192	2	<30	28	0.5	<2	8.1	4	19	1.3	87	11	10.6
215-35	32.10	32.63	0.53	LTF	2	66	220	<2	194	39	2.0	3	14.0	10	49	1.6	33	28	9.3
215-36	32.63	33.16	0.53	LTF	2	55	205	<2	80	26	1.1	3	13.0	10	27	1.3	28	21	8
215-37	33.16	33.70	0.54	LTF	2	59	226	<2	133	36	1.7	4	13.0	11	41	<0.5	42	25	6.1
215-38	33.70	34.21	0.51	UTF	2	56	204	<2	34	33	1.0	3	17.0	10	29	2.6	26	21	6.1
215-39	34.21	34.73	0.52	UTF	4	67	229	<2	<30	50	2.1	5	14.0	10	46	1.1	41	25	4.7
215-40	34.73	35.24	0.51	UTF	2	71	234	<2	190	43	2.2	8	11.0	11	49	1.1	43	25	4.7
215-41	35.24	35.76	0.52	UTF	3	76	260	<2	53	46	2.3	8	12.0	11	54	2.1	52	24	3.9
215-42	35.76	36.27	0.51	UTF	3	76	257	<2	111	52	2.4	8	13.0	11	61	<0.5	42	25	4
215-43	36.27	36.79	0.52	UTF	2	57	254	<2	<30	46	1.6	4	10.0	8	34	<0.5	214	22	4.4
215-44	36.79	37.30	0.51	UTF	3	94	270	2	42	56	3.1	9	16.0	12	66	1.2	46	26	3.5
215-45	37.30	37.80	0.50	UTF	2	77	251	<2	106	48	2.4	6	17.0	11	51	1.7	42	29	2.7
215-46	37.80	38.30	0.50	UTF	3	81	254	<2	96	53	2.7	8	20.0	12	57	<0.5	45	29	3.6
215-47	38.30	38.90	0.60	UTF	3	110	301	2	<30	64	4.5	15	13.0	16	84	2.1	63	30	3.7
215-48	38.90	39.39	0.49	UTF	3	95	259	2	80	58	3.1	9	19.0	12	63	1.7	53	40	3.5
215-49	39.39	40.00	0.61	UTF	4	110	288	2	42	61	4.5	16	9.6	15	92	2.0	63	33	2
215-50	40.00	40.43	0.43	ICH	1	41	195	<2	80	8.1	0.3	<2	5.0	5	11	0.9	22	14	12.2
215-51	40.43	40.86	0.43	ICH	1	41	238	<2	143	10	0.5	3	3.3	6	14	<0.5	33	14	11.8
215-52	40.86	41.30	0.44	UTF	2	26	226	<2	71	11	0.5	<2	3.5	3	22	1.5	20	10	14
215-53	41.30	41.87	0.57	UTF	3	55	289	2	84	43	2.3	11	10.0	13	48	2.2	59	26	4.4
215-54	41.87	42.43	0.56	UTF	3	40	244	<2	64	32	1.3	4	12.0	10	36	<0.5	38	18	10.2
215-55	42.43	43.00	0.57	UTF	2	63	278	2	60	50	2.5	9	10.0	14	54	<0.5	52	26	3.7
215-56	43.00	43.50	0.50	TC	1	22	193	<2	50	11	0.2	<2	8.8	4	12	0.9	23	10	15.5
215-57	43.50	44.00	0.50	TC	2	12	176	<2	35	11	0.2	<2	7.4	3	13	1.2	17	7	15
215-58	44.00	44.50	0.50	TC	2	17	180	<2	51	8.7	0.2	<2	6.6	3	14	<0.5	30	7	15.8
215-59	44.50	45.00	0.50	TC	2	19	188	<2	45	10	0.2	<2	7.6	3	11	<0.5	20	10	15.8
215-60	45.00	45.52	0.52	CB	2	28	240	<2	131	27	1.4	5	6.8	10	34	0.9	41	18	10.4
215-61	45.52	46.00	0.48	CB	2	31	210	<2	97	20	0.9	2	7.1	6	26	0.7	28	14	8.3
215-62	46.00	46.52	0.52	PDM	6	97	355	4	<30	75	5.0	19	5.1	20	106	<0.5	93	40	0
215-63	46.52	47.03	0.51	PDM	3	105	413	4	<30	82	5.6	22	7.5	24	114	1.3	96	38	0
215-64	47.03	47.55	0.52	PDM	4	104	374	3	95	76	5.0	20	8.0	23	107	<0.5	91	42	0

									Table E.2										
										Minor Elements									
Sample	From	To	Interval	Facies	As	B	Ba	Be	Cl	Cr	Cs	Ga	Hf	Nb	Rb	Se	Sr	Y	
215-65	47.55	48.06	0.51	PDM	4	100	365	3	420	78	5.1	19	8.6	21	107	1.8	89	42	0
215-66	48.06	48.58	0.52	PDM	7	90	336	3	342	71	4.3	15	8.8	20	86	0.8	80	37	0
215-67	48.58	49.09	0.51	PDM	3	78	290	3	230	65	3.9	13	7.8	15	82	<0.5	78	33	0
215-68	49.09	49.61	0.52	PDM	4	91	331	2	310	67	4.1	14	10.0	19	89	0.7	80	38	0
215-69	49.61	50.12	0.51	PDM	3	91	355	2	362	69	3.9	16	11.0	19	90	<0.5	89	39	0
215-70	50.12	50.64	0.52	PDM	3	82	315	2	269	64	3.5	14	12.0	18	80	<0.5	70	34	0
215-71	50.64	51.15	0.51	PDM	4	74	317	2	170	59	3.1	10	12.0	16	74	0.8	66	34	0
215-72	51.15	51.67	0.52	PDM	4	74	302	2	420	59	2.9	12	12.0	17	65	1.2	70	30	0
215-73	51.67	52.18	0.51	PDM	3	72	258	2	507	62	2.9	12	13.0	17	65	<0.5	64	34	0
215-74	52.18	52.70	0.52	PDM	4	77	264	2	294	62	3.2	14	12.0	17	68	2.8	62	30	0
215-75	52.70	53.24	0.54	UTF	4	64	235	<2	420	49	2.5	10	11.0	15	52	<0.5	56	33	Not
215-76	53.24	53.81	0.57	UTF	3	60	223	<2	400	47	2.5	10	11.0	14	55	<0.5	52	22	Bitumen
215-77	53.81	54.29	0.48	UTF	3	60	225	<2	302	47	2.6	10	9.7	14	52	<0.5	48	30	Saturated
215-78	54.29	54.81	0.52	UTF	6	58	222	<2	311	45	2.3	8	11.0	13	50	1.5	48	22	Below
215-79	54.81	55.33	0.52	UTF	8	64	238	<2	558	54	2.8	11	11.0	16	60	<0.5	60	30	Here
215-80	55.33	55.80	0.47	UTF	6	58	222	<2	388	51	2.7	10	11.0	17	57	1.0	56	30	
215-81	55.80	56.32	0.52	OV	5	114	215	2	273	83	5.2	23	7.0	20	91	<0.5	77	34	
215-82	56.32	56.85	0.53	OV	6	148	223	2	204	89	6.5	23	6.7	22	106	1.6	87	26	
215-83	56.85	57.37	0.52	OV	9	178	284	2	319	93	6.8	27	6.9	28	116	0.6	129	31	
215-84	57.37	57.90	0.53	OV	6	156	216	2	359	87	6.2	19	11.0	28	89	1.2	119	25	
215-85	57.90	58.45	0.55	CS	4	46	68	<2	749	20	<0.2	<2	6.6	11	<10	1.0	54	7	
215-86	58.45	59.00	0.55	CS	2	50	54	<2	318	26	1.1	4	6.7	11	14	0.8	37	11	
215-87	59.00	59.50	0.50	COAL	21	339	381	1	329	18	1.2	7	4.2	18	<10	1.8	918	22	
215-88	59.50	60.00	0.50	C (O+W	1	19	36	<2	361	12	<0.2	<2	5.9	12	<10	0.9	28	7	
215-89	60.00	60.50	0.50	C (O+W	2	14	49	<2	167	9.7	<0.2	<2	5.2	7	<10	1.2	18	11	
215-90	60.50	61.00	0.50	C (O+W	2	5.2	14	<2	70	2.5	<0.2	<2	1.6	<2	<10	<0.5	9	0	
215-91	61.00	61.50	0.50	CS	15	116	44	<2	585	30	0.3	6	8.6	16	<10	<0.5	68	20	
215-92	61.50	62.00	0.50	CS	3	34	46	<2	480	32	0.3	<2	11.0	19	<10	1.5	42	23	
215-93	62.00	62.47	0.47	FCWS	7	27	79	<2	485	32	0.7	7	6.5	11	<10	<0.5	40	15	
215-94	62.47	62.95	0.48	FCWS	3	11	25	<2	652	20	<0.2	4	1.7	5	<10	<0.5	40	4	
215-95	62.95	63.42	0.47	FCWS	2	14	38	<2	877	28	<0.2	4	1.9	5	<10	<0.5	69	4	
215-96	63.42	63.90	0.48	FCWS	2	15	132	<2	682	29	<0.2	4	1.7	8	<10	<0.5	65	0	
215-97	63.9	64.3	0.40	Siltstone	2	27	35	<2	198	17	<0.2	<2	10.0	19	<10	0.6	39	20	

Table E.2

Analytical Data

					Metallic Elements										Precious Metals				
Test Lab					1	1	1	1	mt	1	1	1	1	1	1	1	1	1	1
Unit of Measurement					ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Sample #	From (m)	To (m)	Interval	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Ag	Au (NA)	Au(Fire)	Pd	Pt
215-1	14.85	15.14	0.29	LTF	16	19	3	29	8	<5	56	2	41	570	<0.4	<.002	0.003	<.003	<.005
215-2	15.14	15.76	0.62	LTF	13	12	<2	30	8	<5	49	<1	29	458	<0.4	<.002	0.001	<.003	<.005
215-3	15.76	16.28	0.52	LTF	120	14	7	31	8	<5	57	880	33	555	<0.4	0.006	0.016	<.003	<.005
215-4	16.28	16.75	0.47	LTF	85	11	2	29	13	<5	54	570	27	573	0.4	<.002	0.009	<.003	<.005
215-5	16.75	17.30	0.55	LTF	26	13	<2	44	11	<5	53	80	30	616	<0.4	0.003	0.005	<.003	<.005
215-6	17.30	17.90	0.60	UTF	17	16	4	30	11	<5	63	3	42	463	<0.4	<.002	0.003	<.003	<.005
215-7	17.90	18.50	0.60	UTF	31	17	4	32	12	<5	58	110	42	491	<0.4	0.003	0.010	<.003	<.005
215-8	18.50	19.10	0.60	LTF	15	13	3	30	8	<5	44	3	21	446	<0.4	<.002	0.003	<.003	<.005
215-9	19.10	19.41	0.31	SM	12	18	3	20	15	<5	87	68	27	341	0.5	0.006	0.006	<.003	<.005
215-10	19.41	19.96	0.55	SM	12	20	2	30	18	<5	97	3	50	297	<0.4	<.002	0.001	<.003	<.005
215-11	19.96	20.51	0.55	SM	20	24	4	49	14	<5	101	2	79	341	<0.4	0.002	0.001	<.003	<.005
215-12	20.51	21.05	0.54	SM	22	20	4	39	15	<5	99	4	72	328	<0.4	0.003	0.001	<.003	<.005
215-13	21.05	21.59	0.54	SM	25	21	3	36	15	<5	100	30	69	299	<0.4	<.002	0.003	<.003	<.005
215-14	21.59	22.10	0.51	SM	24	26	5	43	10	<5	111	4	79	288	0.5	<.002	0.001	<.003	0.006
215-15	22.10	22.50	0.40	PDM	20	18	2	36	12	<5	88	4	62	341	<0.4	0.002	0.002	<.003	<.005
215-16	22.50	22.90	0.40	PDM	17	18	3	33	11	<5	78	<1	60	378	<0.4	0.002	0.002	<.003	<.005
215-17	22.90	23.30	0.40	PDM	17	18	3	29	5	<5	74	8	49	343	0.5	0.003	0.008	<.003	<.005
215-18	23.30	23.68	0.38	UTF	14	19	<2	29	8	<5	66	3	45	403	0.4	<.002	0.004	<.003	<.005
215-19	23.68	24.05	0.37	UTF	45	20	4	31	15	<5	56	230	41	623	<0.4	0.003	0.007	<.003	0.005
215-20	24.05	24.53	0.48	LTF	21	22	4	27	20	<5	52	<1	35	363	<0.4	<.002	0.002	<.003	0.004
215-21	24.53	25.00	0.47	LTF	20	28	<2	23	9	<5	39	1	12	205	<0.4	<.002	0.002	<.003	<.005
215-22	25.00	25.52	0.52	TC	7.1	20	3	24	<5	<5	36	1	6	215	<0.4	<.002	0.003	<.003	<.005
215-23	25.52	26.04	0.52	TC	13	16	<2	20	6	<5	35	<1	7	362	<0.4	<.002	0.003	<.003	0.005
215-24	26.04	26.56	0.52	TC	3.8	9	<2	25	8	<5	33	<1	7	455	<0.4	<.002	0.003	<.003	<.005
215-25	26.56	27.08	0.52	TC	2.7	8	<2	20	9	<5	35	<1	8	245	<0.4	<.002	0.002	<.003	<.005
215-26	27.08	27.60	0.52	TC	5.5	7	<2	21	9	<5	37	<1	10	143	<0.4	<.002	0.003	<.003	<.005
215-27	27.60	28.12	0.52	TC	12	11	<2	23	5	<5	33	<1	5	180	<0.4	<.002	0.001	<.003	<.005
215-28	28.12	28.65	0.53	TC	5.7	13	<2	25	8	<5	32	1	8	324	<0.4	<.002	0.004	<.003	0.004
215-29	28.65	29.20	0.55	UTF	8.3	16	<2	22	11	<5	43	2	23	509	<0.4	0.020	0.002	<.003	<.005
215-30	29.20	29.75	0.55	LTF	47	55	2	24	13	6	42	1	25	961	<0.4	<.002	0.001	<.003	0.004

								Table E.2											
								Metallic Elements								Precious Metals			
Sample #	(m)	To (m)	Interval	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Ag	Au (NA)	Au(Fire)	Pd	Pt
215-31	29.75	30.30	0.55	LTF	6.6	12	<2	22	13	<5	42	1	23	410	<0.4	<.002	0.001	<.003	0.006
215-32	30.30	30.85	0.55	LTF	16	12	<2	23	6	<5	38	1	12	652	<0.4	<.002	0.001	<.003	0.004
215-33	30.85	31.40	0.55	LTF	8.2	9	<2	21	11	<5	40	<1	11	517	<0.4	<.002	0.003	<.003	<.005
215-34	31.40	32.10	0.70	SID	11	8	3	16	<5	<5	16	63	8	287	<0.4	0.048	0.077	<.003	0.005
215-35	32.10	32.63	0.53	LTF	9.2	12	<2	21	8	<5	44	11	22	583	<0.4	0.002	0.001	<.003	0.009
215-36	32.63	33.16	0.53	LTF	5.3	10	2	25	9	<5	49	1	18	541	0.4	0.002	0.002	<.003	<.005
215-37	33.16	33.70	0.54	LTF	7.2	11	<2	24	10	<5	56	1	25	497	<0.4	0.002	0.002	<.003	<.005
215-38	33.70	34.21	0.51	UTF	8	12	<2	26	9	<5	45	2	22	660	0.4	0.002	0.002	<.003	<.005
215-39	34.21	34.73	0.52	UTF	46	25	3	30	9	<5	55	190	33	475	<0.4	0.006	0.022	<.003	<.005
215-40	34.73	35.24	0.51	UTF	13	17	2	29	17	<5	55	2	38	408	0.5	<.002	0.002	<.003	<.005
215-41	35.24	35.76	0.52	UTF	18	22	2	30	14	<5	53	2	38	445	<0.4	<.002	0.002	0.004	<.005
215-42	35.76	36.27	0.51	UTF	90	25	5	31	19	<5	55	560	34	528	0.5	0.014	0.077	<.003	<.005
215-43	36.27	36.79	0.52	UTF	100	15	5	27	8	<5	37	720	25	446	<0.4	0.047	0.048	<.003	<.005
215-44	36.79	37.30	0.51	UTF	16	19	3	28	15	<5	61	3	41	569	0.8	<.002	0.001	<.003	<.005
215-45	37.30	37.80	0.50	UTF	34	23	2	28	9	<5	50	93	35	605	0.5	0.002	0.009	<.003	<.005
215-46	37.80	38.30	0.50	UTF	22	15	3	34	14	<5	55	55	34	678	0.5	0.005	0.017	<.003	<.005
215-47	38.30	38.90	0.60	UTF	22	20	2	35	20	<5	71	2	55	463	<0.4	0.003	0.004	<.003	<.005
215-48	38.90	39.39	0.49	UTF	31	18	2	28	17	<5	65	120	44	686	0.5	0.003	0.005	0.004	<.005
215-49	39.39	40.00	0.61	UTF	17	18	<2	38	24	<5	79	3	57	337	0.6	0.002	0.002	<.003	<.005
215-50	40.00	40.43	0.43	ICH	3	4	<2	41	7	<5	41	<1	10	386	<0.4	<.002	0.001	<.003	<.005
215-51	40.43	40.86	0.43	ICH	3.4	13	<2	27	10	<5	45	<1	19	220	0.5	<.002	0.001	<.003	<.005
215-52	40.86	41.30	0.44	UTF	5.8	12	<2	27	<5	<5	41	<1	13	147	<0.4	<.002	0.001	<.003	<.005
215-53	41.30	41.87	0.57	UTF	9.8	12	4	26	7	<5	54	3	34	446	<0.4	<.002	0.001	0.002	<.005
215-54	41.87	42.43	0.56	UTF	8.1	10	3	24	<5	<5	48	2	25	458	0.4	<.002	0.001	0.002	<.005
215-55	42.43	43.00	0.57	UTF	42	12	3	26	10	<5	57	270	34	418	<0.4	0.004	0.003	0.002	<.005
215-56	43.00	43.50	0.50	TC	5.5	9	<2	32	<5	<5	43	<1	9	374	<0.4	<.002	0.001	0.002	<.005
215-57	43.50	44.00	0.50	TC	4.6	7	3	24	4	<5	39	1	8	298	<0.4	<.002	0.001	0.002	<.005
215-58	44.00	44.50	0.50	TC	12	7	2	26	6	<5	39	<1	10	366	<0.4	<.002	0.001	0.002	<.005
215-59	44.50	45.00	0.50	TC	3.3	7	2	24	<5	<5	38	<1	9	370	<0.4	<.002	0.001	0.003	<.005
215-60	45.00	45.52	0.52	CB	6.8	10	2	24	8	<5	52	<1	26	324	<0.4	<.002	0.001	0.002	<.005
215-61	45.52	46.00	0.48	CB	5.8	7	<2	24	<5	<5	44	<1	16	318	0.3	<.002	0.003	0.002	<.005
215-62	46.00	46.52	0.52	PDM	24	24	3	41	11	<5	92	48	66	294	0.5	<.002	0.009	0.002	<.005
215-63	46.52	47.03	0.51	PDM	21	23	2	45	10	<5	104	7	74	292	<0.4	<.002	0.006	0.002	<.005
215-64	47.03	47.55	0.52	PDM	20	22	<2	41	14	<5	94	8	69	298	<0.4	<.002	0.002	0.002	<.005

								Table E.2											
								Metallic Elements								Precious Metals			
Sample #	(m)	To (m)	Interval	Facies	Co	Cu	Mo	Ni	Pb	Sn	V	W	Zn	Zr	Ag	Au (NA)	Au(Fire)	Pd	Pt
215-65	47.55	48.06	0.51	PDM	19	18	2	35	9	<5	84	4	65	320	<0.4	<.002	0.001	0.002	<.005
215-66	48.06	48.58	0.52	PDM	21	16	<2	31	8	<5	76	13	55	348	<0.4	<.002	0.001	0.002	<.005
215-67	48.58	49.09	0.51	PDM	18	16	3	29	5	<5	67	25	47	320	0.6	<.002	0.004	0.002	<.005
215-68	49.09	49.61	0.52	PDM	19	15	<2	31	10	<5	67	13	51	382	<0.4	<.002	0.003	0.002	<.005
215-69	49.61	50.12	0.51	PDM	24	19	2	30	12	<5	66	61	54	390	0.4	<.002	0.002	0.003	<.005
215-70	50.12	50.64	0.52	PDM	26	14	3	28	11	<5	59	78	43	600	<0.4	<.002	0.001	0.002	<.005
215-71	50.64	51.15	0.51	PDM	20	16	<2	26	8	<5	56	22	40	436	<0.4	<.002	0.001	0.002	<.005
215-72	51.15	51.67	0.52	PDM	18	16	<2	26	10	<5	54	19	42	492	0.5	<.002	0.002	0.002	<.005
215-73	51.67	52.18	0.51	PDM	28	20	2	25	8	<5	53	55	40	500	<0.4	0.002	0.005	0.002	<.005
215-74	52.18	52.70	0.52	PDM	17	13	3	27	<5	<5	57	4	43	498	<0.4	0.002	0.001	0.002	<.005
215-75	52.70	53.24	0.54	UTF	13	18	<2	27	10	<5	53	2	36	482	0.5	<.002	0.002	0.002	<.005
215-76	53.24	53.81	0.57	UTF	20	19	<2	24	8	<5	51	9	33	460	<0.4	0.005	0.001	0.002	<.005
215-77	53.81	54.29	0.48	UTF	11	14	2	24	6	<5	52	2	35	478	<0.4	<.002	0.001	0.002	<.005
215-78	54.29	54.81	0.52	UTF	15	16	<2	26	12	<5	49	2	33	424	<0.4	<.002	0.001	0.002	<.005
215-79	54.81	55.33	0.52	UTF	20	15	<2	26	14	<5	51	45	41	452	<0.4	0.002	0.004	0.003	<.005
215-80	55.33	55.80	0.47	UTF	18	17	<2	26	14	<5	49	32	41	484	<0.4	0.004	0.008	0.004	<.005
215-81	55.80	56.32	0.52	OV	15	22	<2	36	13	<5	85	13	49	294	<0.4	<.002	0.003	0.002	<.005
215-82	56.32	56.85	0.53	OV	14	22	<2	46	20	<5	93	4	70	276	<0.4	<.002	0.001	0.002	<.005
215-83	56.85	57.37	0.52	OV	15	21	<2	47	22	<5	103	7	63	290	0.4	<.002	0.002	0.002	<.005
215-84	57.37	57.90	0.53	OV	17	19	2	29	15	<5	75	7	45	442	0.4	<.002	0.001	0.002	<.005
215-85	57.90	58.45	0.55	CS	58	49	3	13	4	<5	20	43	4	298	<0.4	<.002	0.001	0.002	<.005
215-86	58.45	59.00	0.55	CS	51	26	3	12	<5	<5	24	250	11	348	<0.4	<.002	0.002	0.002	<.005
215-87	59.00	59.50	0.50	COAL	7.3	15	3	12	9	<5	22	3	3	434	<0.4	0.003	0.000	0.001	<.005
215-88	59.50	60.00	0.50	C (O+W	19	10	<2	15	<5	<5	18	110	2	244	<0.4	<.002	0.003	0.002	<.005
215-89	60.00	60.50	0.50	C (O+W	15	17	<2	19	8	<5	30	<1	6	246	0.5	<.002	0.001	0.002	<.005
215-90	60.50	61.00	0.50	C (O+W	7.2	16	<2	16	<5	<5	28	<1	2	68	<0.4	<.002	0.001	0.002	<.005
215-91	61.00	61.50	0.50	CS	44	25	5	21	9	<5	54	110	6	392	<0.4	<.002	0.002	0.002	<.005
215-92	61.50	62.00	0.50	CS	25	29	4	19	<5	<5	30	3	3	448	<0.4	<.002	0.001	0.002	<.005
215-93	62.00	62.47	0.47	FCWS	14	14	2	16	9	<5	42	20	6	272	<0.4	0.002	0.019	0.002	<.005
215-94	62.47	62.95	0.48	FCWS	62	34	2	22	11	<5	20	160	4	58	<0.4	0.009	0.038	0.002	<.005
215-95	62.95	63.42	0.47	FCWS	110	74	4	21	8	<5	25	200	5	54	<0.4	0.046	0.082	0.010	<.005
215-96	63.42	63.90	0.48	FCWS	34	31	3	20	9	<5	26	52	4	58	<0.4	0.007	0.006	0.002	<.005
215-97	63.9	64.3	0.40	Siltstone	11	13	3	13	<5	<5	9	35	2	438	<0.4	0.210	0.002	0.003	<.005

Table E.2

Analytical Data

					Primary Elements									
Test Lab					1	1	1	1	1	1	1	1	1	1
Unit of Measurement					(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Sample #	From (m)	To (m)	Interval	Facies	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
215-1	14.85	15.14	0.29	LTF	4.00	0.06	0.88	1.02	0.22	0.01	0.15	0.02	37.03	0.47
215-2	15.14	15.76	0.62	LTF	2.37	0.03	0.64	0.78	0.15	0.01	0.18	0.02	36.31	0.37
215-3	15.76	16.28	0.52	LTF	3.32	0.06	0.81	0.94	0.19	0.01	0.22	0.03	36.15	0.50
215-4	16.28	16.75	0.47	LTF	2.54	0.04	0.72	0.80	0.14	0.01	0.21	0.02	36.22	0.42
215-5	16.75	17.30	0.55	LTF	3.02	0.04	0.70	0.84	0.15	0.01	0.23	0.03	36.68	0.45
215-6	17.30	17.90	0.60	UTF	4.55	0.06	0.98	1.20	0.23	0.01	0.28	0.03	36.83	0.55
215-7	17.90	18.50	0.60	UTF	4.49	0.04	0.94	1.28	0.25	0.01	0.26	0.04	36.92	0.52
215-8	18.50	19.10	0.60	LTF	2.11	0.03	0.68	0.66	0.14	0.01	0.16	0.03	37.25	0.32
215-9	19.10	19.41	0.31	SM	7.74	0.17	1.02	1.17	0.32	0.01	0.36	0.02	26.40	0.61
215-10	19.41	19.96	0.55	SM	9.56	0.06	1.39	1.81	0.47	0.01	0.36	0.03	30.65	0.67
215-11	19.96	20.51	0.55	SM	8.45	0.06	1.47	1.77	0.47	0.01	0.33	0.03	30.81	0.65
215-12	20.51	21.05	0.54	SM	8.82	0.06	1.65	1.80	0.49	0.01	0.30	0.05	30.70	0.65
215-13	21.05	21.59	0.54	SM	8.46	0.27	4.61	1.71	0.80	0.06	0.30	0.05	28.56	0.61
215-14	21.59	22.10	0.51	SM	9.94	0.17	2.95	1.97	0.55	0.06	0.33	0.05	28.75	0.68
215-15	22.10	22.50	0.40	PDM	7.88	0.06	2.51	1.66	0.44	0.06	0.28	0.05	31.10	0.62
215-16	22.50	22.90	0.40	PDM	7.24	0.45	5.25	1.47	0.86	0.08	0.25	0.08	30.45	0.56
215-17	22.90	23.30	0.40	PDM	6.12	0.21	2.40	1.22	0.37	0.06	0.22	0.04	32.68	0.51
215-18	23.30	23.68	0.38	UTF	5.65	0.06	1.61	1.22	0.30	0.03	0.20	0.03	33.68	0.49
215-19	23.68	24.05	0.37	UTF	4.50	0.06	0.96	1.03	0.21	0.01	0.17	0.03	35.00	0.45
215-20	24.05	24.53	0.48	LTF	2.03	0.09	0.89	0.60	0.10	0.01	0.10	0.02	33.45	0.21
215-21	24.53	25.00	0.47	LTF	0.91	0.05	0.30	0.41	0.04	0.01	0.06	0.02	36.98	0.15
215-22	25.00	25.52	0.52	TC	0.75	0.03	0.29	0.36	0.03	0.01	0.05	0.02	37.87	0.13
215-23	25.52	26.04	0.52	TC	0.70	0.01	0.24	0.39	0.05	0.01	0.03	0.02	36.95	0.14
215-24	26.04	26.56	0.52	TC	0.71	0.03	0.32	0.36	0.04	0.01	0.03	0.02	37.30	0.16
215-25	26.56	27.08	0.52	TC	0.75	0.02	0.22	0.39	0.03	0.01	0.05	0.01	38.40	0.14
215-26	27.08	27.60	0.52	TC	0.82	0.03	0.24	0.42	0.05	0.01	0.03	0.02	37.26	0.11
215-27	27.60	28.12	0.52	TC	0.70	0.03	0.23	0.39	0.02	0.01	0.03	0.02	37.57	0.11
215-28	28.12	28.65	0.53	TC	0.73	0.03	0.27	0.37	0.04	0.01	0.05	0.02	38.42	0.14
215-29	28.65	29.20	0.55	UTF	1.98	0.06	0.92	0.57	0.10	0.01	0.08	0.02	37.03	0.30
215-30	29.20	29.75	0.55	LTF	0.84	0.03	0.53	0.36	0.03	0.01	0.03	0.02	36.95	0.32

Table E.2

Primary Elements

Sample #	From (m)	To (m)	Interval	Facies	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
215-31	29.75	30.30	0.55	LTF	2.06	0.06	0.58	0.61	0.11	0.01	0.08	0.02	36.49	0.27
215-32	30.30	30.85	0.55	LTF	0.92	0.03	0.38	0.39	0.03	0.01	0.06	0.02	37.14	0.26
215-33	30.85	31.40	0.55	LTF	1.33	0.03	0.65	0.45	0.06	0.01	0.06	0.02	37.00	0.25
215-34	31.40	32.10	0.70	SID	1.06	2.08	12.45	0.36	1.80	0.11	0.06	0.02	26.37	0.17
215-35	32.10	32.63	0.53	LTF	2.44	0.18	1.39	0.66	0.19	0.03	0.09	0.03	36.10	0.33
215-36	32.63	33.16	0.53	LTF	2.07	0.05	0.72	0.61	0.10	0.01	0.09	0.02	37.02	0.30
215-37	33.16	33.70	0.54	LTF	2.86	0.17	1.51	0.73	0.26	0.04	0.11	0.02	36.20	0.35
215-38	33.70	34.21	0.51	UTF	2.13	0.04	0.70	0.61	0.09	0.03	0.11	0.02	36.69	0.33
215-39	34.21	34.73	0.52	UTF	3.50	0.15	1.51	0.86	0.25	0.04	0.14	0.03	35.00	0.38
215-40	34.73	35.24	0.51	UTF	3.87	0.06	1.23	0.95	0.21	0.04	0.16	0.02	35.00	0.38
215-41	35.24	35.76	0.52	UTF	4.10	0.08	1.08	0.98	0.24	0.04	0.21	0.07	36.15	0.40
215-42	35.76	36.27	0.51	UTF	4.07	0.10	1.59	0.96	0.28	0.04	0.17	0.02	36.03	0.42
215-43	36.27	36.79	0.52	UTF	2.65	4.27	1.92	0.67	0.49	0.04	0.14	0.03	31.95	0.29
215-44	36.79	37.30	0.51	UTF	4.68	0.08	1.41	1.16	0.28	0.04	0.20	0.03	35.60	0.46
215-45	37.30	37.80	0.50	UTF	3.71	0.10	1.15	0.96	0.20	0.04	0.17	0.02	36.52	0.42
215-46	37.80	38.30	0.50	UTF	4.09	0.06	1.12	0.98	0.23	0.04	0.19	0.03	36.41	0.44
215-47	38.30	38.90	0.60	UTF	6.16	0.13	1.71	1.35	0.33	0.06	0.28	0.03	33.57	0.55
215-48	38.90	39.39	0.49	UTF	4.72	0.35	2.27	1.17	0.44	0.05	0.24	0.03	33.17	0.48
215-49	39.39	40.00	0.61	UTF	6.47	0.09	1.75	1.38	0.38	0.04	0.25	0.03	32.74	0.50
215-50	40.00	40.43	0.43	ICH	1.04	0.11	0.53	0.47	0.10	0.01	0.13	0.02	37.74	0.21
215-51	40.43	40.86	0.43	ICH	2.13	0.06	0.53	0.75	0.09	0.01	0.16	0.03	36.78	0.21
215-52	40.86	41.30	0.44	UTF	1.23	0.05	0.37	0.55	0.06	0.01	0.08	0.02	36.21	0.14
215-53	41.30	41.87	0.57	UTF	4.43	0.18	1.18	1.20	0.28	0.03	0.30	0.02	36.30	0.38
215-54	41.87	42.43	0.56	UTF	2.66	0.08	0.88	0.80	0.18	0.03	0.19	0.02	36.88	0.28
215-55	42.43	43.00	0.57	UTF	4.63	0.08	1.10	1.17	0.26	0.03	0.21	0.03	36.52	0.39
215-56	43.00	43.50	0.50	TC	0.87	0.01	0.26	0.45	0.05	0.01	0.05	0.04	37.69	0.16
215-57	43.50	44.00	0.50	TC	0.66	0.01	0.20	0.39	0.04	0.01	0.05	0.01	37.72	0.13
215-58	44.00	44.50	0.50	TC	0.72	0.05	0.22	0.39	0.05	0.01	0.06	0.01	37.73	0.14
215-59	44.50	45.00	0.50	TC	0.74	0.04	0.21	0.40	0.05	0.01	0.05	0.01	38.74	0.15
215-60	45.00	45.52	0.52	CB	3.15	0.05	0.73	0.83	0.16	0.03	0.15	0.02	37.03	0.29
215-61	45.52	46.00	0.48	CB	1.82	0.04	0.51	0.61	0.08	0.03	0.10	0.02	37.01	0.19
215-62	46.00	46.52	0.52	PDM	7.56	0.46	7.88	1.72	0.74	0.16	0.28	0.08	26.54	0.58
215-63	46.52	47.03	0.51	PDM	8.68	0.23	3.81	2.12	0.51	0.09	0.32	0.07	30.00	0.64
215-64	47.03	47.55	0.52	PDM	8.06	0.20	3.30	1.94	0.53	0.08	0.32	0.03	30.91	0.64

Table E.2

					Primary Elements									
Sample #	From (m)	To (m)	Interval	Facies	Al	Ca	Fe	K	Mg	Mn	Na	P	Si	Ti
215-65	47.55	48.06	0.51	PDM	7.75	0.26	3.33	1.82	0.64	0.08	0.29	0.03	31.16	0.63
215-66	48.06	48.58	0.52	PDM	6.77	0.32	5.19	1.58	0.50	0.12	0.28	0.05	30.33	0.58
215-67	48.58	49.09	0.51	PDM	6.02	0.54	8.15	1.39	0.93	0.12	0.23	0.06	27.39	0.51
215-68	49.09	49.61	0.52	PDM	6.65	0.19	2.73	1.58	0.40	0.07	0.27	0.05	33.07	0.58
215-69	49.61	50.12	0.51	PDM	6.76	0.33	2.48	1.60	0.41	0.07	0.27	0.05	34.39	0.59
215-70	50.12	50.64	0.52	PDM	6.15	0.14	2.23	1.39	0.31	0.05	0.24	0.05	34.39	0.52
215-71	50.64	51.15	0.51	PDM	5.37	0.19	2.58	1.29	0.31	0.05	0.24	0.05	34.59	0.49
215-72	51.15	51.67	0.52	PDM	5.24	0.05	1.75	1.26	0.26	0.04	0.23	0.03	35.89	0.49
215-73	51.67	52.18	0.51	PDM	4.82	0.32	2.04	1.03	0.30	0.05	0.25	0.05	35.30	0.49
215-74	52.18	52.70	0.52	PDM	5.31	0.18	1.74	1.07	0.30	0.04	0.18	0.03	34.88	0.53
215-75	52.70	53.24	0.54	UTF	3.94	0.22	1.88	0.86	0.27	0.13	0.16	0.03	35.99	0.45
215-76	53.24	53.81	0.57	UTF	3.77	0.07	1.62	0.83	0.20	0.05	0.14	0.02	36.28	0.42
215-77	53.81	54.29	0.48	UTF	3.68	0.07	1.56	0.77	0.20	0.05	0.12	0.03	36.11	0.40
215-78	54.29	54.81	0.52	UTF	3.57	0.18	1.69	0.79	0.21	0.05	0.11	0.03	35.74	0.42
215-79	54.81	55.33	0.52	UTF	4.36	0.08	1.62	0.94	0.24	0.04	0.17	0.03	36.18	0.49
215-80	55.33	55.80	0.47	UTF	4.05	0.04	1.17	0.87	0.20	0.03	0.14	0.02	36.96	0.46
215-81	55.80	56.32	0.52	OV	7.83	0.28	4.29	1.19	0.52	0.05	0.22	0.05	29.84	0.64
215-82	56.32	56.85	0.53	OV	8.03	0.28	3.17	1.48	0.65	0.04	0.35	0.07	30.46	0.70
215-83	56.85	57.37	0.52	OV	10.27	0.38	1.95	1.97	0.78	0.02	0.43	0.02	28.92	0.84
215-84	57.37	57.90	0.53	OV	7.28	0.21	1.19	1.29	0.49	0.01	0.33	0.03	29.99	0.84
215-85	57.90	58.45	0.55	CS	0.76	0.09	0.46	0.06	0.05	0.01	0.37	0.02	39.09	0.31
215-86	58.45	59.00	0.55	CS	1.56	0.03	0.33	0.15	0.08	0.01	0.11	0.02	40.01	0.39
215-87	59.00	59.50	0.50	COAL	1.68	0.83	1.82	0.03	0.26	0.01	0.63	0.13	6.67	0.60
215-88	59.50	60.00	0.50	FC (O+W)	0.18	0.04	0.34	0.03	0.02	0.01	0.07	0.02	41.85	0.36
215-89	60.00	60.50	0.50	FC (O+W)	0.70	0.03	0.55	0.15	0.04	0.01	0.05	0.02	40.73	0.22
215-90	60.50	61.00	0.50	FC (O+W)	0.24	0.01	0.39	0.03	0.03	0.01	0.03	0.02	39.54	0.06
215-91	61.00	61.50	0.50	CS	2.36	0.10	1.03	0.06	0.04	0.01	0.20	0.01	35.22	0.52
215-92	61.50	62.00	0.50	CS	2.17	0.06	0.48	0.03	0.03	0.01	0.10	0.02	40.79	0.54
215-93	62.00	62.47	0.47	FCWS	3.61	0.09	0.37	0.24	0.10	0.01	0.19	0.06	40.71	0.25
215-94	62.47	62.95	0.48	FCWS	1.80	0.22	0.52	0.06	0.12	0.03	0.09	0.02	42.15	0.07
215-95	62.95	63.42	0.47	FCWS	1.94	0.04	0.45	0.08	0.03	0.00	0.11	0.03	41.11	0.07
215-96	63.42	63.90	0.48	FCWS	1.78	0.03	0.44	0.10	0.02	0.00	0.10	0.07	41.21	0.07
215-97	63.9	64.3	0.40	Siltstone	0.15	0.03	0.29	0.03	0.02	0.00	0.03	0.02	43.80	0.54

									Table E.2													
									Analytical Data													
				Rare Earths												Trace Elements						
Test Lab				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Unit of Measurement				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Sample #	From (m)	To (m)	Facies	Ce	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb	Bi	Br	Cd	Hg	Ir	Sb	Ta
215-1	14.85	15.14	LTF	81	1.29	5.0	36.6	0.51	34	7.8	5.8	0.9	9.9	3.0	3.47	<5	<0.5	<0.5	<1	<0.001	0.5	1.0
215-2	15.14	15.76	LTF	52	0.84	4.1	23.6	0.41	21	5.0	3.7	0.7	6.3	2.1	2.65	<5	<0.5	<0.5	<1	<0.001	0.3	0.8
215-3	15.76	16.28	LTF	72	1.24	5.0	33.0	0.55	32	7.0	5.1	0.9	9.5	2.9	3.78	<5	<0.5	<0.5	<1	<0.001	0.4	1.4
215-4	16.28	16.75	LTF	66	1.06	5.0	30.2	0.55	26	5.7	4.9	0.9	8.1	2.6	3.62	<5	<0.5	<0.5	<1	<0.001	0.3	0.8
215-5	16.75	17.30	LTF	72	1.11	4.9	32.2	0.54	31	6.8	5.1	1.0	8.5	2.7	3.47	<5	<0.5	<0.5	<1	<0.001	0.4	0.9
215-6	17.30	17.90	UTF	83	1.34	6.3	36.3	0.55	37	9.1	5.5	1.0	11	2.9	3.86	<5	<0.5	<0.5	<1	<0.001	0.5	1.1
215-7	17.90	18.50	UTF	80	1.29	5.1	35.0	0.54	33	8.6	5.3	0.9	10	3.0	3.76	<5	<0.5	<0.5	<1	<0.001	0.5	0.9
215-8	18.50	19.10	LTF	59	0.96	4.1	25.4	0.39	23	4.7	3.7	0.7	7.1	2.3	2.59	<5	<0.5	<0.5	<1	<0.001	0.4	0.5
215-9	19.10	19.41	SM	40	0.68	2.6	19.1	0.28	17	9.3	2.7	0.5	6.1	1.5	1.95	<5	<0.5	<0.5	<1	<0.001	0.3	0.7
215-10	19.41	19.96	SM	99	1.70	7.0	46.8	0.54	42	17.0	7	1.2	15	3.8	3.94	<5	<0.5	<0.5	<1	<0.001	0.7	1.3
215-11	19.96	20.51	SM	98	1.67	5.8	45.9	0.54	42	15.0	6.8	1.1	13	3.5	3.94	<5	<0.5	<0.5	<1	<0.001	0.7	1.1
215-12	20.51	21.05	SM	98	1.65	6.5	45.1	0.55	38	16.0	6.5	1.2	14	3.6	4.01	<5	0.6	<0.5	<1	<0.001	0.7	1.4
215-13	21.05	21.59	SM	92	1.54	7.0	42.1	0.54	39	20.0	6.3	1.2	14	3.2	3.95	<5	<0.5	<0.5	<1	<0.001	0.6	1.3
215-14	21.59	22.10	SM	101	1.68	5.8	46.1	0.51	38	17.0	6.7	1.1	14	3.5	3.82	<5	<0.5	<0.5	<1	<0.001	0.7	1.4
215-15	22.10	22.50	PDM	90	1.48	5.6	41.6	0.51	40	14.0	6.3	1.0	13	3.3	3.83	<5	<0.5	<0.5	<1	<0.001	0.7	1.5
215-16	22.50	22.90	PDM	86	1.45	5.3	39.0	0.54	36	13.0	5.7	1.0	13	3.2	3.92	<5	<0.5	<0.5	<1	<0.001	0.6	1.3
215-17	22.90	23.30	PDM	83	1.38	4.3	37.4	0.49	32	16.0	5.6	1.0	12	3.1	3.66	<5	<0.5	<0.5	<1	<0.001	0.5	1.3
215-18	23.30	23.68	UTF	72	1.14	4.4	32.6	0.45	31	9.1	4.9	0.8	10	2.7	3.13	<5	<0.5	<0.5	<1	<0.001	0.4	0.9
215-19	23.68	24.05	UTF	77	1.17	4.0	35.5	0.52	32	7.4	5	0.9	11	3.1	3.49	<5	<0.5	<0.5	<1	<0.001	0.4	0.9
215-20	24.05	24.53	LTF	60	1.30	4.7	32.5	0.30	32	4.1	5.5	0.7	8.7	1.9	2.08	<5	<0.5	<0.5	<1	<0.001	0.4	0.4
215-21	24.53	25.00	LTF	23	0.39	1.0	9.6	0.10	9	1.1	1.3	0.2	2.3	0.7	0.68	<5	<0.5	<0.5	<1	<0.001	0.2	0.3
215-22	25.00	25.52	TC	24	0.35	1.0	9.9	0.12	10	1.2	1.4	0.2	3.2	0.8	0.73	<5	<0.5	<0.5	<1	<0.001	0.2	0.3
215-23	25.52	26.04	TC	33	0.40	1.7	15.5	0.23	15	1.0	2.3	0.3	5.1	1.1	1.43	<5	<0.5	<0.5	<1	<0.001	0.1	0.4
215-24	26.04	26.56	TC	31	0.43	1.7	13.7	0.14	14	1.1	2.1	0.3	3.6	0.8	0.86	<5	<0.5	<0.5	<1	<0.001	<0.1	<0.3
215-25	26.56	27.08	TC	18	0.31	1.0	7.9	0.12	7	0.9	1.3	0.2	2.2	0.5	0.7	<5	<0.5	<0.5	<1	<0.001	0.1	0.3
215-26	27.08	27.60	TC	23	0.39	1.0	10.4	0.13	11	1.3	1.6	0.2	3	0.7	0.78	<5	<0.5	<0.5	<1	<0.001	0.1	<0.3
215-27	27.60	28.12	TC	17	0.27	1.0	7.7	0.09	7	0.8	1.2	0.2	1.8	0.5	0.53	<5	<0.5	<0.5	<1	<0.001	0.1	0.3
215-28	28.12	28.65	TC	54	0.46	3.0	27.1	0.22	21	1.3	3.6	0.5	10	1.4	1.38	<5	<0.5	<0.5	<1	<0.001	0.1	0.3
215-29	28.65	29.20	UTF	48	0.74	3.0	22.1	0.34	22	3.3	3.6	0.5	6.1	1.6	2.15	<5	<0.5	<0.5	<1	<0.001	0.3	0.4
215-30	29.20	29.75	LTF	55	0.69	3.0	26.3	0.41	25	2.3	3.9	0.5	7.9	1.8	2.53	<5	<0.5	<0.5	<1	<0.001	0.2	<0.3

									Table E.2													
									Rare Earths									Trace Elements				
Sample	)	To (m)	Facies	Ce	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb	Bi	Br	Cd	Hg	Ir	Sb	Ta
215-31	29.75	30.30	LTF	55	0.81	3.3	25.5	0.34	21	3.8	3.9	0.6	7.5	1.8	2.22	<5	<0.5	<0.5	<1	<0.001	0.2	0.6
215-32	30.30	30.85	LTF	47	0.64	3.1	22.4	0.40	22	1.9	3.4	0.5	6.3	1.9	2.48	<5	<0.5	<0.5	<1	<0.001	0.2	0.7
215-33	30.85	31.40	LTF	43	0.67	2.6	19.0	0.30	20	2.6	3.2	0.4	5.2	1.4	1.73	<5	<0.5	<0.5	<1	<0.001	0.2	0.3
215-34	31.40	32.10	SID	31	0.52	2.0	14.1	0.21	14	3.1	2.3	0.3	3.8	1.1	1.39	<5	<0.5	<0.5	<1	<0.001	0.2	<0.3
215-35	32.10	32.63	LTF	58	0.90	4.0	27.0	0.42	22	4.8	4.2	0.7	7.4	1.9	2.68	<5	<0.5	<0.5	<1	<0.001	0.3	0.7
215-36	32.63	33.16	LTF	49	0.74	2.7	22.6	0.35	20	3.4	3.6	0.5	6.1	1.7	2.24	<5	<0.5	<0.5	<1	<0.001	0.3	0.8
215-37	33.16	33.70	LTF	58	0.94	4.0	26.9	0.42	28	6.2	4.3	0.7	7.7	2.0	2.63	<5	<0.5	<0.5	<1	<0.001	0.3	0.9
215-38	33.70	34.21	UTF	59	0.83	3.5	27.0	0.42	27	3.4	4.2	0.6	7.7	2.1	2.6	<5	<0.5	<0.5	<1	<0.001	0.3	0.6
215-39	34.21	34.73	UTF	68	1.07	5.3	31.4	0.46	28	6.6	5	0.8	9.6	2.3	3	<5	<0.5	<0.5	<1	<0.001	0.4	0.8
215-40	34.73	35.24	UTF	59	0.96	4.0	27.2	0.41	25	6.0	4.4	0.7	7.8	2.0	2.72	<5	<0.5	0.4	<1	<0.001	0.4	0.8
215-41	35.24	35.76	UTF	65	1.03	4.6	29.9	0.44	30	5.9	4.9	0.7	8.4	2.3	2.92	<5	<0.5	<0.5	<1	<0.001	0.4	0.7
215-42	35.76	36.27	UTF	76	1.14	4.3	36.2	0.51	35	7.1	5.8	0.9	11	2.7	3.56	<5	<0.5	<0.5	<1	<0.001	0.5	1.1
215-43	36.27	36.79	UTF	52	0.88	3.7	24.3	0.37	24	6.4	4	0.7	7.1	1.6	2.47	<5	<0.5	<0.5	<1	<0.001	0.3	0.8
215-44	36.79	37.30	UTF	85	1.23	5.3	39.7	0.56	38	7.4	6.2	0.9	12	2.9	3.6	<5	<0.5	<0.5	<1	<0.001	0.4	0.9
215-45	37.30	37.80	UTF	75	1.14	5.3	34.9	0.52	34	6.1	5.6	0.9	9.8	2.5	3.47	<5	<0.5	<0.5	<1	<0.001	0.4	0.7
215-46	37.80	38.30	UTF	86	1.25	6.0	40.4	0.60	40	6.5	6.5	0.9	12	2.6	3.78	<5	<0.5	0.5	<1	<0.001	0.4	1.0
215-47	38.30	38.90	UTF	88	1.39	6.0	40.3	0.60	35	9.7	6.6	1.1	12	3.0	3.85	<5	<0.5	<0.5	<1	<0.001	0.5	1.2
215-48	38.90	39.39	UTF	90	1.38	6.6	42.5	0.63	41	11.0	6.6	1.0	12	3.1	4.06	<5	<0.5	<0.5	<1	<0.001	1.2	0.8
215-49	39.39	40.00	UTF	81	1.39	6.0	37.3	0.53	38	10.0	6.3	1.1	11	2.4	3.43	<5	<0.5	<0.5	<1	<0.001	0.4	1.1
215-50	40.00	40.43	ICH	15	0.25	1.0	6.6	0.14	7	1.3	1.1	0.2	2	0.6	0.83	<5	<0.5	<0.5	<1	<0.001	<0.1	<0.3
215-51	40.43	40.86	ICH	17	0.28	1.0	7.9	0.11	7	1.3	1.2	0.2	1.9	0.5	0.72	<5	<0.5	<0.5	<1	<0.001	0.1	0.3
215-52	40.86	41.30	UTF	20	0.35	1.1	8.6	0.12	8	1.8	1.5	0.2	2.1	0.7	0.72	<5	<0.5	<0.5	<1	<0.001	0.2	<0.3
215-53	41.30	41.87	UTF	56	0.97		27.6	0.35	24	6.1	4.2	0.7	8	2.4	2.5	<5	<0.5	0.5	<1	<0.001	0.4	0.7
215-54	41.87	42.43	UTF	44	0.72		21.2	0.32	20	4.8	3.2	0.6	6.5	2.0	2.12	<5	<0.5	<0.5	<1	<0.001	0.3	0.7
215-55	42.43	43.00	UTF	59	0.99		29.1	0.37	25	6.6	4.5	0.8	8.7	2.6	2.6	<5	<0.5	<0.5	<1	<0.001	0.4	0.9
215-56	43.00	43.50	TC	28	0.35		14.3	0.19	13	1.3	1.9	0.3	4.1	1.1	1.19	<5	<0.5	<0.5	<1	<0.001	0.1	<0.3
215-57	43.50	44.00	TC	24	0.30		11.9	0.16	10	1.3	1.6	0.2	3.2	1.0	1	<5	<0.5	<0.5	<1	<0.001	0.1	0.4
215-58	44.00	44.50	TC	27	0.37		13.4	0.14	12	1.2	1.8	0.3	4.2	1.1	1.01	<5	<0.5	<0.5	<1	<0.001	0.1	<0.3
215-59	44.50	45.00	TC	25	0.32		12.3	0.16	11	1.3	1.6	0.3	3.9	1.0	1.07	<5	<0.5	<0.5	<1	<0.001	0.2	0.4
215-60	45.00	45.52	CB	37	0.62		18.4	0.25	16	4.0	2.8	0.5	5.6	1.7	1.66	<5	<0.5	<0.5	<1	<0.001	0.3	0.6
215-61	45.52	46.00	CB	31	0.51		15.4	0.21	14	2.9	2.3	0.4	5	1.3	1.44	<5	<0.5	<0.5	<1	<0.001	0.3	0.5
215-62	46.00	46.52	PDM	80	1.50		40.8	0.48	33	13.0	6.6	1.1	12	3.3	3.65	<5	<0.5	<0.5	<1	<0.001	0.6	1.1
215-63	46.52	47.03	PDM	92	1.65		45.9	0.54	43	15.0	7.5	1.2	14	3.5	3.99	<5	<0.5	<0.5	<1	<0.001	0.7	1.2
215-64	47.03	47.55	PDM	91	1.51		44.3	0.51	41	15.0	7.3	1.2	13	3.6	3.9	<5	<0.5	0.5	<1	<0.001	0.6	1.1

									Table E.2													
									Rare Earths										Trace Elements			
Sample	)	To (m)	Facies	Ce	Eu	Gd	La	Lu	Nd	Sc	Sm	Tb	Th	U	Yb	Bi	Br	Cd	Hg	Ir	Sb	Ta
215-65	47.55	48.06	PDM	90	1.60		45.0	0.54	43	14.0	7.1	1.3	14	3.8	4.07	<5	<0.5	0.5	<1	<0.001	0.7	1.3
215-66	48.06	48.58	PDM	81	1.42		39.9	0.53	38	14.0	6.4	1.1	12	3.3	3.89	<5	<0.5	0.6	<1	<0.001	0.7	1.2
215-67	48.58	49.09	PDM	72	1.25		35.3	0.47	33	14.0	5.7	1.1	11	3.1	3.47	<5	<0.5	0.5	<1	<0.001	0.5	1.0
215-68	49.09	49.61	PDM	75	1.40		39.5	0.50	37	11.0	6.3	1.1	12	3.4	3.75	<5	<0.5	0.5	<1	<0.001	0.6	1.2
215-69	49.61	50.12	PDM	80	1.40		40.0	0.50	37	12.0	6.3	1.1	12	3.7	3.83	<5	<0.5	0.5	<1	<0.001	0.6	1.3
215-70	50.12	50.64	PDM	73	1.20		36.7	0.47	35	10.0	5.6	0.9	12	3.2	3.34	<5	<0.5	<0.5	<1	<0.001	0.5	1.0
215-71	50.64	51.15	PDM	68	1.14		34.5	0.49	31	10.0	5.3	0.9	11	3.5	3.54	<5	<0.5	<0.5	<1	<0.001	0.5	1.1
215-72	51.15	51.67	PDM	66	1.12		34.3	0.46	32	9.0	5.2	0.9	11	3.2	3.38	<5	<0.5	<0.5	<1	<0.001	0.5	1.0
215-73	51.67	52.18	PDM	70	1.17		35.6	0.49	34	9.0	5.4	1.0	11	3.4	3.45	<5	<0.5	0.7	<1	<0.001	0.5	1.2
215-74	52.18	52.70	PDM	73	1.17		37.2	0.48	34	10.0	5.4	1.0	12	3.4	3.46	<5	<0.5	<0.5	<1	<0.001	0.5	1.1
215-75	52.70	53.24	UTF	61	1.02		29.8	0.47	28	7.1	4.7	0.7	8.9	2.5	2.97	<5	0.6	0.5	<1	<0.001	0.4	1.1
215-76	53.24	53.81	UTF	61	0.97		29.6	0.43	24	6.9	4.7	0.7	8.9	2.4	2.75	<5	<0.5	0.5	<1	<0.001	0.4	1.0
215-77	53.81	54.29	·UTF	59	0.95		28.0	0.41	22	6.7	4.5	0.7	8.3	2.2	2.71	<5	<0.5	0.6	<1	<0.001	0.4	0.9
215-78	54.29	54.81	UTF	59	0.96		28.3	0.44	28	6.7	4.5	0.7	8.3	2.2	2.76	<5	<0.5	0.6	<1	<0.001	0.5	0.9
215-79	54.81	55.33	UTF	67	1.12		32.5	0.49	30	8.0	5.1	0.8	9.8	2.5	3.25	<5	<0.5	0.6	<1	<0.001	0.5	1.0
215-80	55.33	55.80	UTF	66	1.07		31.8	0.47	30	7.6	5	0.9	9.3	2.5	3.16	<5	<0.5	0.6	<1	<0.001	0.4	0.8
215-81	55.80	56.32	OV	81	1.36		41.2	0.51	37	13.0	6.2	0.9	13	2.8	3.3	<5	<0.5	0.9	<1	<0.001	0.6	1.0
215-82	56.32	56.85	OV	76	1.18		39.2	0.48	31	13.0	5.3	0.9	13	3.1	3.14	<5	<0.5	0.9	<1	<0.001	0.6	1.0
215-83	56.85	57.37	OV	76	1.12		40.3	0.47	31	14.0	5.2	0.8	13	3.2	3.16	<5	<0.5	0.9	<1	<0.001	0.8	1.7
215-84	57.37	57.90	OV	70	1.09		37.4	0.56	30	13.0	4.6	0.8	12	3.7	3.58	<5	1.0	0.6	<1	<0.001	0.6	2.0
215-85	57.90	58.45	CS	13	0.20		6.7	0.20	5	2.1	0.9	0.2	3.1	1.1	1.2	<5	0.9	<0.5	<1	<0.001	0.2	0.7
215-86	58.45	59.00	CS	19	0.32		9.6	0.23	7	2.9	1.2	0.3	4	1.5	1.49	6.0	0.6	0.6	<1	<0.001	0.2	0.9
215-87	59.00	59.50	COAL	47	0.55		27.8	0.23	16	7.2	2.6	0.5	6.8	2.3	1.49	<5	0.9	0.6	<1	<0.001	0.4	0.9
215-88	59.50	60.00	C (O+W	10	0.20		5.1	0.18	4	1.3	0.6	0.2	2.4	1.2	1.14	<5	<0.5	<0.5	<1	<0.001	0.2	0.7
215-89	60.00	60.50	C (O+W	10	0.16		4.9	0.15	4	1.2	0.7	0.2	2.2	0.9	0.91	<5	<0.5	<0.5	<1	<0.001	0.1	0.4
215-90	60.50	61.00	C (O+W	6	0.10		2.8	0.04	2	0.6	0.4	<0.1	1.1	0.5	0.25	<5	<0.5	<0.5	<1	<0.001	<0.1	<0.3
215-91	61.00	61.50	CS	42	0.83		18.6	0.31	20	7.9	3.6	0.7	5.6	6.2	2.02	<5	0.9	<0.5	<1	<0.001	0.5	1.0
215-92	61.50	62.00	CS	41	0.83		17.0	0.38	18	5.6	3.6	0.7	7.1	6.8	2.31	<5	<0.5	<0.5	<1	<0.001	0.4	1.1
215-93	62.00	62.47	FCWS	35	0.38		22.3	0.18	14	4.5	2	0.3	6.7	3.1	1.17	<5	0.8	<0.5	<1	<0.001	0.2	0.8
215-94	62.47	62.95	FCWS	36	0.27		21.5	0.05	11	1.8	1.4	0.2	2.7	1.0	0.33	<5	0.7	<0.5	<1	<0.001	0.1	0.3
215-95	62.95	63.42	FCWS	45	0.38		21.6	0.04	16	2.0	2	0.3	3.4	1.1	0.34	<5	1.1	<0.5	<1	<0.001	0.2	<0.3
215-96	63.42	63.90	FCWS	27	0.30		11.3	0.05	9	2.6	1.6	0.2	3.5	1.3	0.33	<5	0.8	<0.5	<1	<0.001	0.1	0.4
215-97	63.9	64.3	Siltstone	13	0.25		7.3	0.29	4	1.9	0.8	0.3	3.2	1.7	1.88	<5	<0.5	<0.5	<1	<0.001	0.3	1.2

Table E.3 Balance of Chemical Analyses
Core Hole 209

Sample #	From (m)	To (m)	Interval	Facies	Primary Elements %	Minor Elements %	Trace Elements %	Rare Earths %	Metals %	Total Solids %	Bitumen %	Silica as SiO2 %	Aluminum as Al2O3 %
209-1	28.1	28.6	0.5	TC	85.853%	.075%	.000%	.005%	.042%	86.0%	14.4%	83.2%	1.3%
209-2	28.6	29.1	0.5	TC	86.771%	.041%	.000%	.004%	.042%	86.9%	14.8%	84.3%	1.4%
209-3	29.1	29.6	0.5	TC	80.024%	.038%	.000%	.005%	.051%	80.1%	14.8%	77.8%	1.3%
209-4	29.6	30.1	0.5	TC	80.930%	.037%	.000%	.005%	.053%	81.0%	15.1%	78.7%	1.3%
209-5	30.1	30.6	0.5	TC	80.301%	.037%	.000%	.006%	.049%	80.4%	14.7%	78.2%	1.3%
209-6	30.6	31.1	0.5	TC	82.420%	.043%	.000%	.005%	.052%	82.5%	14.6%	80.0%	1.4%
209-7	31.1	31.6	0.5	TC	90.614%	.044%	.000%	.005%	.061%	90.7%	14.6%	88.5%	1.4%
209-8	31.6	32.1	0.5	TC	89.556%	.058%	.000%	.007%	.068%	89.7%	12.5%	86.4%	2.0%
209-9	32.1	32.6	0.5	TC	91.148%	.071%	.000%	.007%	.071%	91.3%	15.2%	87.4%	2.5%
209-10	32.6	33.1	0.5	TC	90.947%	.055%	.000%	.007%	.062%	91.1%	14.9%	88.3%	1.5%
209-11	33.1	33.6	0.5	TC	89.880%	.049%	.000%	.007%	.063%	90.0%	14.3%	87.4%	1.4%
209-12	33.6	34.1	0.5	TC	90.675%	.065%	.000%	.005%	.068%	90.8%	14.5%	87.4%	2.0%
209-13	34.1	34.6	0.5	TC	91.787%	.056%	.000%	.006%	.072%	91.9%	14.4%	89.3%	1.6%
209-14	34.6	35.09	0.49	ICH	90.488%	.058%	.000%	.006%	.072%	90.6%	14.5%	87.5%	1.9%
209-15	35.09	35.58	0.49	ICH	90.784%	.069%	.000%	.005%	.069%	90.9%	9.9%	88.2%	1.5%
209-16	35.58	36.07	0.49	ICH	92.834%	.075%	.000%	.006%	.074%	93.0%	10.5%	89.4%	2.1%
209-17	36.07	36.56	0.49	ICH	89.036%	.090%	.000%	.006%	.072%	89.2%	11.3%	85.5%	2.1%
209-18	36.56	37.05	0.49	ICH	88.626%	.078%	.000%	.007%	.082%	88.8%	9.3%	84.9%	2.3%
209-19	37.05	37.54	0.49	ICH	89.289%	.088%	.000%	.007%	.073%	89.5%	14.1%	85.9%	2.0%
209-20	37.54	38.03	0.49	ICH	89.955%	.197%	.000%	.008%	.075%	90.2%	13.4%	84.6%	3.3%
209-21	38.03	38.52	0.49	ICH	90.875%	.095%	.000%	.006%	.070%	91.0%	13.3%	87.3%	2.2%
209-22	38.52	39.01	0.49	ICH	90.079%	.088%	.000%	.005%	.074%	90.2%	14.6%	87.6%	1.5%
209-23	39.01	39.5	0.49	ICH	91.504%	.096%	.000%	.005%	.074%	91.7%	13.6%	88.9%	1.4%
209-24	39.5	39.99	0.49	ICH	88.808%	.580%	.000%	.006%	.067%	89.5%	11.3%	83.3%	2.0%
209-25	39.99	40.48	0.49	ICH	88.962%	.564%	.000%	.007%	.064%	89.6%	11.4%	83.4%	2.2%
209-26	40.48	41	0.52	ICH	90.893%	.265%	.000%	.005%	.066%	91.2%	14.1%	87.4%	1.6%
209-27	41	41.57	0.57	TC	89.435%	.039%	.000%	.003%	.062%	89.5%	17.0%	88.0%	.9%
209-28	41.57	42.14	0.57	TC	90.378%	.388%	.000%	.007%	.083%	90.9%	13.9%	86.2%	1.5%
209-29	42.14	42.7	0.56	TC	89.707%	.128%	.000%	.005%	.074%	89.9%	15.0%	87.2%	1.3%
209-30	42.7	43.18	0.48	ICH	89.163%	.136%	.000%	.009%	.092%	89.4%	9.2%	83.6%	3.4%
209-31	43.18	43.66	0.48	ICH	88.774%	.124%	.000%	.008%	.094%	89.0%	12.4%	84.4%	2.6%

Table E.3 Balance of Chemical Analyses
Core Hole 209

Sample #	From (m)	To (m)	Interval	Facies	Primary Elements %	Minor Elements %	Trace Elements %	Rare Earths %	Metals %	Total Solids		Bitumen %	Silica as SiO2 %	Aluminum as Al2O3 %
209-32	43.66	44.14	0.48	ICH	87.987%	.148%	.000%	.010%	.089%	88.2%		10.3%	83.2%	3.0%
209-33	44.14	44.62	0.48	ICH	88.289%	.186%	.000%	.005%	.075%	88.6%		12.6%	84.2%	2.1%
209-34	44.62	45.1	0.48	ICH	84.011%	.087%	.000%	.006%	.078%	84.2%		13.5%	81.4%	1.4%
209-35	45.1	45.58	0.48	ICH	85.426%	.074%	.000%	.004%	.069%	85.6%		16.1%	83.6%	1.1%
209-36	45.58	46.06	0.48	ICH	86.821%	.148%	.000%	.007%	.077%	87.1%		12.3%	83.4%	1.9%
209-37	46.06	46.54	0.48	ICH	85.313%	.150%	.000%	.007%	.083%	85.6%		13.0%	81.2%	2.4%
209-38	46.54	47	0.462	ICH	85.885%	.101%	.000%	.006%	.080%	86.1%		12.5%	82.5%	2.3%
209-39	47	47.5	0.498	ICH	85.880%	.158%	.000%	.006%	.070%	86.1%		13.6%	81.7%	2.6%
209-40	47.5	48	0.5	ICH	86.289%	.097%	.000%	.008%	.093%	86.5%		12.6%	82.2%	2.4%
209-41	48	48.53	0.53	FE	85.240%	.110%	.000%	.004%	.071%	85.4%		15.1%	83.1%	1.2%
209-42	48.53	49.06	0.53	FE	82.704%	.137%	.000%	.003%	.072%	82.9%		15.3%	80.6%	1.2%
209-43	49.06	49.6	0.54	FE	84.585%	.153%	.000%	.004%	.064%	84.8%		15.1%	83.5%	.7%
209-44	49.6	50	0.4	OV	89.265%	.871%	.000%	.021%	.114%	90.3%		4.0%	68.8%	12.6%
209-45	50	50.4	0.4	OV	89.816%	.437%	.000%	.021%	.122%	90.4%		5.7%	71.0%	13.0%
209-46	50.4	50.89	0.49	FC	85.621%	.030%	.000%	.004%	.096%	85.8%		2.8%	84.5%	.7%
209-47	50.89	51.37	0.48	FC	85.246%	.021%	.000%	.003%	.075%	85.3%		14.4%	84.3%	.5%
209-48	51.37	51.86	0.49	FC	82.828%	.038%	.000%	.003%	.071%	82.9%		13.9%	81.5%	.7%
209-49	51.86	52.34	0.48	FC	83.851%	.051%	.000%	.004%	.073%	84.0%		17.4%	82.3%	.9%
209-50	52.34	52.83	0.49	FC	85.703%	.067%	.000%	.004%	.066%	85.8%		16.6%	82.6%	1.7%
209-51	52.83	53.31	0.48	FC	84.071%	.042%	.000%	.003%	.059%	84.2%		17.5%	82.5%	.9%
209-52	53.31	53.8	0.49	FC	82.382%	.019%	.000%	.008%	.082%	82.5%		16.8%	81.4%	.5%
209-53	53.8	54.28	0.48	FC	82.590%	.036%	.000%	.006%	.094%	82.7%		15.0%	80.2%	1.4%
209-54	54.28	54.77	0.49	FC	93.584%	.050%	.000%	.006%	.079%	93.7%		16.5%	90.6%	2.0%
209-55	54.77	55.25	0.48	FC	85.028%	.047%	.000%	.005%	.082%	85.2%		16.4%	82.3%	1.7%
209-56	55.25	55.74	0.49	FC	85.565%	.053%	.000%	.005%	.084%	85.7%		17.1%	82.5%	1.9%
209-57	55.74	56.22	0.48	FC	80.571%	.065%	.000%	.005%	.086%	80.7%		16.8%	78.2%	1.5%
209-58	56.22	56.71	0.49	FC	81.741%	.051%	.000%	.007%	.084%	81.9%		15.9%	79.4%	1.4%
209-59	56.71	57.2	0.49	FC	81.311%	.040%	.000%	.006%	.087%	81.4%		15.5%	80.0%	.7%
209-60	57.2	57.65	0.45	DMM	88.789%	.356%	.000%	.016%	.115%	89.3%		Not	69.9%	13.1%
209-61	57.65	58.1	0.45	DMM	88.368%	.192%	.000%	.014%	.114%	88.7%		Saturated	70.9%	12.5%
209-62	58.1	58.55	0.45	DMM	89.176%	.331%	.000%	.018%	.121%	89.6%		With	67.6%	15.5%
209-63	58.55	59	0.45	DMM	87.357%	.326%	.000%	.017%	.118%	87.8%		Bitumen	67.2%	14.3%
209-64	59	59.5	0.5	COAL	78.870%	.458%	.000%	.015%	.124%	79.5%		Below	57.0%	15.0%
209-65	59.5	60	0.5	CS	85.693%	.354%	.000%	.010%	.115%	86.2%		This	78.1%	4.0%
209-66	60	60.5	0.5	COAL	75.616%	.555%	.000%	.012%	.119%	76.3%		Depth	62.8%	7.7%
209-67	60.5	61	0.5	CS	90.844%	.532%	.000%	.011%	.100%	91.5%		.0%	79.7%	7.3%
209-68	61	61.4	0.4	DMM	81.882%	1.060%	.000%	.019%	.122%	83.1%		.0%	57.9%	15.8%

Table E.3 Balance of Chemical Analyses
Core Hole 209

Sample #	From (m)	To (m)	Interval	Facies	Primary Elements %	Minor Elements %	Trace Elements %	Rare Earths %	Metals %	Total Solids		Bitumen %	Silica as SiO2 %	Aluminum as Al2O3 %	
209-69	61.4	61.8	0.4	DMM	78.924%	.805%	.000%	.011%	.114%	79.9%		.0%	64.6%	8.6%	
209-70	61.8	62.2	0.4	CS	85.496%	.543%	.000%	.011%	.120%	86.2%		.0%	75.1%	5.4%	
209-71	62.2	62.6	0.4	CS	82.560%	.361%	.000%	.011%	.127%	83.1%		.0%	74.2%	4.9%	
209-72	62.6	63.05	0.45	DMM	85.145%	.478%	.000%	.012%	.127%	85.8%		.0%	73.5%	7.2%	
209-73	63.05	63.5	0.45	DMM	88.446%	.359%	.000%	.012%	.125%	88.9%		.0%	78.6%	6.0%	
209-74	63.5	64	0.5	CS	89.280%	.317%	.000%	.004%	.115%	89.7%		.0%	83.4%	1.6%	
209-75	64	64.5	0.5	CS	87.271%	.424%	.000%	.014%	.156%	87.9%		.0%	76.8%	6.7%	
209-76	64.5	65	0.5	CS	92.358%	.335%	.000%	.007%	.116%	92.8%		.0%	85.9%	3.8%	
209-77	65	65.47	0.47	FC	88.847%	.304%	.000%	.007%	.142%	89.3%		.0%	82.4%	3.8%	
209-78	65.47	65.95	0.48	FC	95.119%	.229%	.000%	.005%	.113%	95.5%		.0%	90.3%	2.5%	
209-79	65.95	66.42	0.47	FC	90.397%	.335%	.000%	.006%	.228%	91.0%		.0%	84.7%	3.0%	
209-80	66.42	66.9	0.48	FC	90.460%	.281%	.000%	.004%	.132%	90.9%		.0%	86.4%	2.2%	
209-81	66.9	67.37	0.47	FC	94.696%	.266%	.000%	.004%	.141%	95.1%		.0%	90.0%	1.0%	
209-82	67.37	67.85	0.48	FC	91.425%	.248%	.000%	.004%	.141%	91.8%		.0%	88.8%	.9%	
										87.4%					

Table E.4 Balance of Chemical Analysis

Core Hole 215

Sample	From	To	Interval	Facies	Primary Elements	Minor Elements	Trace Elements	Rare Earths	Metals	Precious Metals	Bitumen	Total Solids		Silica as SiO2	Aluminum as Al2O3
215-1	14.85	15.14	0.29	LTF	90.606%	.089%	.000%	.022%	.102%	.000%	1.4%	90.8%		79.2%	7.6%
215-2	15.14	15.76	0.62	LTF	85.005%	.088%	.000%	.014%	.082%	.000%	8.9%	85.2%		77.7%	4.5%
215-3	15.76	16.28	0.52	LTF	87.255%	.100%	.000%	.020%	.224%	.000%	5.4%	87.6%		77.3%	6.3%
215-4	16.28	16.75	0.47	LTF	85.349%	.083%	.000%	.018%	.180%	.000%	6.8%	85.6%		77.5%	4.8%
215-5	16.75	17.30	0.55	LTF	87.353%	.090%	.000%	.020%	.118%	.000%	3.8%	87.6%		78.5%	5.7%
215-6	17.30	17.90	0.60	UTF	91.753%	.104%	.000%	.023%	.089%	.000%	2.9%	92.0%		78.8%	8.6%
215-7	17.90	18.50	0.60	UTF	91.856%	.107%	.000%	.022%	.108%	.000%	.0%	92.1%		79.0%	8.5%
215-8	18.50	19.10	0.60	LTF	86.356%	.071%	.000%	.016%	.079%	.000%	6.5%	86.5%		79.7%	4.0%
215-9	19.10	19.41	0.31	SM	75.904%	.142%	.000%	.012%	.081%	.000%	.0%	76.1%		56.5%	14.6%
215-10	19.41	19.96	0.55	SM	90.002%	.148%	.000%	.029%	.073%	.000%	.0%	90.3%		65.6%	18.1%
215-11	19.96	20.51	0.55	SM	88.279%	.141%	.000%	.028%	.088%	.000%	.0%	88.5%		65.9%	16.0%
215-12	20.51	21.05	0.54	SM	89.122%	.140%	.000%	.028%	.084%	.000%	3.5%	89.4%		65.7%	16.7%
215-13	21.05	21.59	0.54	SM	88.870%	.133%	.000%	.028%	.083%	.000%	.0%	89.1%		61.1%	16.0%
215-14	21.59	22.10	0.51	SM	89.455%	.166%	.000%	.028%	.084%	.000%	.0%	89.7%		61.5%	18.8%
215-15	22.10	22.50	0.40	PDM	89.113%	.131%	.000%	.026%	.081%	.000%	.0%	89.4%		66.5%	14.9%
215-16	22.50	22.90	0.40	PDM	91.552%	.125%	.000%	.025%	.083%	.000%	.0%	91.8%		65.1%	13.7%
215-17	22.90	23.30	0.40	PDM	88.343%	.141%	.000%	.024%	.076%	.000%	.0%	88.6%		69.9%	11.6%
215-18	23.30	23.68	0.38	UTF	88.059%	.103%	.000%	.020%	.081%	.000%	.0%	88.3%		72.0%	10.7%
215-19	23.68	24.05	0.37	UTF	87.305%	.109%	.000%	.021%	.142%	.000%	2.7%	87.6%		74.9%	8.5%
215-20	24.05	24.53	0.48	LTF	78.103%	.071%	.000%	.020%	.073%	.000%	3.4%	78.3%		71.5%	3.8%
215-21	24.53	25.00	0.47	LTF	82.189%	.040%	.000%	.006%	.045%	.000%	5.7%	82.3%		79.1%	1.7%
215-22	25.00	25.52	0.52	TC	83.634%	.036%	.000%	.006%	.043%	.000%	14.5%	83.7%		81.0%	1.4%
215-23	25.52	26.04	0.52	TC	81.565%	.037%	.000%	.009%	.062%	.000%	14.4%	81.7%		79.0%	1.3%
215-24	26.04	26.56	0.52	TC	82.452%	.038%	.000%	.008%	.073%	.000%	14.2%	82.6%		79.8%	1.3%
215-25	26.56	27.08	0.52	TC	84.684%	.040%	.000%	.005%	.044%	.000%	14.9%	84.8%		82.1%	1.4%
215-26	27.08	27.60	0.52	TC	82.469%	.046%	.000%	.006%	.032%	.000%	14.3%	82.6%		79.7%	1.5%
215-27	27.60	28.12	0.52	TC	82.795%	.037%	.000%	.004%	.037%	.000%	13.9%	82.9%		80.4%	1.3%
215-28	28.12	28.65	0.53	TC	84.793%	.035%	.000%	.014%	.056%	.000%	13.7%	84.9%		82.2%	1.4%
215-29	28.65	29.20	0.55	UTF	85.781%	.067%	.000%	.013%	.086%	.000%	10.4%	85.9%		79.2%	3.7%
215-30	29.20	29.75	0.55	LTF	82.497%	.049%	.000%	.015%	.157%	.000%	8.6%	82.7%		79.0%	1.6%
215-31	29.75	30.30	0.55	LTF	84.309%	.074%	.000%	.015%	.072%	.000%	14.0%	84.5%		78.1%	3.9%
215-32	30.30	30.85	0.55	LTF	82.776%	.048%	.000%	.013%	.103%	.000%	9.6%	82.9%		79.4%	1.7%

Table E.4 Balance of Chemical Analysis

Core Hole 215

Sample	From	To	Interval	Facies	Primary Elements	Minor Elements	Trace Elements	Rare Earths	Metals	Precious Metals	Bitumen	Total Solids		Silica as SiO2	Aluminum as Al2O3
215-33	30.85	31.40	0.55	LTF	83.752%	.066%	.000%	.012%	.083%	.000%	13.9%	83.9%		79.1%	2.5%
215-34	31.40	32.10	0.70	SID	83.462%	.050%	.000%	.009%	.056%	.000%	10.6%	83.6%		56.4%	2.0%
215-35	32.10	32.63	0.53	LTF	85.861%	.092%	.000%	.016%	.097%	.000%	9.3%	86.1%		77.2%	4.6%
215-36	32.63	33.16	0.53	LTF	85.678%	.066%	.000%	.013%	.090%	.000%	8.0%	85.8%		79.2%	3.9%
215-37	33.16	33.70	0.54	LTF	87.260%	.082%	.000%	.017%	.086%	.000%	6.1%	87.4%		77.4%	5.4%
215-38	33.70	34.21	0.51	UTF	85.073%	.062%	.000%	.016%	.107%	.000%	6.1%	85.3%		78.5%	4.0%
215-39	34.21	34.73	0.52	UTF	86.085%	.071%	.000%	.019%	.116%	.000%	4.7%	86.3%		74.9%	6.6%
215-40	34.73	35.24	0.51	UTF	86.264%	.096%	.000%	.016%	.079%	.000%	4.7%	86.5%		74.9%	7.3%
215-41	35.24	35.76	0.52	UTF	89.216%	.086%	.000%	.018%	.085%	.000%	3.9%	89.4%		77.3%	7.7%
215-42	35.76	36.27	0.51	UTF	89.634%	.093%	.000%	.022%	.177%	.000%	4.0%	89.9%		77.1%	7.7%
215-43	36.27	36.79	0.52	UTF	84.403%	.088%	.000%	.015%	.181%	.000%	4.4%	84.7%		68.3%	5.0%
215-44	36.79	37.30	0.51	UTF	89.912%	.095%	.000%	.024%	.103%	.000%	3.5%	90.1%		76.1%	8.8%
215-45	37.30	37.80	0.50	UTF	89.213%	.091%	.000%	.021%	.119%	.000%	2.7%	89.4%		78.1%	7.0%
215-46	37.80	38.30	0.50	UTF	89.713%	.094%	.000%	.024%	.123%	.000%	3.6%	90.0%		77.9%	7.7%
215-47	38.30	38.90	0.60	UTF	89.345%	.106%	.000%	.024%	.094%	.000%	3.7%	89.6%		71.8%	11.6%
215-48	38.90	39.39	0.49	UTF	86.761%	.102%	.000%	.026%	.136%	.000%	3.5%	87.0%		71.0%	8.9%
215-49	39.39	40.00	0.61	UTF	88.209%	.110%	.000%	.023%	.078%	.000%	2.0%	88.4%		70.0%	12.2%
215-50	40.00	40.43	0.43	ICH	84.764%	.053%	.000%	.004%	.067%	.000%	12.2%	84.9%		80.7%	2.0%
215-51	40.43	40.86	0.43	ICH	85.042%	.067%	.000%	.005%	.046%	.000%	11.8%	85.2%		78.7%	4.0%
215-52	40.86	41.30	0.44	UTF	81.438%	.051%	.000%	.005%	.035%	.000%	14.0%	81.5%		77.5%	2.3%
215-53	41.30	41.87	0.57	UTF	90.640%	.087%	.000%	.016%	.026%	.000%	4.4%	90.8%		77.6%	8.4%
215-54	41.87	42.43	0.56	UTF	87.119%	.067%	.000%	.012%	.022%	.000%	10.2%	87.2%		78.9%	5.0%
215-55	42.43	43.00	0.57	UTF	91.198%	.086%	.000%	.017%	.065%	.000%	3.7%	91.4%		78.1%	8.8%
215-56	43.00	43.50	0.50	TC	83.649%	.043%	.000%	.008%	.016%	.000%	15.5%	83.7%		80.6%	1.6%
215-57	43.50	44.00	0.50	TC	83.020%	.035%	.000%	.006%	.015%	.000%	15.0%	83.1%		80.7%	1.2%
215-58	44.00	44.50	0.50	TC	83.276%	.040%	.000%	.007%	.016%	.000%	15.8%	83.3%		80.7%	1.4%
215-59	44.50	45.00	0.50	TC	85.474%	.040%	.000%	.007%	.014%	.000%	15.8%	85.5%		82.9%	1.4%
215-60	45.00	45.52	0.52	CB	88.122%	.070%	.000%	.010%	.022%	.000%	10.4%	88.2%		79.2%	6.0%
215-61	45.52	46.00	0.48	CB	84.646%	.058%	.000%	.009%	.017%	.000%	8.3%	84.7%		79.2%	3.4%
215-62	46.00	46.52	0.52	PDM	87.665%	.117%	.000%	.023%	.053%	.000%	.0%	87.9%		56.8%	14.3%
215-63	46.52	47.03	0.51	PDM	91.142%	.129%	.000%	.027%	.052%	.000%	.0%	91.4%		64.2%	16.4%
215-64	47.03	47.55	0.52	PDM	90.877%	.134%	.000%	.026%	.048%	.000%	.0%	91.1%		66.1%	15.2%
215-65	47.55	48.06	0.51	PDM	91.010%	.171%	.000%	.027%	.044%	.000%	.0%	91.3%		66.7%	14.6%

Table E.4 Balance of Chemical Analysis

Core Hole 215

Sample	From	To	Interval	Facies	Primary Elements	Minor Elements	Trace Elements	Rare Earths	Metals	Precious Metals	Bitumen	Total Solids		Silica as SiO_2	Aluminum as Al_2O_3
215-66	48.06	48.58	0.52	PDM	89.521%	.150%	.000%	.024%	.040%	.000%	.0%	89.7%		64.9%	12.8%
215-67	48.58	49.09	0.51	PDM	86.887%	.123%	.000%	.021%	.038%	.000%	.0%	87.1%		58.6%	11.4%
215-68	49.09	49.61	0.52	PDM	91.256%	.145%	.000%	.023%	.038%	.000%	.0%	91.5%		70.7%	12.6%
215-69	49.61	50.12	0.51	PDM	94.187%	.156%	.000%	.023%	.045%	.000%	.0%	94.4%		73.6%	12.8%
215-70	50.12	50.64	0.52	PDM	91.842%	.132%	.000%	.021%	.043%	.000%	.0%	92.0%		73.6%	11.6%
215-71	50.64	51.15	0.51	PDM	91.195%	.115%	.000%	.020%	.033%	.000%	.0%	91.4%		74.0%	10.1%
215-72	51.15	51.67	0.52	PDM	92.166%	.143%	.000%	.020%	.032%	.000%	.0%	92.4%		76.8%	9.9%
215-73	51.67	52.18	0.51	PDM	90.751%	.148%	.000%	.021%	.038%	.000%	.0%	91.0%		75.5%	9.1%
215-74	52.18	52.70	0.52	PDM	90.223%	.124%	.000%	.021%	.031%	.000%	.0%	90.4%		74.6%	10.0%
215-75	52.70	53.24	0.54	UTF	89.818%	.127%	.000%	.017%	.028%	.000%	Not	90.0%		77.0%	7.4%
215-76	53.24	53.81	0.57	UTF	89.287%	.120%	.000%	.017%	.028%	.000%	Bitumen	89.5%		77.6%	7.1%
215-77	53.81	54.29	0.48	UTF	88.585%	.108%	.000%	.016%	.026%	.000%	Saturated	88.7%		77.2%	7.0%
215-78	54.29	54.81	0.52	UTF	88.002%	.107%	.000%	.017%	.026%	.000%	Below	88.2%		76.4%	6.7%
215-79	54.81	55.33	0.52	UTF	90.554%	.147%	.000%	.019%	.034%	.000%	Here	90.8%		77.4%	8.2%
215-80	55.33	55.80	0.47	UTF	90.700%	.121%	.000%	.019%	.032%	.000%		90.9%		79.1%	7.7%
215-81	55.80	56.32	0.52	OV	88.803%	.137%	.000%	.024%	.041%	.000%		89.0%		63.8%	14.8%
215-82	56.32	56.85	0.53	OV	89.659%	.144%	.000%	.022%	.047%	.000%		89.9%		65.2%	15.2%
215-83	56.85	57.37	0.52	OV	89.961%	.184%	.000%	.022%	.048%	.000%		90.2%		61.9%	19.4%
215-84	57.37	57.90	0.53	OV	83.901%	.167%	.001%	.021%	.036%	.000%		84.1%		64.1%	13.8%
215-85	57.90	58.45	0.55	CS	86.568%	.127%	.000%	.004%	.026%	.000%		86.7%		83.6%	1.4%
215-86	58.45	59.00	0.55	CS	90.080%	.075%	.001%	.006%	.051%	.000%		90.2%		85.6%	2.9%
215-87	59.00	59.50	0.50	COAL	23.058%	.312%	.000%	.013%	.010%	.000%		23.4%		14.3%	3.2%
215-88	59.50	60.00	0.50	FC (O+W	91.122%	.062%	.000%	.003%	.023%	.000%		91.2%		89.5%	.3%
215-89	60.00	60.50	0.50	FC (O+W	89.946%	.037%	.000%	.003%	.014%	.000%		90.0%		87.1%	1.3%
215-90	60.50	61.00	0.50	FC (O+W	85.843%	.014%	.000%	.002%	.010%	.000%		85.9%		84.6%	.5%
215-91	61.00	61.50	0.50	CS	82.451%	.134%	.000%	.013%	.038%	.000%		82.6%		75.3%	4.5%
215-92	61.50	62.00	0.50	CS	93.164%	.091%	.000%	.012%	.017%	.000%		93.3%		87.2%	4.1%
215-93	62.00	62.47	0.47	FCWS	95.599%	.091%	.000%	.011%	.019%	.000%		95.7%		87.1%	6.8%
215-94	62.47	62.95	0.48	FCWS	95.086%	.096%	.000%	.009%	.041%	.000%		95.2%		90.2%	3.4%
215-95	62.95	63.42	0.47	FCWS	92.618%	.130%	.000%	.011%	.059%	.000%		92.8%		87.9%	3.7%
215-96	63.42	63.90	0.48	FCWS	92.621%	.117%	.000%	.007%	.024%	.000%		92.8%		88.1%	3.4%
215-97	63.9	64.3	0.40	Siltstone	95.451%	.050%	.000%	.004%	.012%	.000%		95.5%		93.7%	.3%
											Average	87.2%			

Table E.5

Detection limits for each method and each element

	Neutron Activation ppm	ICP ppm	Fire Assay ppm		Neutron Activation ppm	ICP ppm	Fire Assay ppm
Ag	2		0.4	Mo	2		
Al	0.001%			Na	0.001%		
As	1			Nb		2	
Au	0.001		0.001	Nd	1		
B	10			Ni	50		
Ba	20			P			
Be		2		Pb		5	
Bi		5		Pd	0.002		0.003
Br	0.2	0.5		Pt	0.005		0.005
Ca	0.20%			Rb	10		
Cd		0.5		S			
Ce	1			Sb	0.1		
Cl	100	30		Sc	0.01		
Co	0.1			Se	0.01	0.05	
Cr	0.5			Si			
Cs	0.2			Sm	0.01		
Cu	50			Sn		5	
Eu	0.05			Sr	0.01%		
Fe	0.01%			Ta	0.3		
Ga		2		Tb	0.1		
Gd	1			Th	0.1		
Hf	0.2			Ti	0.01%		
Hg	1			U	0.1		
Ir	0.001	2		V	0.5		
K				W	1		
La	0.1			Y	1		
Lu	0.01			Yb	0.05		
Mg	0.05%			Zn	10		
Mn	0.1			Zr		5	

Table E.6 Concentration of Elements - Detected vs Average in the Earth's Crust

Element	Detected Min	Detected Max	Detected Mean	Average Earth's Crust
O	-	-	-	46.4%
Si	26.4%	43.8%	36.6%	27.8%
Al	0.15%	9.94%	2.86%	8.32%
Fe	0.06%	4.6%	0.92%	5.63%
Ca	0.006	0.46%	0.09%	4.15%
Na	BDL	0.37%	0.12%	2.36%
Mg	0.001	0.50%	0.18%	2.33%
K	BDL	1.97%	0.67%	2.09%
Ti	0.05%	0.93%	0.33%	0.57%
H	-	-	-	0.14%
P	BDL	0.08%	0.02%	0.10%
Mn	BDL	0.09%	0.02%	0.10%
Ba	14	416	186	425
Sr	8.7	147	42	375
S	42	4922	950	260
C	-	-	-	200
Zr	1.9	79	22	165
V	9	197	59	135
Cl	BDL	877	135	130
Rb	BDL	117	39	90
Ni	2.1	52	21	75
Ce	6	99	42	60
Cu	2.7	75	14	55
Sn	-	-	-	40
Y	BDL	40	17	33
La	2.8	46	20	30
Nd	2	43	20	28
Co	2.7	456	127	25
Sc	0.6	20	5.6	22
Li				20
N	-	-	-	20
Nb	3	28	13	20
Ga	2	27	10	15
Pb	0.9	75	15	12.5
Th	1	15	6.3	10
B	BDL	178	37	10
Pr	-	-	-	8.2
Zn	2	79	22	7

Element	Detected Min	Detected Max	Detected Mean	Average Earth's Crust
Sm	0.4	7.5	3.2	6
Ge	-	-	-	5.4
Gd	1	7	3.9	5.4
Hf	1	20	8	4.5
A	-	-	-	3.5
Dy	0.59	4.25	1.82	3.0
Yb	0.25	3.9	1.8	3.0
Er	-	-	-	2.8
Be	BDL	4	0.7	2.8
U	0.32	6.8	1.8	2.7
Br	0.2	1.2	0.5	2.5
Ta	0.03	2.2	0.8	2.0
As	BDL	10	2.3	1.8
Mo	2	179	23	1.5
W	0.5	913	70	1.5
Ho	-	-	-	1.2
Eu	.07	1.7	.7	1.2
Cs	0	6.8	1.8	1
Tl	-	-	-	0.6
Tb	0.08	1.3	0.5	0.5
Lu	.04	.6	.27	0.5
I	-	-	-	0.5
Sb	0.06	0.8	0.3	0.2
Tm	-	-	-	0.20
Cd	0.09	5	0.9	0.20
Bi	-	-	-	0.17
In	-	-	-	0.10
Pd	.001	.010	.002	.01
Hg	-	-	-	0.08
Ag	0.3	0.8	0.5	0.07
Se	BDL	2.9	0.67	0.05
Pt	.004	.009	.005	.005
Au	.001	1.2	.003	.004
He	-	-		.008
Te	-	-	-	.002
Rh	-	-	-	.005
Ir	-	-	-	.001
Os	-	-	-	.001
Ru	-	-	-	.001

The concentration of major elements is reported in percent by weight.

The concentration of other elements is reported in parts per million.

The avarage concentrationof elements in the earth's crust was derived from 65th Edition of The Handbook of Chemistry and Physics, published by the CRC Press.

Table E.7 Gamma Data for Each Sample Interval

Sample #	Gamma (API)	Sample #	Gamma (API)	Sample #	Gamma (API)	Sample #	Gamma (API)	Sample #	Gamma (API)
209-1	25.25	209-37	23.91	209-73	70.97	215-27	30.4	215-63	113.54
209-2	25.19	209-38	28.44	209-74	39.56	215-28	36.6	215-64	119.77
209-3	19.56	209-39	22.65	209-75	51.61	215-29	50.03	215-65	108.67
209-4	26.42	209-40	30.25	209-76	43.35	215-30	59.18	215-66	100.39
209-5	23.39	209-41	14.82	209-77	23.91	215-31	53.48	215-67	103.61
209-6	20.68	209-42	16.93	209-78	30.38	215-32	55.48	215-68	105.62
209-7	25.3	209-43	24.97	209-79	20.08	215-33	52.64	215-69	105.61
209-8	30.08	209-44	78.62	209-80	18.51	215-34	49.77	215-70	92.7
209-9	18.55	209-45	63.39	209-81	17.07	215-35	54.83	215-71	83.96
209-10	26	209-46	21.69	209-82	15.64	215-36	62.34	215-72	92
209-11	23.49	209-47	14.6	215-1	73.02	215-37	49.85	215-73	97.29
209-12	19.86	209-48	19.35	215-2	71.45	215-38	60.25	215-74	87.6
209-13	27.26	209-49	19.42	215-3	78.77	215-39	66.67	215-75	74.62
209-14	32.02	209-50	21.29	215-4	66.92	215-40	68.92	215-76	81.99
209-15	35.69	209-51	24.26	215-5	77.55	215-41	74.36	215-77	73.23
209-16	47.71	209-52	33.75	215-6	91.04	215-42	72.4	215-78	68.39
209-17	34.67	209-53	37.2	215-7	69.87	215-43	64.76	215-79	71.7
209-18	34.22	209-54	28.31	215-8	74.37	215-44	68.54	215-80	76.75
209-19	33.28	209-55	29.38	215-9	108.52	215-45	72.33	215-81	95.57
209-20	33.4	209-56	29.48	215-10	104.26	215-46	79.63	215-82	111.88
209-21	20.59	209-57	22.27	215-11	106.27	215-47	95.19	215-83	
209-22	24.36	209-58	25.55	215-12	93.74	215-48	83.06	215-84	84.97
209-23	21.05	209-59	44.2	215-13	103.72	215-49	70.88	215-85	21.46
209-24	24.84	209-60	89.36	215-14	101.76	215-50	31.98	215-86	30.52
209-25	18.62	209-61	104.75	215-15	99.14	215-51	34.23	215-87	43.1
209-26	18.74	209-62	100.74	215-16	78.25	215-52	45.04	215-88	29.22
209-27	14.84	209-63	102.69	215-17	88.99	215-53	68.81	215-89	29.11
209-28	29	209-64	93.96	215-18	74.49	215-54	57.48	215-90	35.44
209-29	23.47	209-65	65.14	215-19	68.81	215-55	51.45	215-91	77.1
209-30	34.74	209-66	68.84	215-20	50.45	215-56	38.1	215-92	57.26
209-31	39.21	209-67	69.47	215-21	45.5	215-57	30.65	215-93	24.15
209-32	30.96	209-68	90	215-22	24.61	215-58	30.12	215-94	27.8
209-33	23.63	209-69	85.47	215-23	31.38	215-59	43.62	215-95	41.07
209-34	23.15	209-70	57.49	215-24	40.92	215-60	47.59	215-96	75.51
209-35	19.92	209-71	63.72	215-25	52.99	215-61	43.93	215-97	60.65
209-36	29.43	209-72	77.44	215-26	37.21	215-62	89.8		

Appendix F
Miscellaneous Characterization

Appendix F
Miscellaneous Characterization

Part 1 - Chemical Characterization

In this section elemental concentrations were examined in different types and components of oil sands.

Three groups of oil sands samples are examined:

- whole oil sand from an oil sand prospect:
    - low, medium and high grade oil sand (8%, 10% and 12% by weight bitumen),
- fine tailings from pilot as well as commercial operations,
- effect of leaching fine tailings by strong acid:
    - character of leached material,
    - character of leach liquor (leachate)

Results of the chemical analyses are summarized in Table F.1.

Character of Whole Oil Sand

The concentration of elements in low, medium and high grade oil sand are plotted in Figure F.1

The semi log nature of the plot covers eight orders of magnitude so masks the results somewhat. However trends are evident:

- high grade ore has a lower concentration of almost all elements except silicon.
- low grade ore has two to three times the concentration of most elements except silicon.
- medium grade ore has concentrations that lie between the two extremes.

The differences noted above are attributed to the presence of clay and its associated complex of elements in the lower grade oil sand.

Character of Fine Tails

Elemental concentrations in fine tails are shown by Figure F.2. It also shows the elements present in low grade feed.

The fine tails from Oil Sands Project I were derived from a caustic based extraction process so are expected to have a higher concentration of organic material. (toluene insoluble). The fine tails from Oil Sand Prospect II were derived from a non caustic extraction process that is expected to leave less organic material in the waste. Figure F.4.18 suggests that both samples of fine tails had unusually high concentrations of coarse material present (quartz sand).

Figure F.2 shows that fine tails contain less silica and a greater concentration of all elements. The trend is attributed to the higher concentration of clay present in fine tails. Concentrations of elements besides silica can be expected to be even higher in normal fine tails that contain a higher percentage of clay sized materials.

No significant difference was observed in the two tailings samples. A greater number of samples would have to be analyzed to detect any difference.

Analysis of the fines concentrated in the extraction process employed on Oil Sands Prospect 1 show a significantly higher gold content than was encountered elsewhere in this study. (See Table F.1). This observation is consistent with gold concentrations observed by others in fine streams from this pilot.

Effect of Leaching

Samples were obtained from a pilot plant that was used to explore the effect of using strong acid to leach material from fine tails. Usually such leaching removes metal components.

Concentrations of the various elements are shown by Figure F.3. There is a discrepancy between the units plotted. The concentration of elements in the solid materials is expressed in parts per million of the weight of solids. The concentration of elements in the leachate is expressed in ml per litre of leachate. However, despite the discrepancy, the trend is evident. The leaching process employed at the pilot plant selectively extracts chlorine, iron and aluminum.

Part 2 - Physical Characteristics of the main facies

Physical characteristics of the main facies were determined to aid the interpretation of elemental concentrations. Characterization included:

- grain size analysis determined by hydrometer (ASTM method D-422),
- Methylene Blue indication of surface activity.

Prior to testing, Dean Stark analysis was performed to remove all bitumen. This treatment is needed to allow particles to disperse freely in the solution so the hydrometer test can be employed. It is possible that the Dean Stark analysis also removes some of the fine grained components. However, a check of constituents before and after analysis indicates that the error in fine grained components should be small - a percent or two at the most.

Grain size analysis

Hydrometer analysis followed procedures outlined in ASTM standard D- 422. Deviations from the standard included:

- samples were pre soaked for a number of days to ensure that fine grained components entered the water phase,
- several samples were re tested to check on the consistency of results. No discrepancies were observed.

Table F.2 lists the samples tested and the results.

Grain size curves for the main facies and for fine tails are shown in figures F.4.1 through F.4.18.

The grain size plots show the total amount of clay sized material (size less than two microns). The total amount of clay sized material represents important information because fine grained components can dominate the physical behaviour of the material. Some traditional grain size analyses that are widely used in the oil sands industry only look at the distribution of grain sizes above one micron and miss identifying the amount of fine grained material.

The indicated grain size for the major bitumen bearing facies shows little clay sized material. More was expected but the data are believed to be representative because of the care exercised during sample preparation.

Up to half of the particles in the fine grained facies are clay sized material. Fine tails often have similar amounts of clay sized material although the samples tested in this program did not. For that reason it is concluded that the fine tails tested were not representative. They contain unrepresentative amounts of coarse material and hence silica.

Surface area measurement.

Methylene Blue tests were performed to give an indication of the surface activity of the material. Tests followed standard ASTM procedures.

Methylene Blue preferentially coats the surface of solid particles with a layer one molecule thick before it enters the surrounding solution. The surface area is indicated by the amount of a standard solution of Methylene Blue absorbed on the solids before surplus material is available to react in the surrounding fluid. The test is an approximate one.

The minimum MTB value recorded is 10 ml/100g. Values below 10 ml/100g are recorded as 10.

Table F.1 - Miscellaneous Testing - Element Concentrations

Table F.1

Miscellaneous Testing

Oil Sand, Fine Tails and Leached Fine Tails

Element	Prospect I Low Grade Feed	Prospect I Med Grade Feed	Prospect I High Grade Feed	Prospect I Conc Ext Fines	Prospect II Fine Tails	Project I Fine Tails	Fine Tails Ext Pilot Part leach	Fine Tails Ext Pilot Leached	Liquor from Ext Pilot	Element
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
Ag	0.9			36.8		500			0.08	Ag
Al	25100	12400	8300	38500	92300	94200	43100	18700	13656	Al
As	4	2	3	5	4	6	6	8	0.13	As
Au	0.006	0.001	0.002	1.2		0.003	0.003			Au
B	37	17	15	44	120	93	74	113	3.3	B
Ba	302	177	127	296		414	501	456	0.22	Ba
Be					2	3			0.41	Be
Bi									0.31	Bi
Br					357		2.3	460	0.057	Br
Ca	12400	3000	1300	5400	3820	1700		564	34	Ca
Cd				0.5		0.8		0.9	0.01	Cd
Ce	40	23	15	47	86	101	60	91	5.5	Ce
Cl	34	30		86		65	53	100	600	Cl
Co	7.7	2.8	2.5	7.6	13	20	11	3.6	2.11	Co
Cr	28	15	11	96	78	89	47	28	11	Cr
Cs	1.3	0.6	0.3	1.7	5.5	5.1	2.3	1.2		Cs
Cu	7	5	4	17	17	35	31	34	0.45	Cu
Eu	0.69	0.33	0.23	0.77	1.33	1.71	0.69	0.94	0.1	Eu
Fe	10700	7400	4700	17100	25900	26200	7300	13700	4232	Fe
Ga	3			8	30	21	7	5	2.56	Ga
Gd										Gd
Hf	8.6	4.4	3.1	9.4	4.6	13	14	16	0.14	Hf
Hg										Hg
Ir					0.001					Ir
K	9500	5000	3200	9500	15490	16700	12200	7340	256	K
La	19.7	11.4	7.6	22.8	39.9	48.5	33.7	50.3	2.2	La
Lu	0.28	0.14	0.09	0.28	0.33	0.63	0.47	0.54	0.02	Lu
Mg	2300	500	1000	2100	6790	4000	2400	610	5.4	Mg

Table F.1 - Miscellaneous Testing - Element Concentrations

				Table F.1						
				Miscellaneous Testing (cont.)						
Element	Oil Sands Prospect I Low Grade Feed ppm	Oil Sands ProspectI Med Grade Feed ppm	Oil Sands Prospect I High Grade Feed ppm	Oil Sands Prospect I Conc Ext Fines ppm	Oil Sands Prospect II Fine Tails ppm	Oil Sands Project I Fine Tails ppm	Oil Sands Fine Tails Ext Pilot Part leach ppm	Oil Sands Fine Tails Ext Pilot Leached ppm	Leach Liquor from Ext Pilot ppm	Element
Mn	100	100		300	700	500			101.8	Mn
Mo				10	2	3	6	5	0.01	Mo
Na	2200	1700	600	1300	1130	1200	1100	760	23.4	Na
Nb	7	3	4	10	26	24	28	35	0.75	Nb
Nd	18	10	7	20	34	46	21	27	4.3	Nd
Ni	18	18	20	63	41	36	32	19	5.8	Ni
P	200	200	100	500	470	600	200	221	2.2	P
Pb	10		7	25	14	14	32	20	0.1	Pb
Pd	0.002	0.002	0.002	0.212		0.002	0.002			Pd
Pt				0.013						Pt
Rb	35	19		42	95	86	48	36	9.1	Rb
S									26910	S
Sb	0.3	0.2	0.1	2.8	0.4	0.6	1.6	0.8	0.01	Sb
Sc	3.5	1.8	0.9	4.5	11	11	5	4.6	1.5	Sc
Se		1.1	1	19	0.6	0.5		3.2		Se
Si	370900	375900	354300	364900	222600	274500	337600	341800	500	Si
Sm	3.1	1.7	1.2	3.6	5.7	8	3.4	3.8	0.42	Sm
Sn					52			10	0.15	Sn
Sr	65	34	24	61	116	94	66	88	7.2	Sr
Ta	0.5			0.6	1	1.6	1.5	1.7		Ta
Tb	0.5	0.2	0.2	0.5	0.9	1.3	0.6	0.8	0.05	Tb
Th	5.3	4.1	2	5.9	10	13	6.5	0.2		Th
Ti	2500	1300	100	3200	4580	700	7300	7540	3.3	Ti
U	1.5	0.7	0.5	1.6	2.7	3.6	2.3	2.9	0.18	U
V	32	34	42	41	106	95	69	31	9.7	V
W	20				2	24	7	3		W
Y	18	7	7	15	37	43	32	39	2.15	Y
Yb	1.78	0.84	0.57	1.78	2.28	4.1	3.07	3.84	0.12	Yb
Zn	22	13	7	35		67	15	10	11.15	Zn
Zr	25	19	12	41	186	69	19	280	1.3	Zr

Figure F.1 Concentration of Elements vs Ore Grade

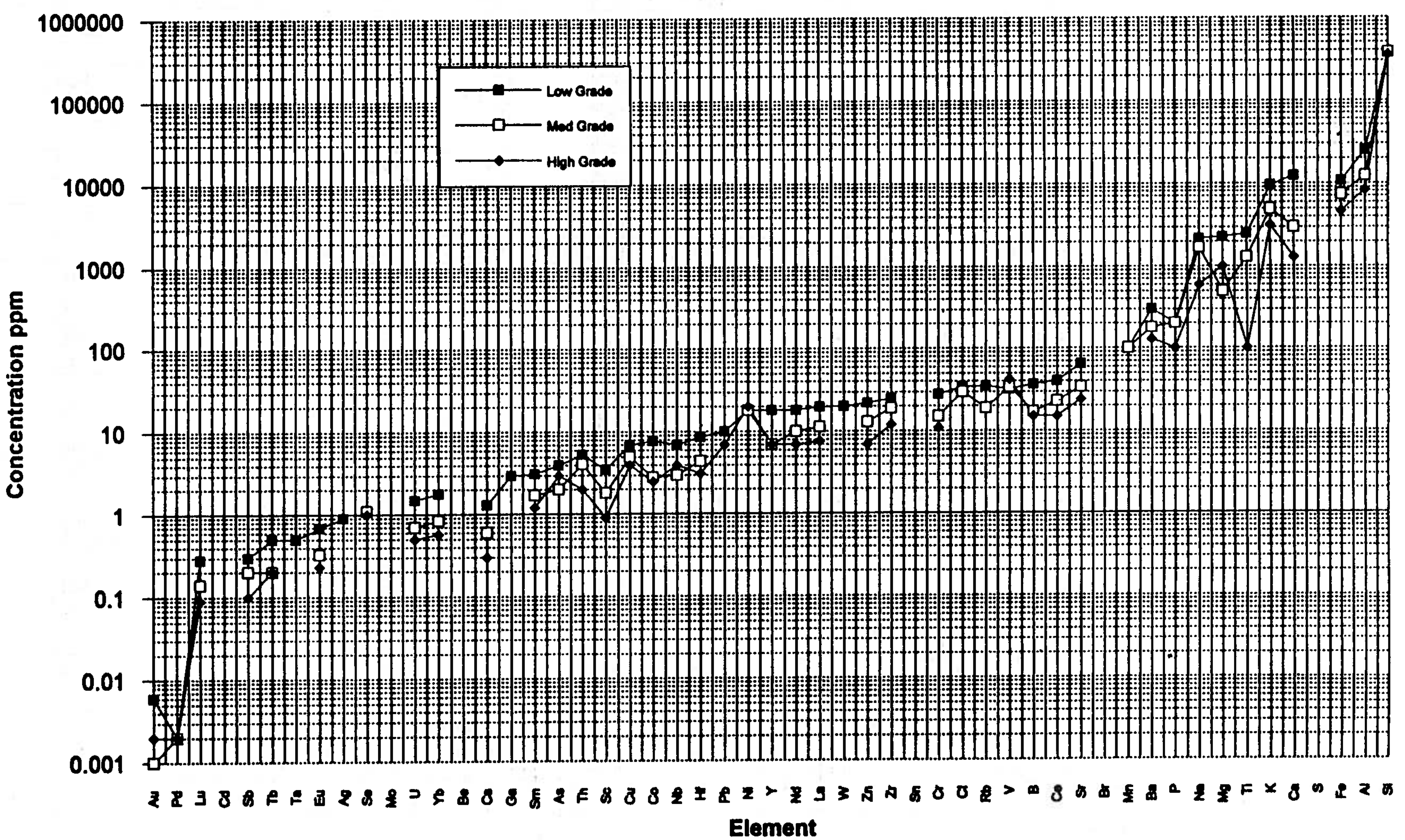


Figure F.2 Concentration of Elements in Fine Tails

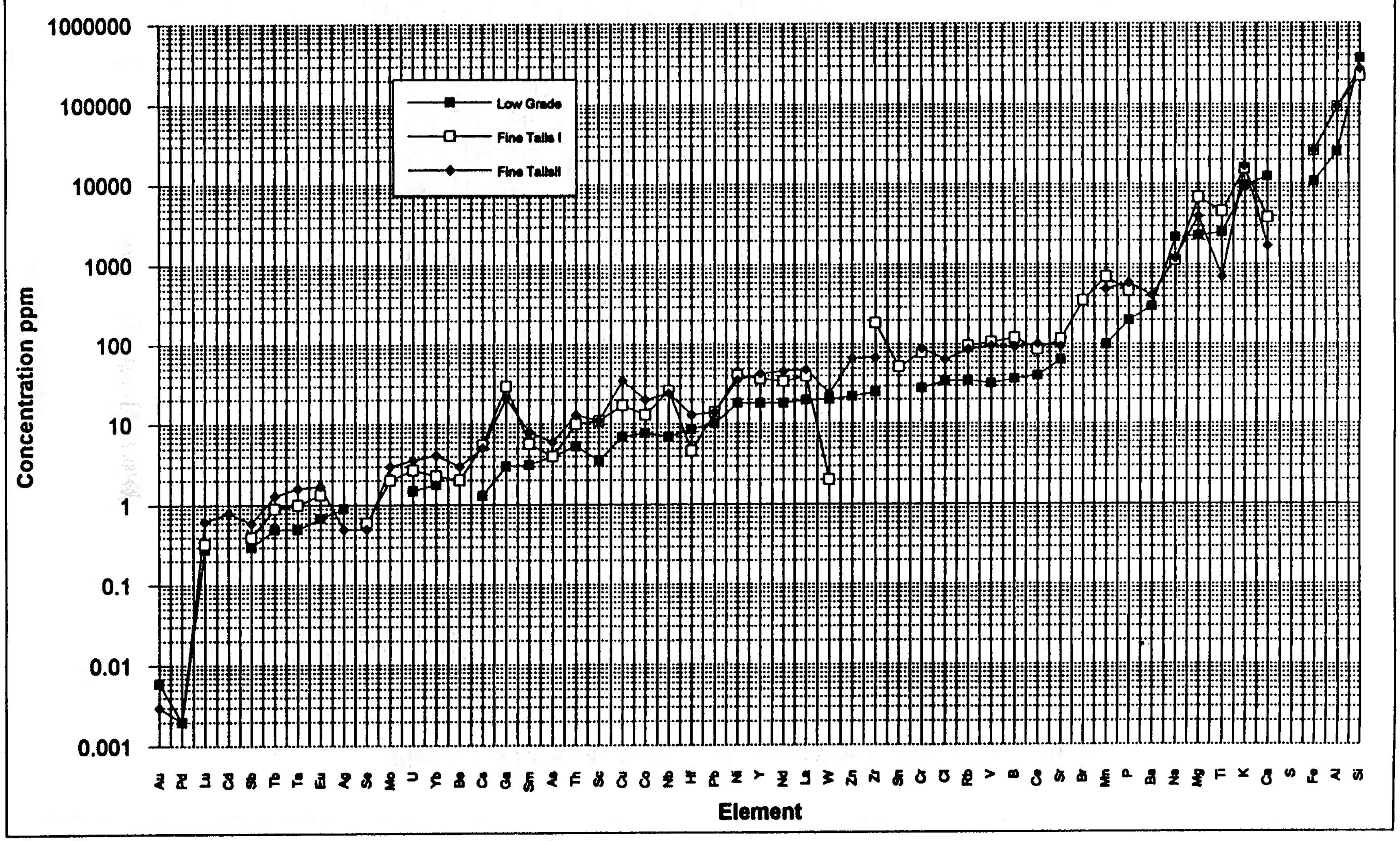


Figure F.3 Effect of Acid Leaching on Concentration of Elements

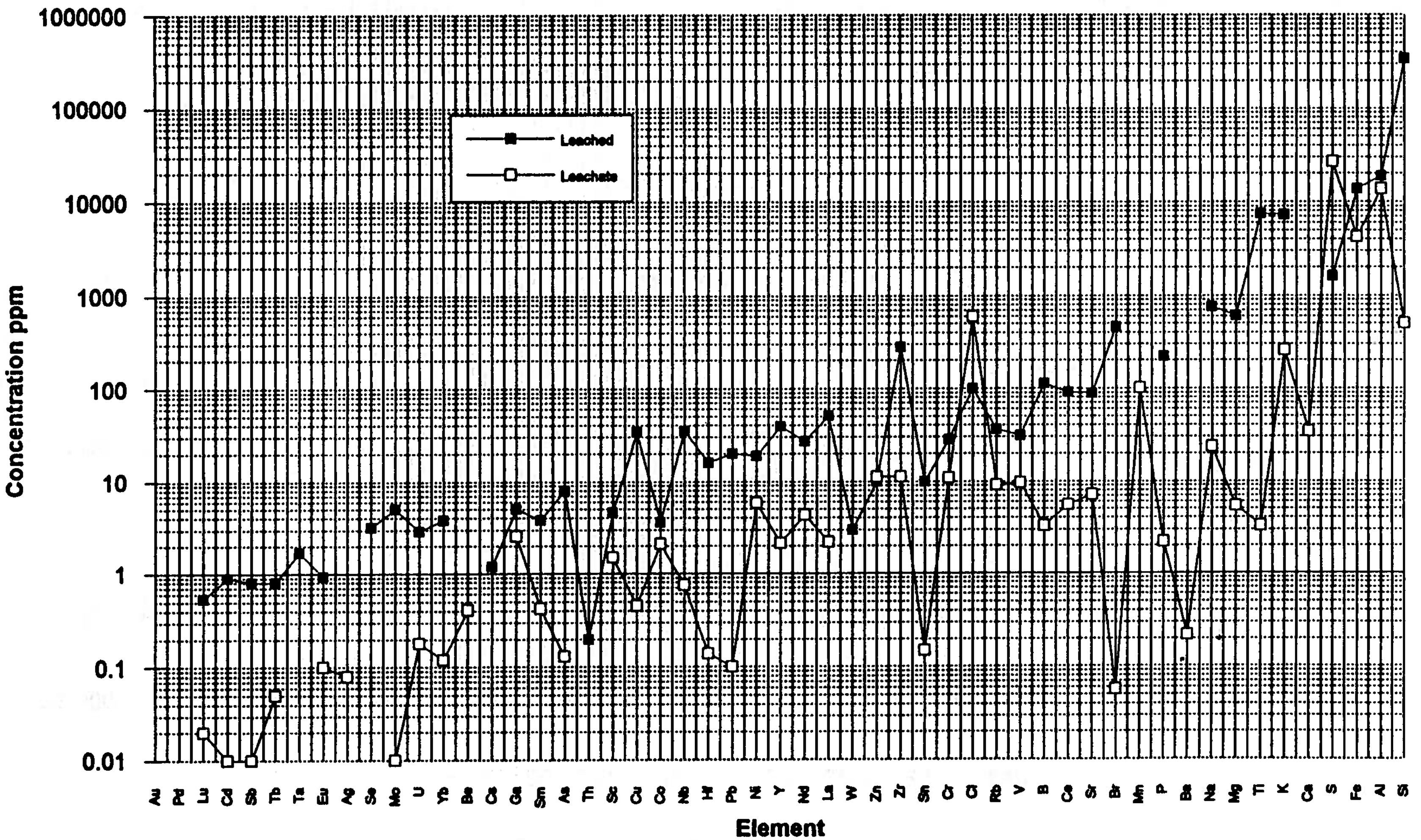
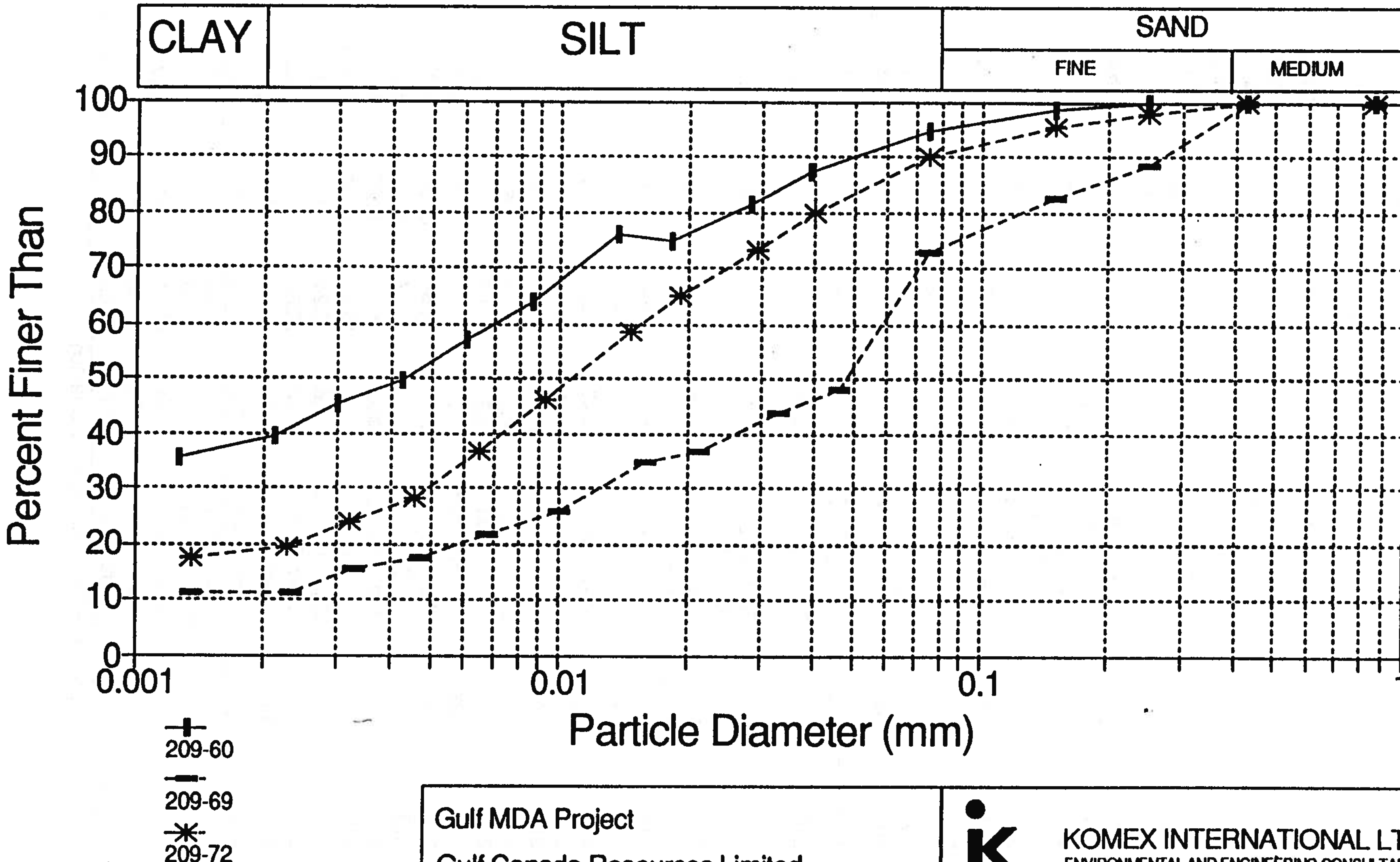


Table F.2 - Summary of Grain Size Analyses

Bore Hole	Sample #	Face	% Sand	% Silt	%Clay	MTB (ml/100g)
209	67	Crevasse Splay	2.5	71.85	25.65	325.00
209	74,75,76	Crevasse Splay	49.34	43.41	7.25	43.48
209	60	Delta Marsh Mud	5.46	54.99	39.55	960.00
209	69	Delta Marsh Mud	27.2	61.55	11.25	202.25
209	72	Delta Marsh Mud	9.98	70.62	19.4	230.77
209	54	Fluvial Channel	88.94	8.01	3.05	<10
209	48	Fluvial Channel	89.02	8.73	2.25	<10
209	77	Fluvial Channel	43.74	44.91	11.35	248.87
209	78,79	Fluvial Channel	58.28	38.12	3.6	55.00
209	41	Fluvial Estuarine	90.84	5.91	3.25	<10
209	22	Interchannel	90.26	6.49	3.25	<10
209	33	Interchannel	84.22	14.13	1.65	<10
209	36	Interchannel	92.28	6.12	1.6	<10
209	16	Interchannel	89.18	8.02	2.8	<10
209	4	Tidal Channel	30.42	67.68	1.9	<10
209	13	Tidal Channel	92.02	4.33	3.65	<10
209	45	Overbank Muds	15.85	61.15	23	Insuff Sample
209	28	Tidal Channel	88.28	8.47	3.25	<10
215	60,61	Channel Breccia	68.24	29.76	2	<10
215	85,86	Fluvial Channel/ Crevasse Splay	66.66	30.19	3.15	15.00
215	88,89,90	Fluvial Channel/ Oil and Water	82.98	15.17	1.85	<10
215	93,94, 95,96	Fluvial Channel/ Water Sands	82.48	15.67	1.85	<10
215	23	Interchannel	90.64	8.01	1.35	<10
215	57	Interchannel	93	3.7	3.3	<10
215	2	Lower Tidal Flat	93.46	4.29	2.25	<10
215	5	Lower Tidal Flat	25.38	72.72	1.9	<10
215	21	Lower Tidal Flat	91.82	4.88	3.3	<10
215	33	Lower Tidal Flat	74.21	24.14	1.65	<10
215	34	Lower Tidal Flat	78.93	17.57	3.5	<10
215	82	Overbank Muds	1.7	42.85	55.45	1277.78
215	63	Pro Delta Mud	0.98	60.67	38.35	961.54
215	74	Pro Delta Mud	25.38	63.37	11.25	269.66
215	17	Pro Delta Mud	20.6	59.85	19.55	392.16
215	10	Salt Marsh	1.42	52.23	46.35	1318.18
215	18	Upper Tidal Flat	35.36	58.24	6.4	83.33
215	39	Upper Tidal Flat	67.42	28.88	3.7	70.37
215	53,55	Upper Tidal Flat	54	42.4	3.6	55.00
215	76	Upper Tidal Flat	54.5	41.45	4.05	130.08
A	4	Oilsand Process	62.7	32.95	4.35	<10
A	5	Oilsand Process	24	72.05	3.95	180.00
A	6	Oilsand Process	17.44	80.71	1.85	90.00
A	7	Oilsand Process	18.74	77.96	3.3	Insuff Sample
Oslo Sludge		Oilsand Process	15.7	70.65	13.65	Insuff Sample

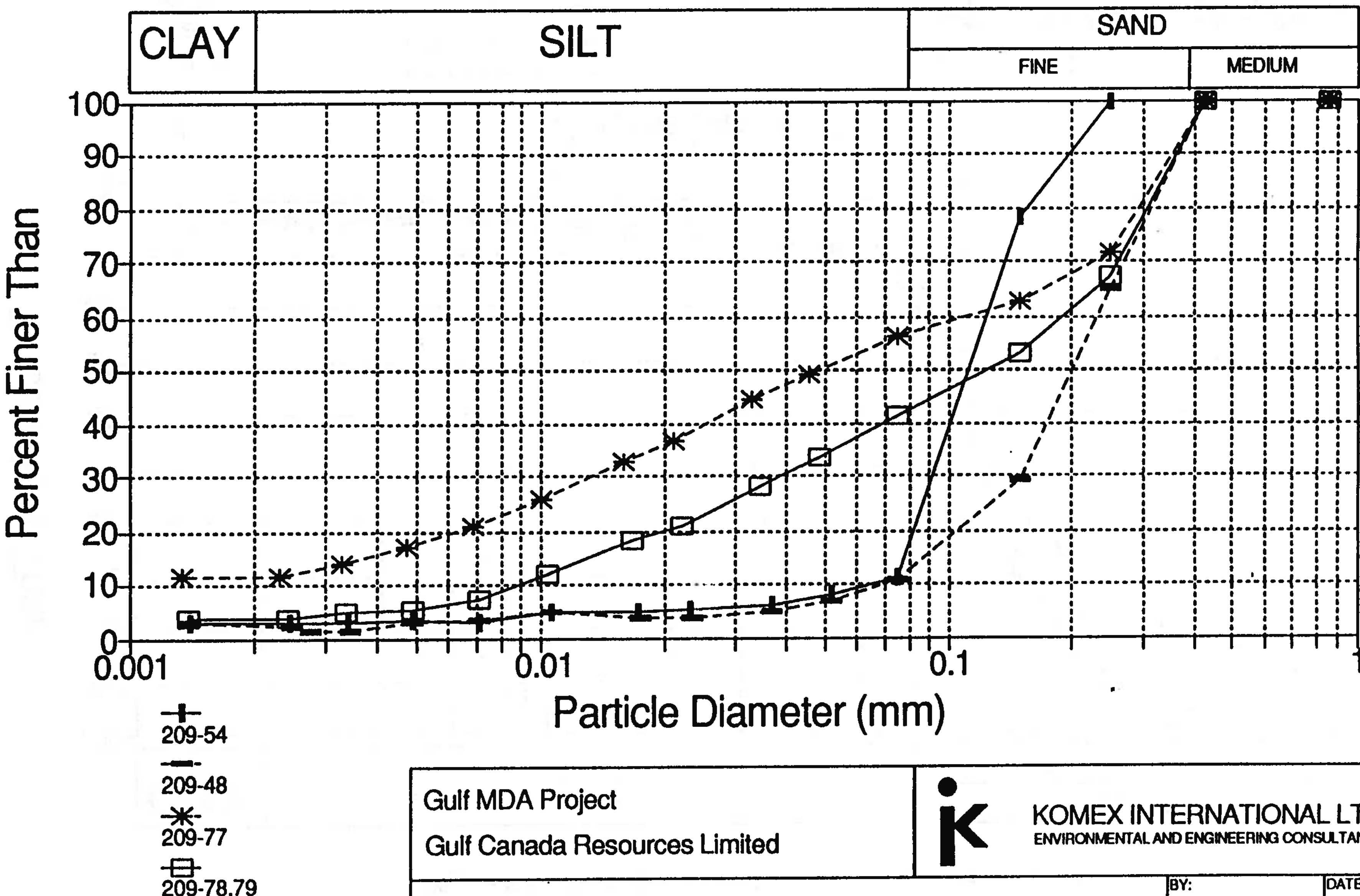
NOTE: <10 denotes less than 1 ml was needed for 10g

Figure F.4.1 Grain Size Analysis of Key Facies - Delta Marsh Mud



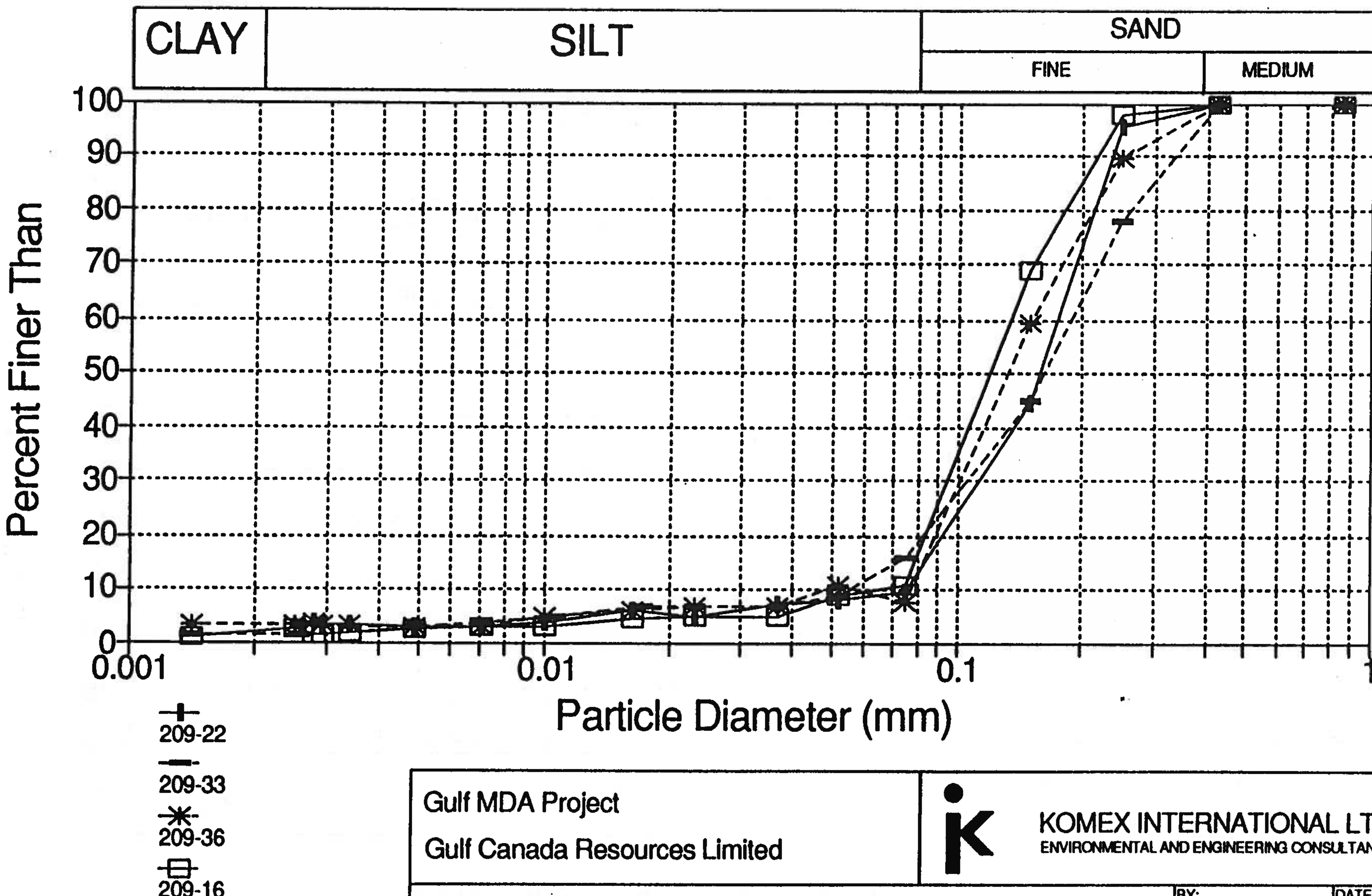
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS
Grain Size Analysis BH-209 Delta Marsh Mud	BY: DATE: APPPROVED: FIGURE:

Figure F.4.2 Grain Size Analysis of Key Facies - Fluvial Channel - 209



Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-209 Fluvial Channel Samples	BY:	DATE:
	APPPROVED:	FIGURE:

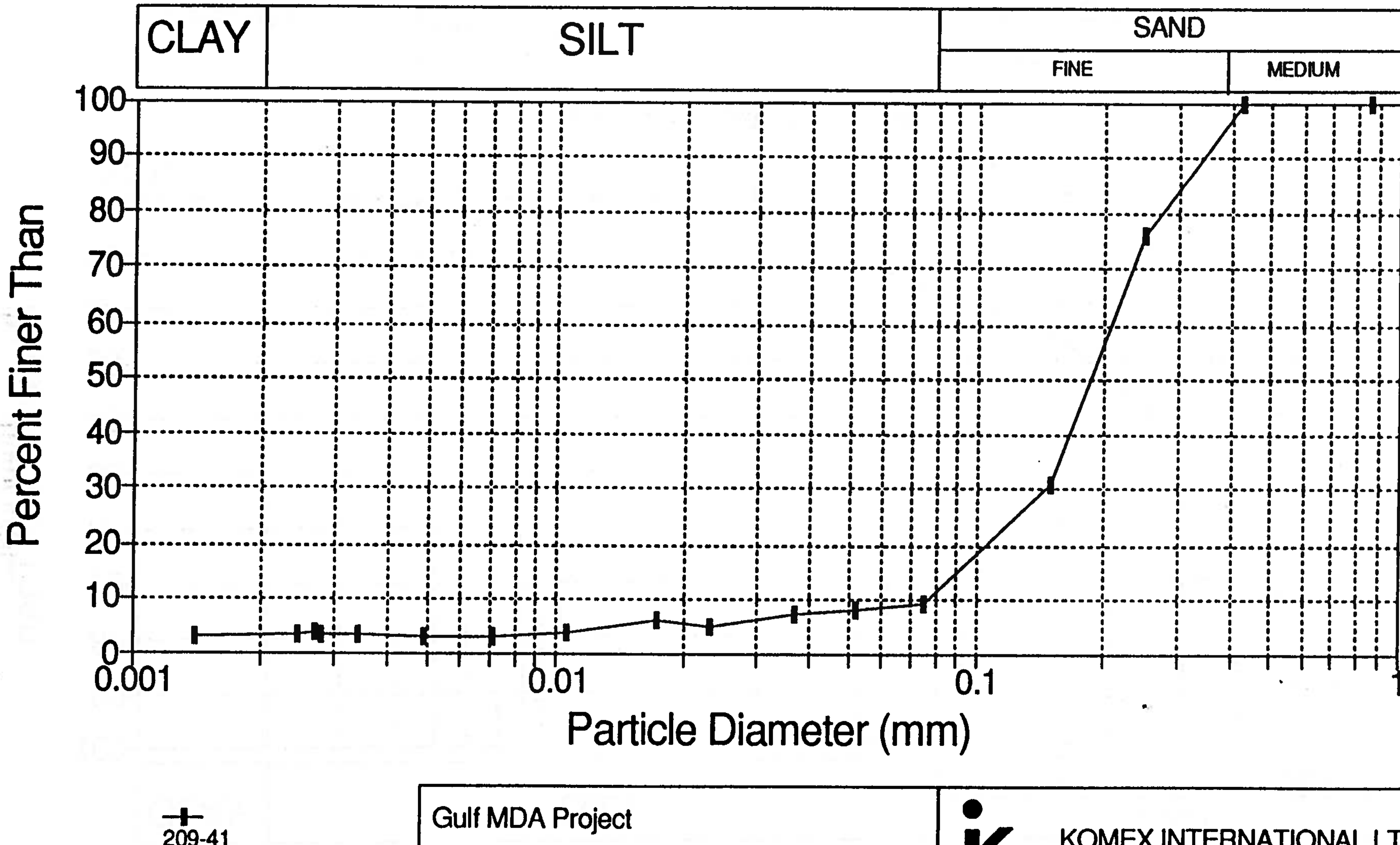
Figure F.4.3 Grain Size Analysis of Key Facies - Interchannel



Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-209 Interchannel Samples	BY:	DATE:
	APPPROVED:	FIGURE:

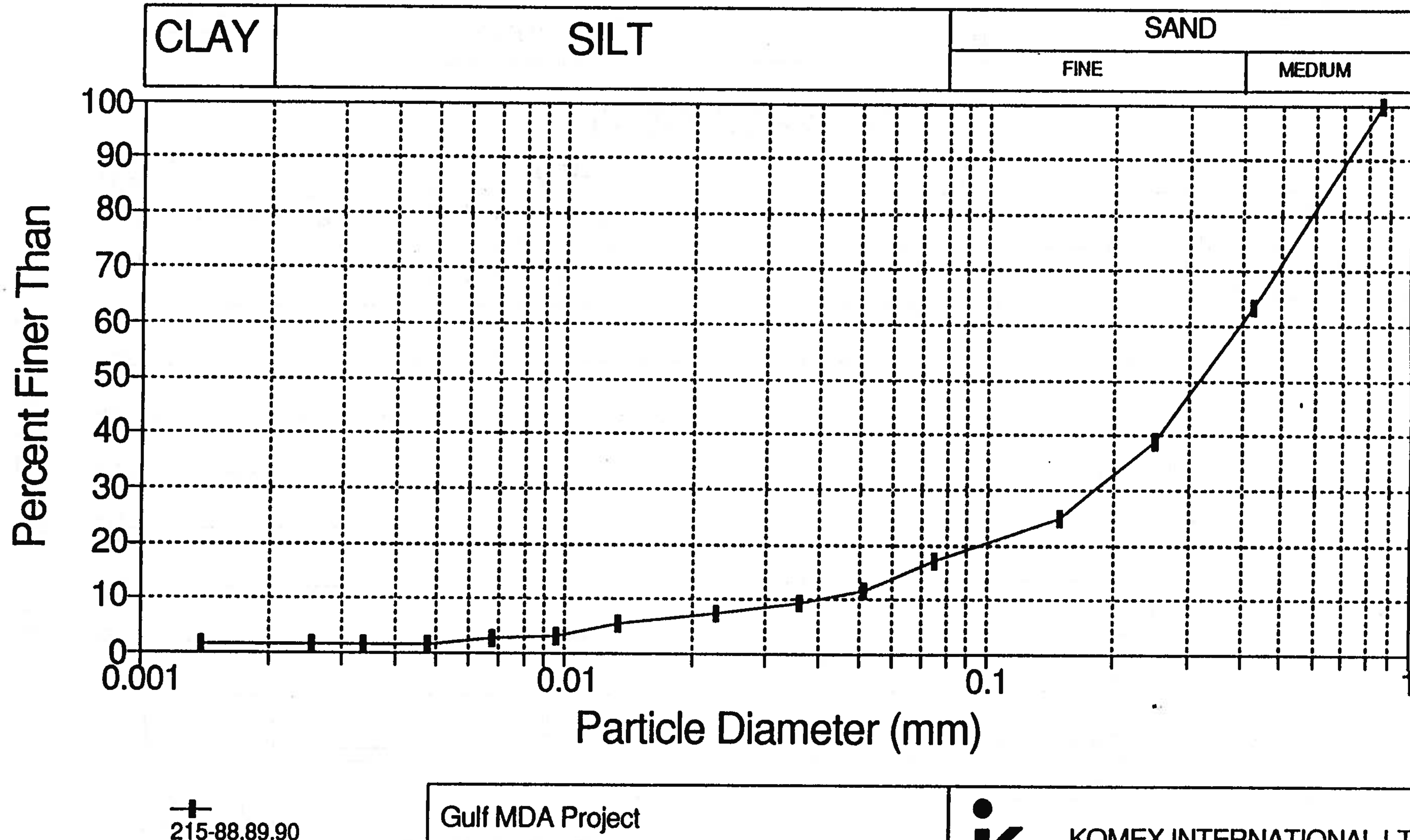
- F. 14 -

Figure F.4.4 Grain Size Analysis of Key Facies - Fluvial Estuarine



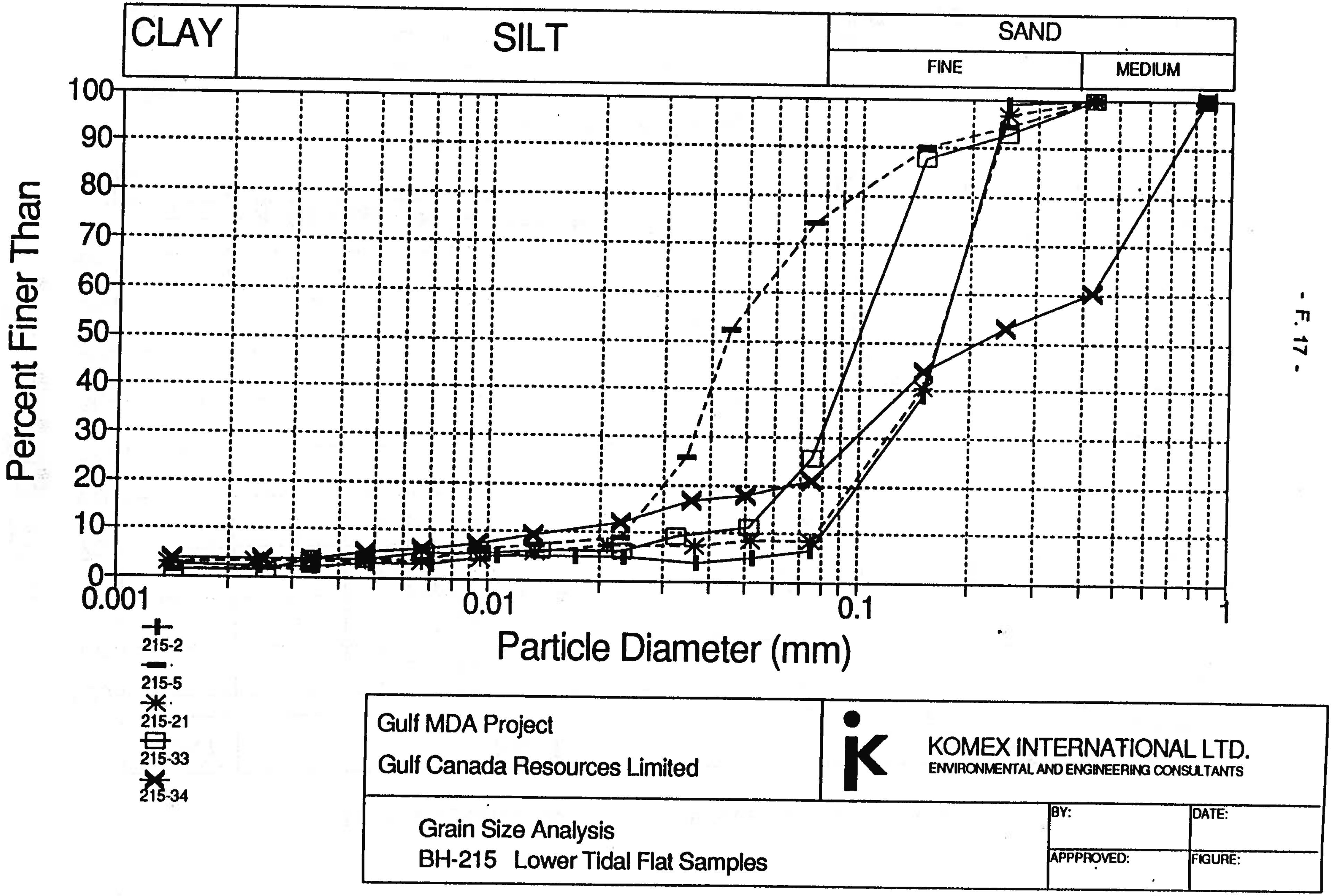
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-209 Fluvial Estuarine Samples	BY:	DATE:
	APPPROVED:	FIGURE:

Figure F.4.5 Grain Size Analysis of Key Facies - Fluvial Channel - Oil and Water



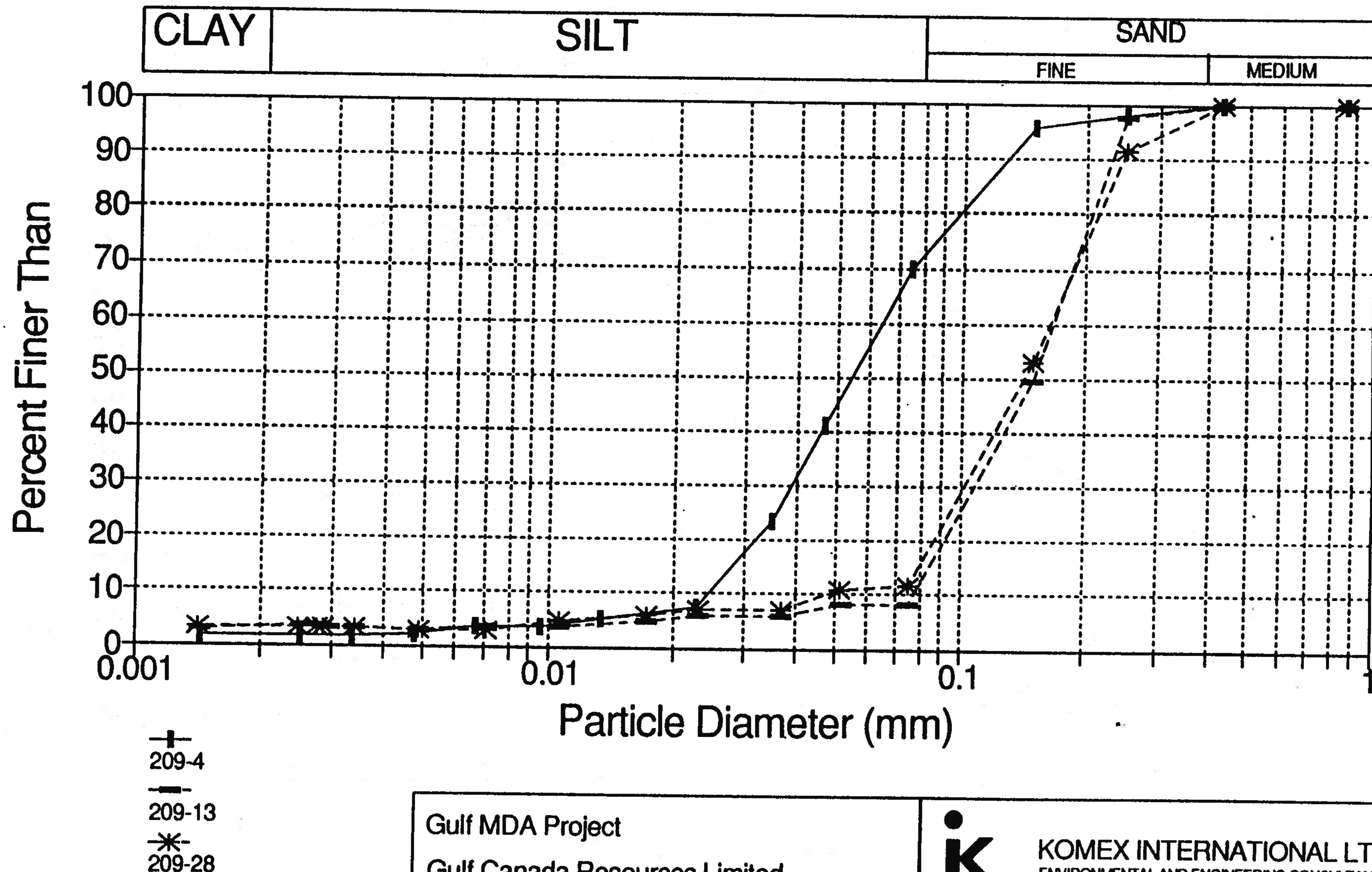
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-215 Fluvial Channel-Oil and Water	BY: APPPROVED:	DATE: FIGURE:

Figure F.4.6 Grain Size Analysis of Key Facies - Lower Tidal Flat



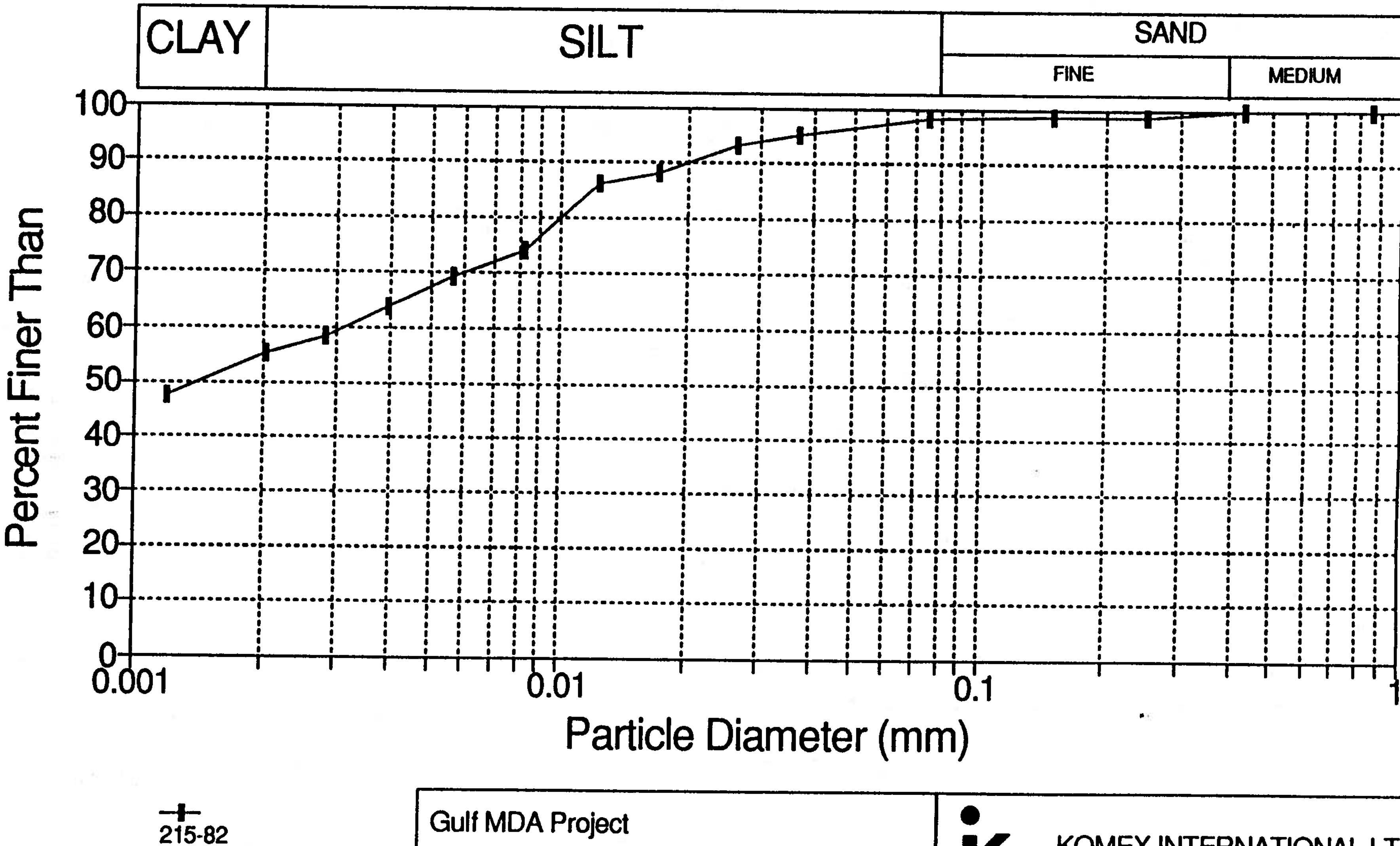
- F. 17 -

Figure F.4.7 Grain Size Analysis of Key Facies - Tidal Channel



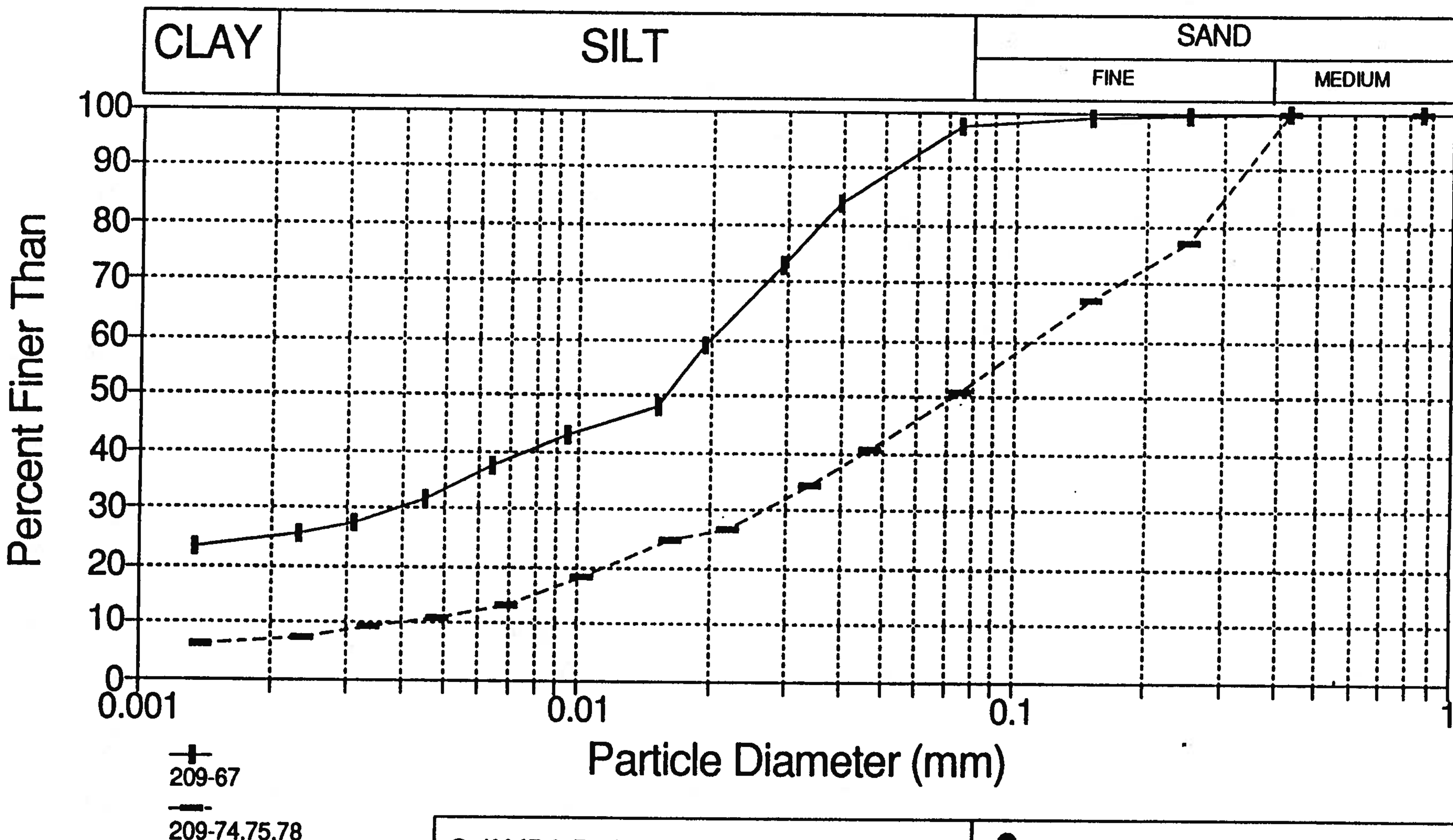
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-209 Tidal Channel Samples	BY: APPPROVED:	DATE: FIGURE:

Figure F.4.8 Grain Size Analysis of Key Facies - Overbank Mud



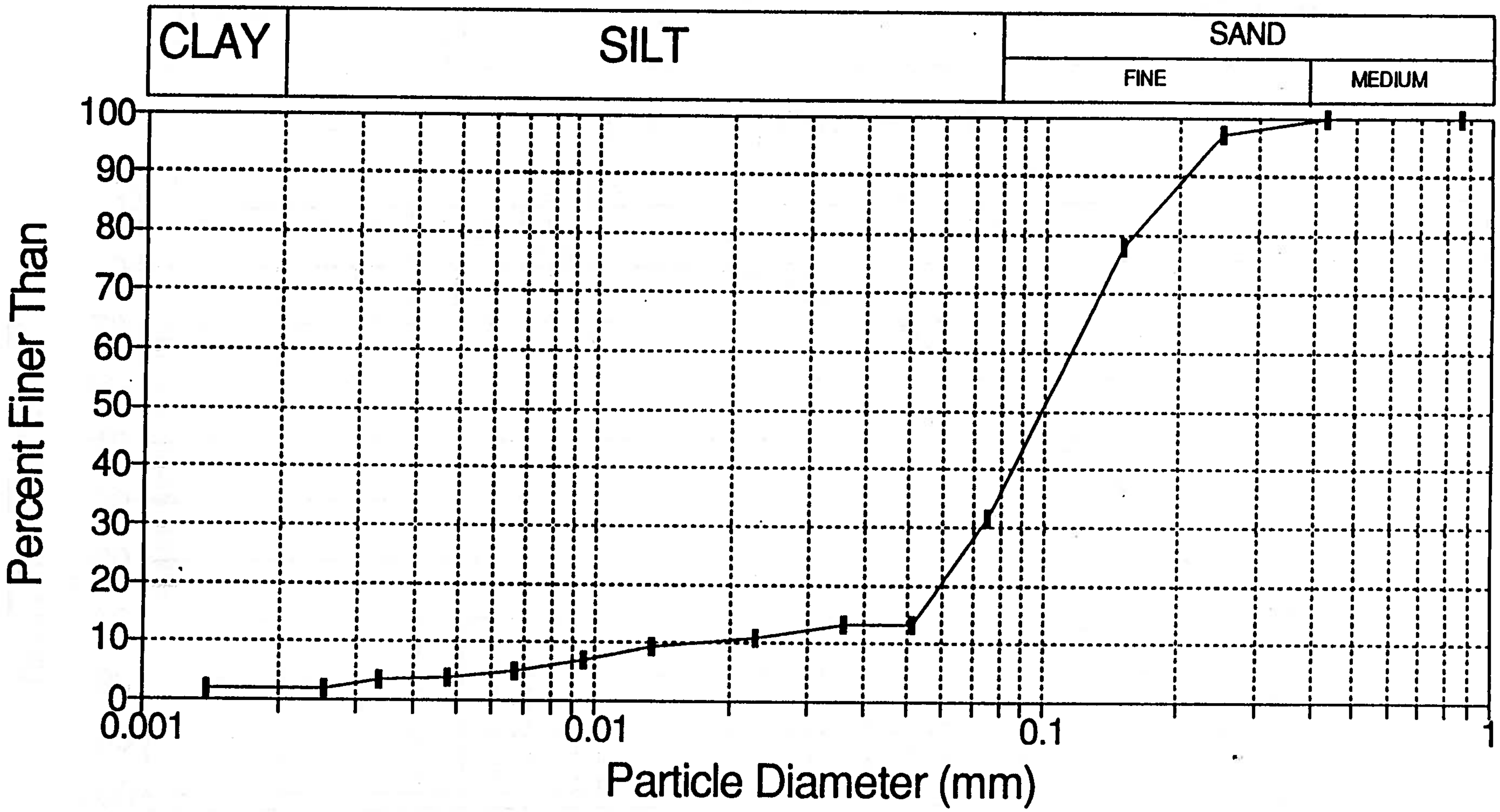
Gulf MDA Project Gulf Canada Resources Limited		KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS
Grain Size Analysis BH-215 Overbank Mud Samples	BY: APPPROVED:	DATE: FIGURE:

Figure F.4.9 Grain Size Analysis of Key Facies - Crevasse Splay



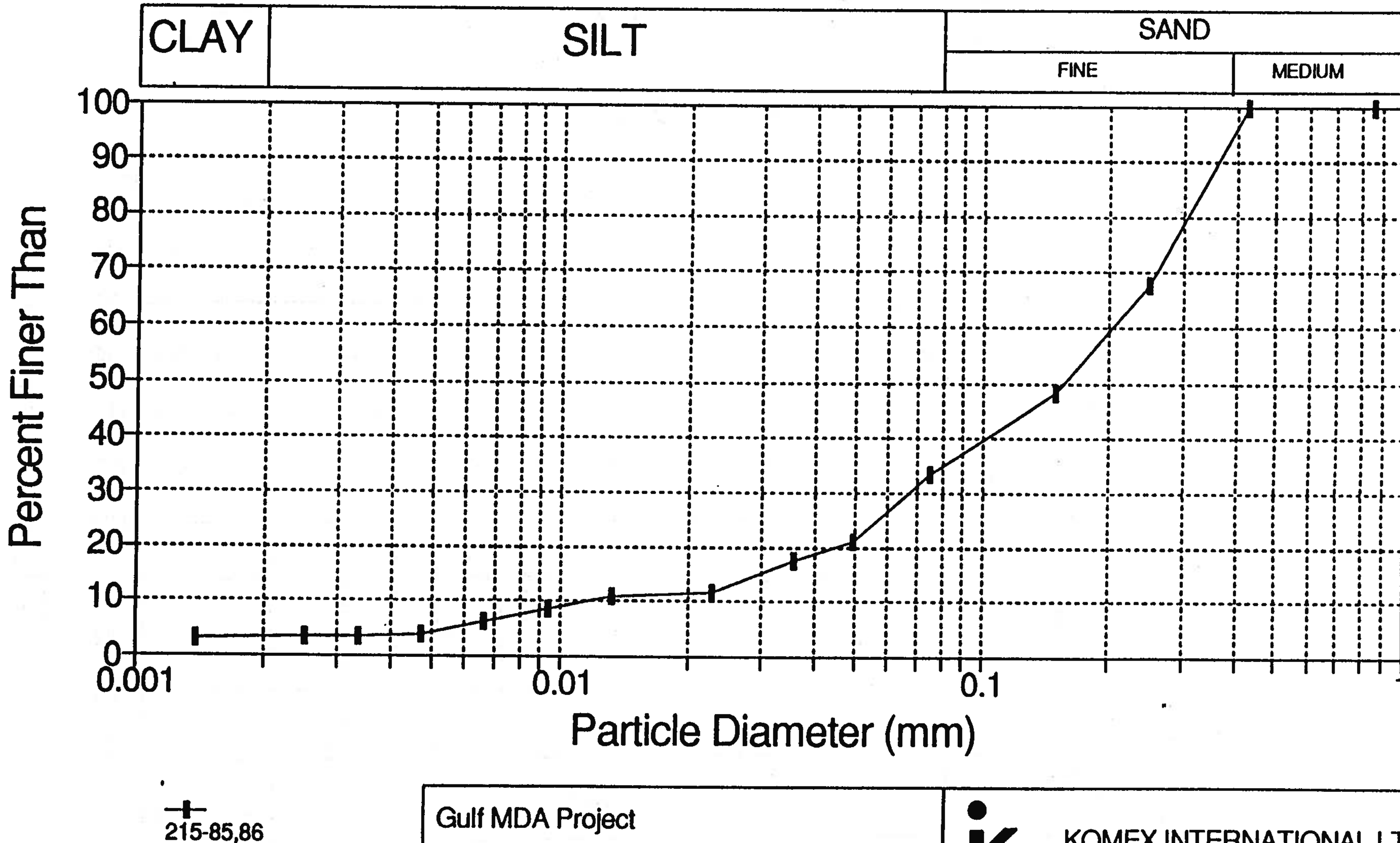
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS		
Grain Size Analysis BH-209 Crevasse Splay Samples		BY:	DATE:
		APPPROVED:	FIGURE:

Figure F.4.10 Grain Size Analysis of Key Facies - Channel Breccia



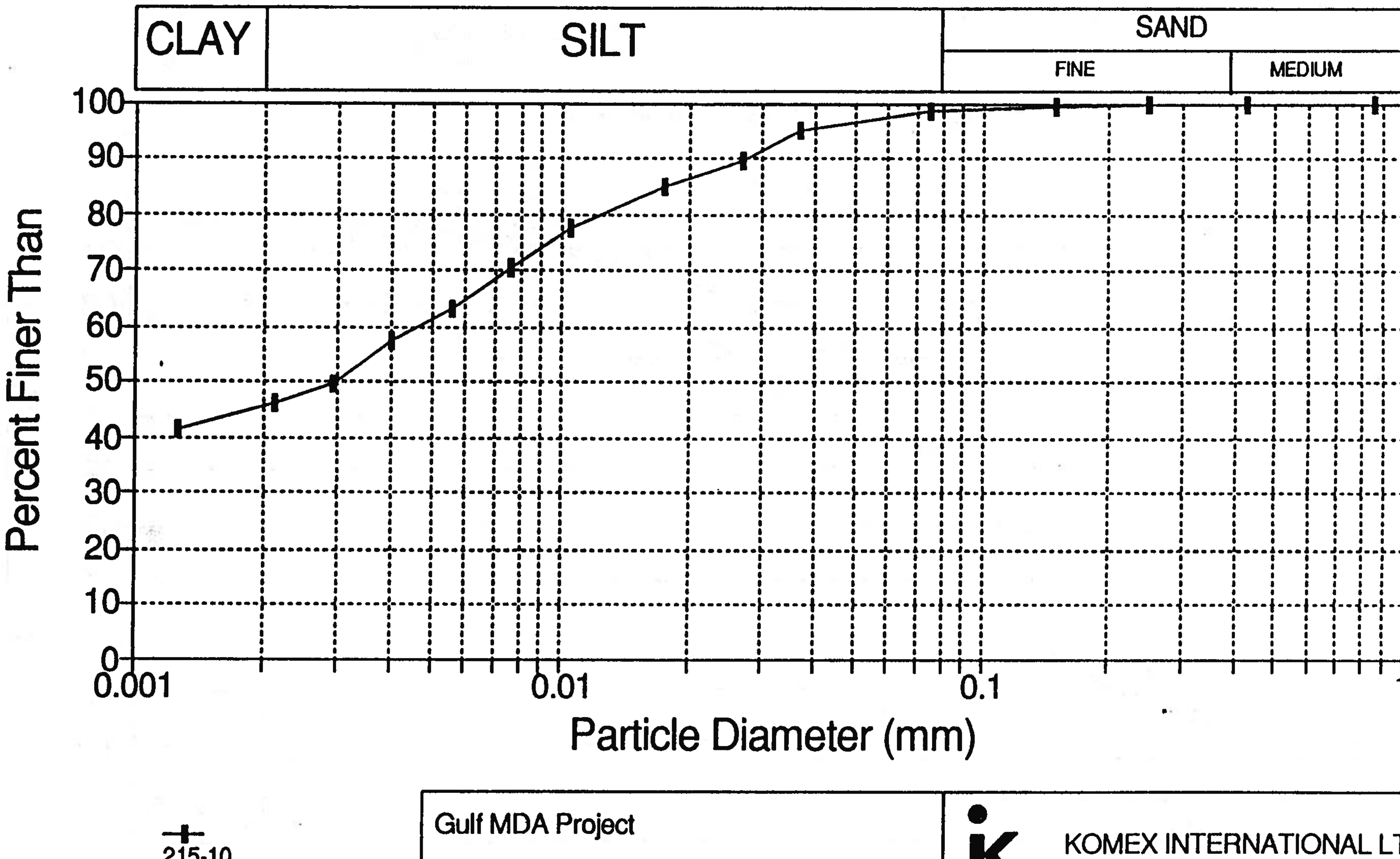
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS		
Grain Size Analysis BH-215 Channel Breccia		BY:	DATE:
		APPPROVED:	FIGURE:

Figure F.4.11 Grain Size Analysis of Key Facies - Crevasse Splay/Fluvial Channel



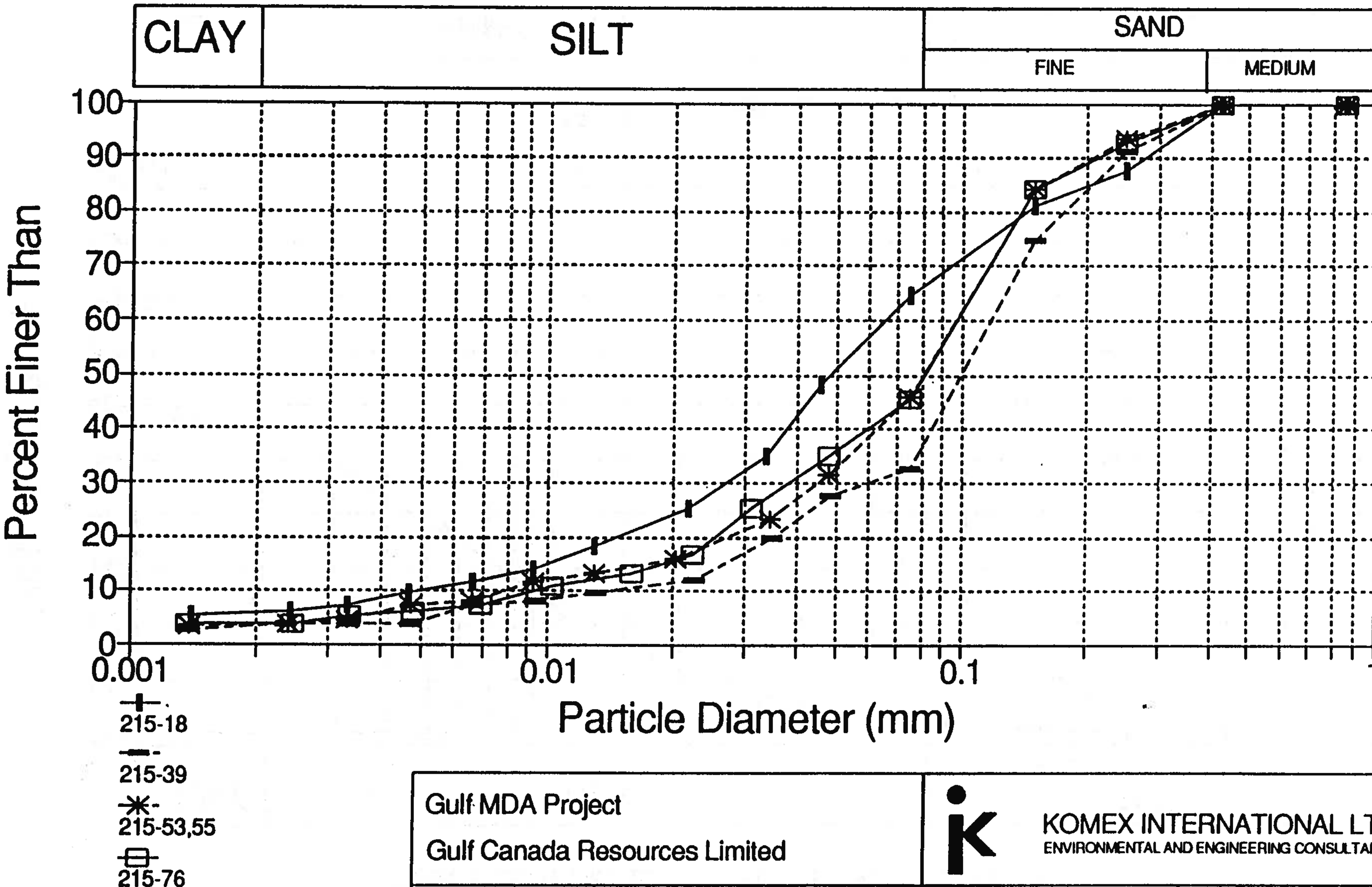
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-215 Crevasse Splay/Fluvial Channel	BY:	DATE:
	APPPROVED:	FIGURE:

Figure F.4.12 Grain Size Analysis of Key Facies - Salt Marsh



Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS		
Grain Size Analysis BH-215 Salt Marsh Samples		BY:	DATE:
		APPPROVED:	FIGURE:

Figure F.4.13 Grain Size Analysis of Key Facies - Upper Tidal Flat



Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-215 Upper Tidal Flat	BY: APPPROVED:	DATE: FIGURE:

Figure F.4.14 Grain Size Analysis of Key Facies - Pro Delta Mud

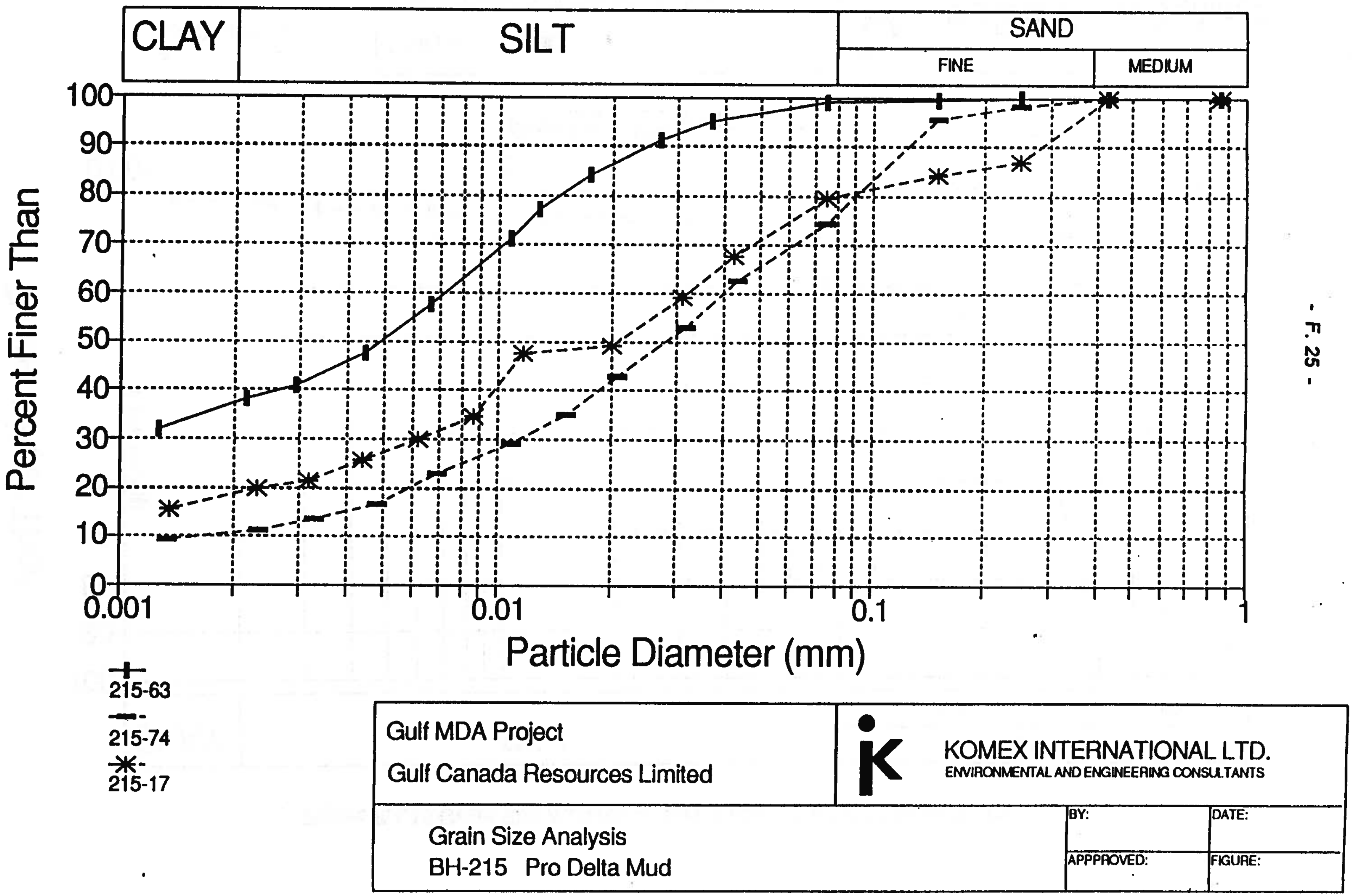
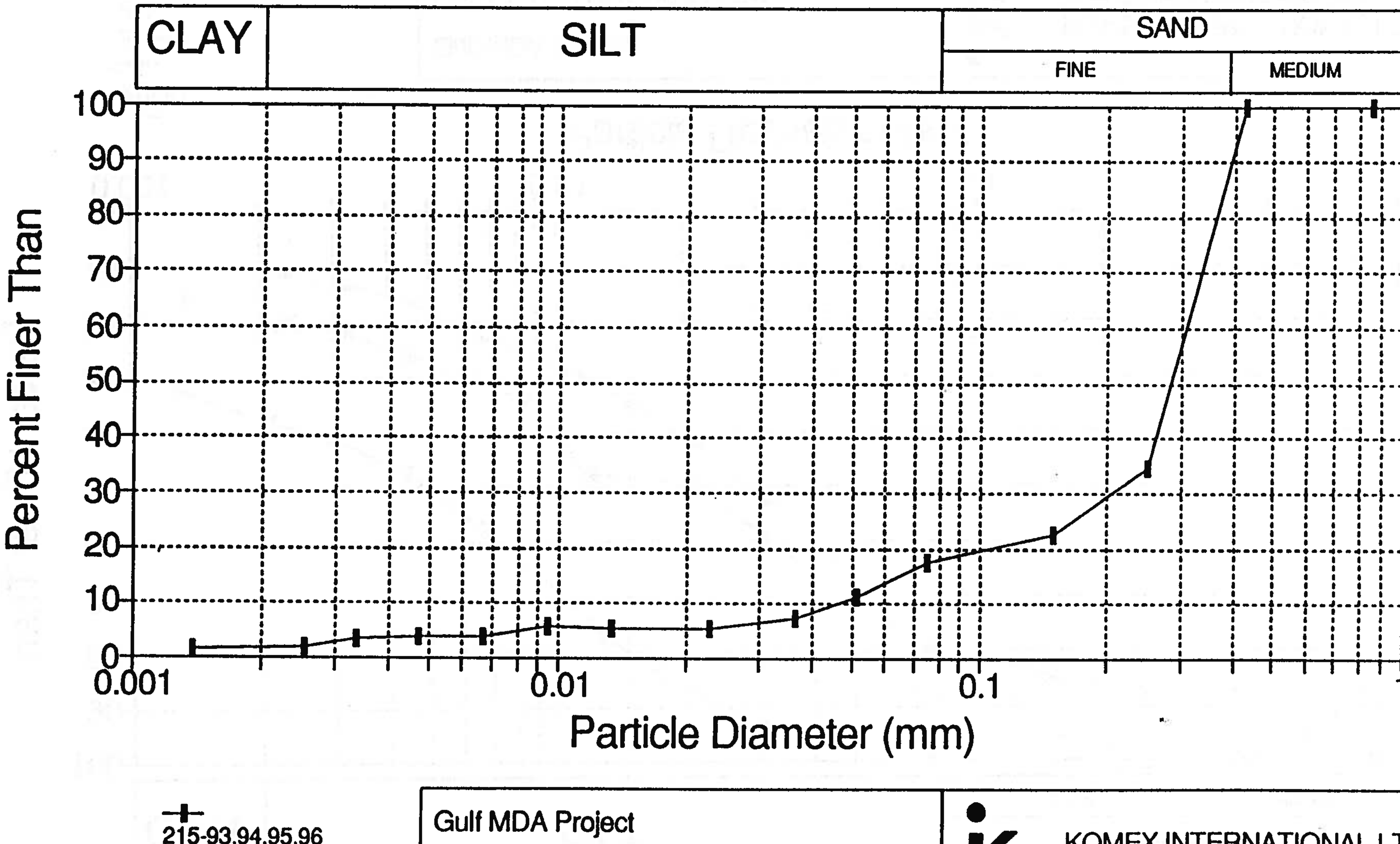
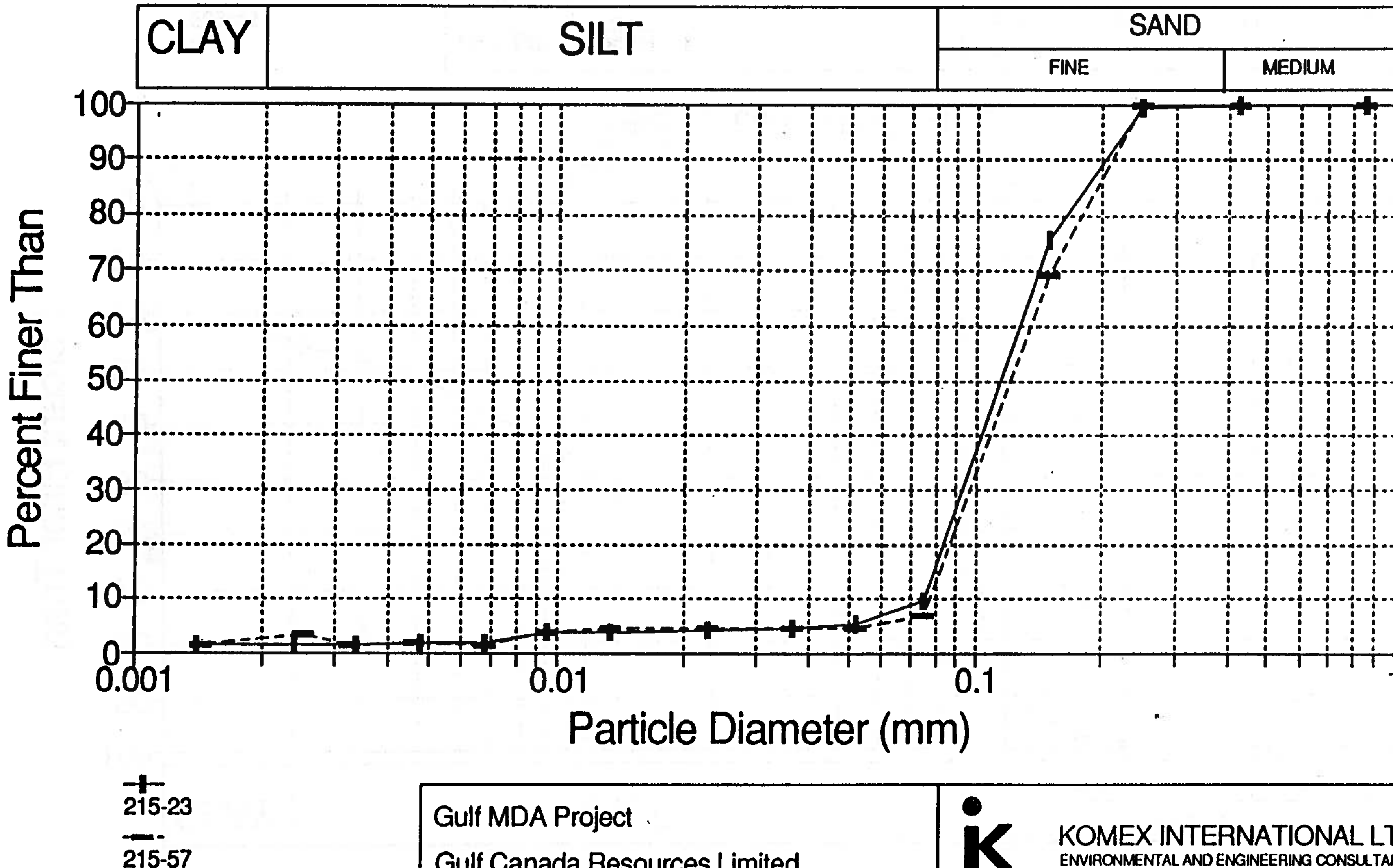


Figure F.4.15 Grain Size Analysis of Key Facies - Fluvial Channel/Water Sand



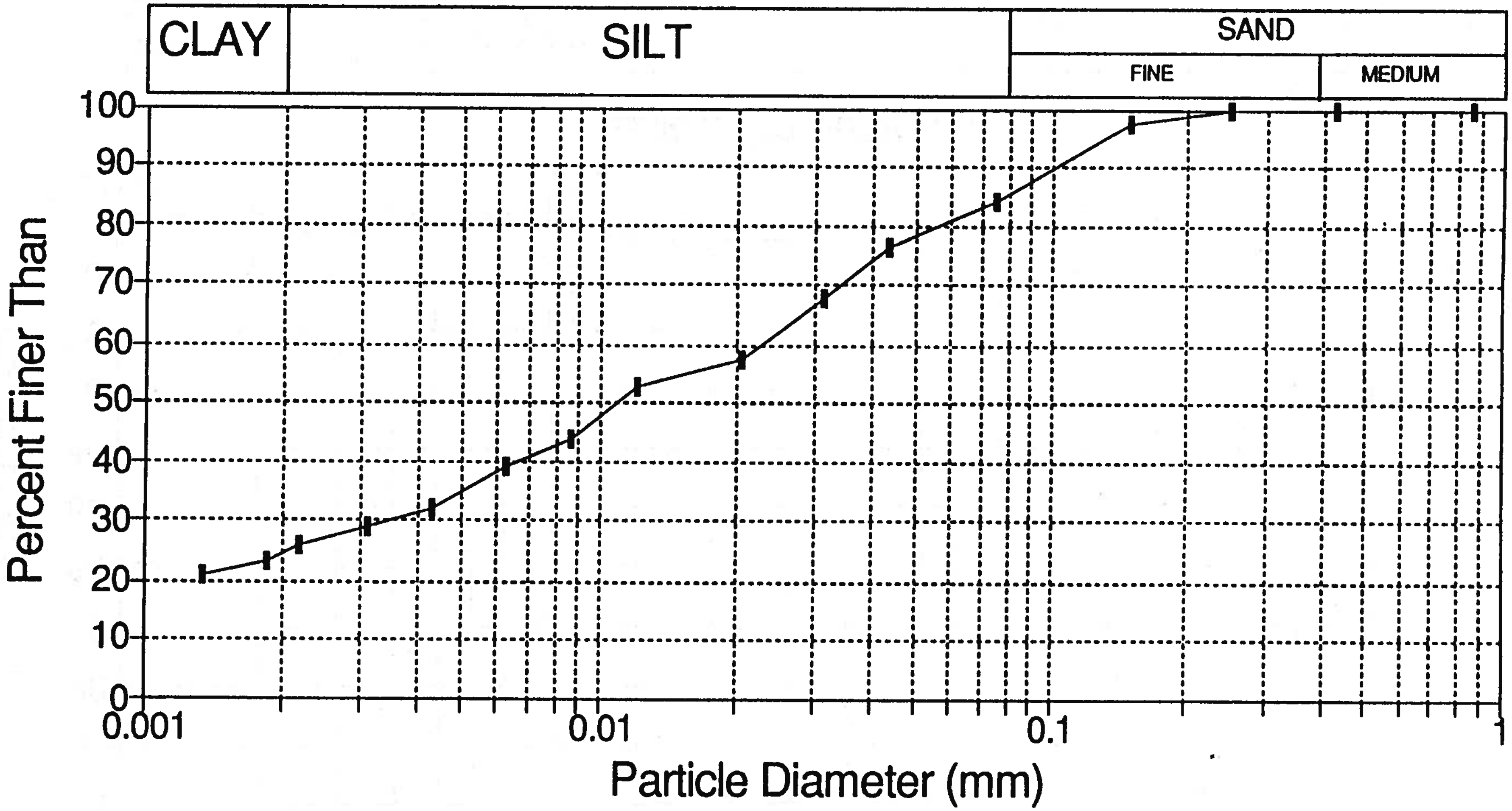
Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS
Grain Size Analysis BH-215 Fluvial Channel/Water Sand Samples	BY: DATE: APPPROVED: FIGURE:

Figure F.4.16 Grain Size Analysis of Key Facies - Interchannel - 215



Gulf MDA Project Gulf Canada Resources Limited		KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-215 Interchannel Samples		BY:	DATE:
		APPPROVED:	FIGURE:

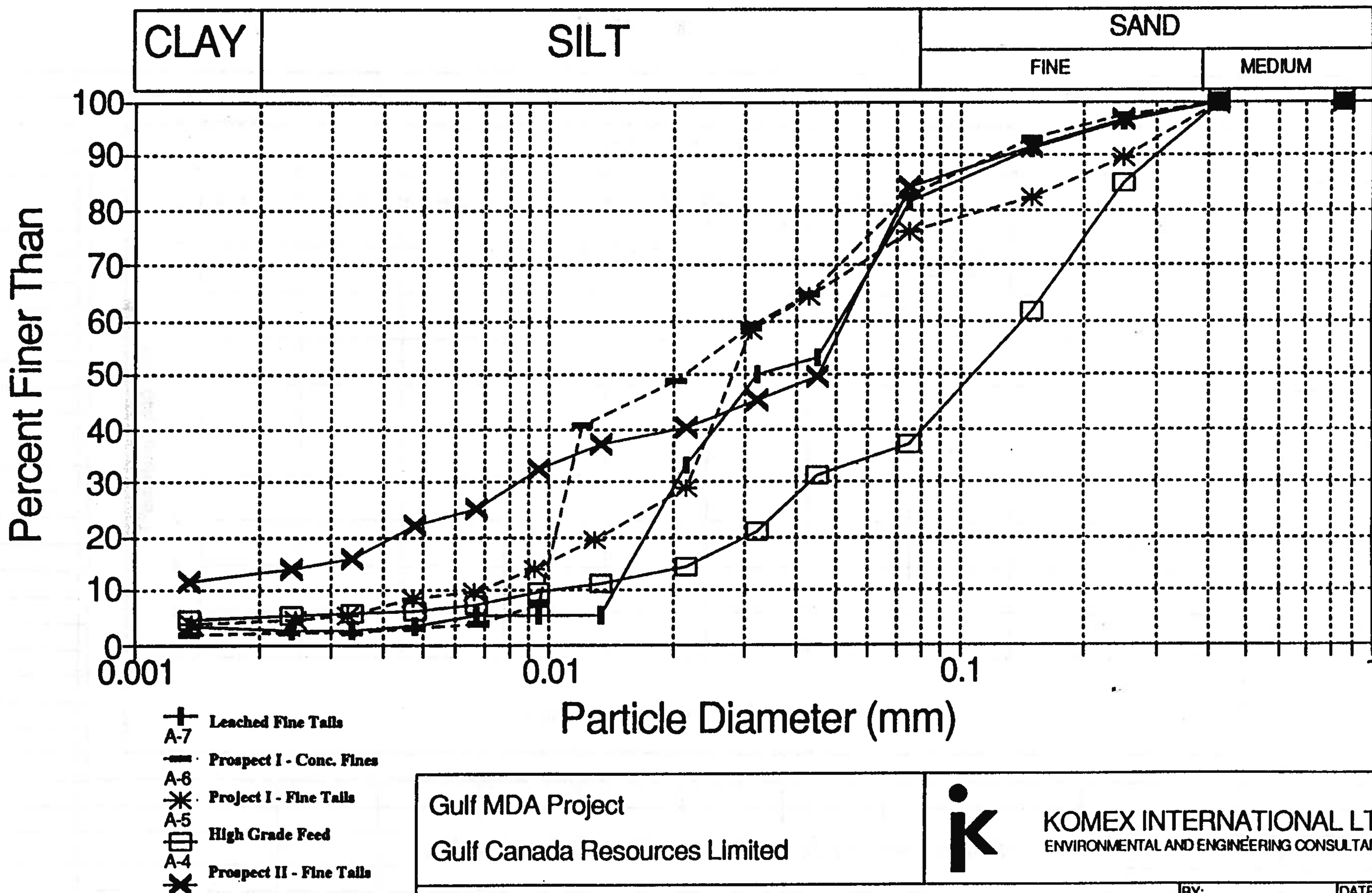
Figure F.4.17 Grain Size Analysis of Key Facies - Overbank Mud - 209



- F. 28

Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis BH-209 Overbank Mud Samples	BY:	DATE:
	APPPROVED:	FIGURE:

Figure F.4.18 Grain Size Analysis of Key Facies - Fine Tails Characterization



Gulf MDA Project Gulf Canada Resources Limited	KOMEX INTERNATIONAL LTD. ENVIRONMENTAL AND ENGINEERING CONSULTANTS	
Grain Size Analysis Oilsand Process Samples	BY:	DATE:
	APPPROVED:	FIGURE:

Figure F.5 Clay Content Indicated by Various Methods

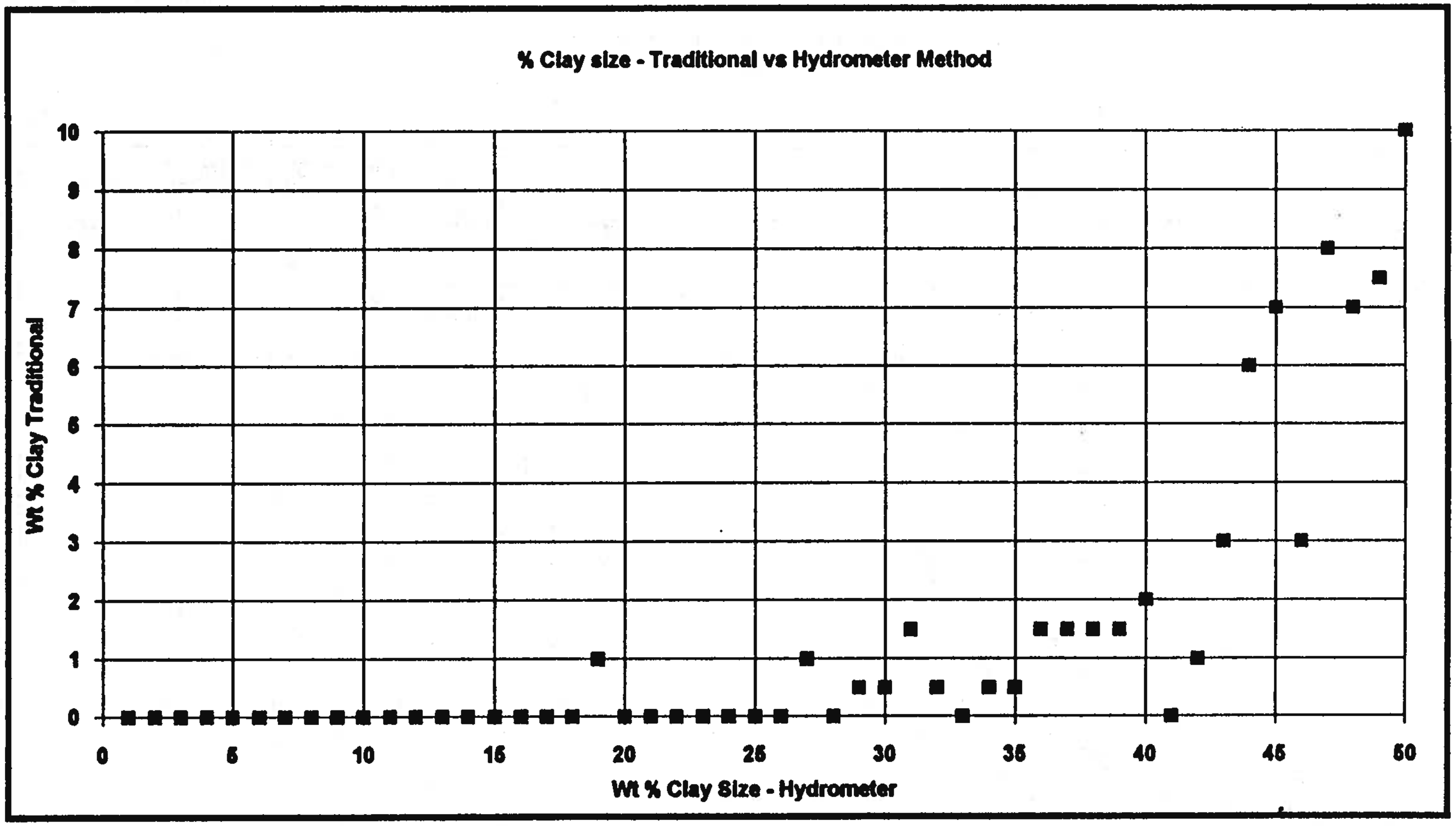
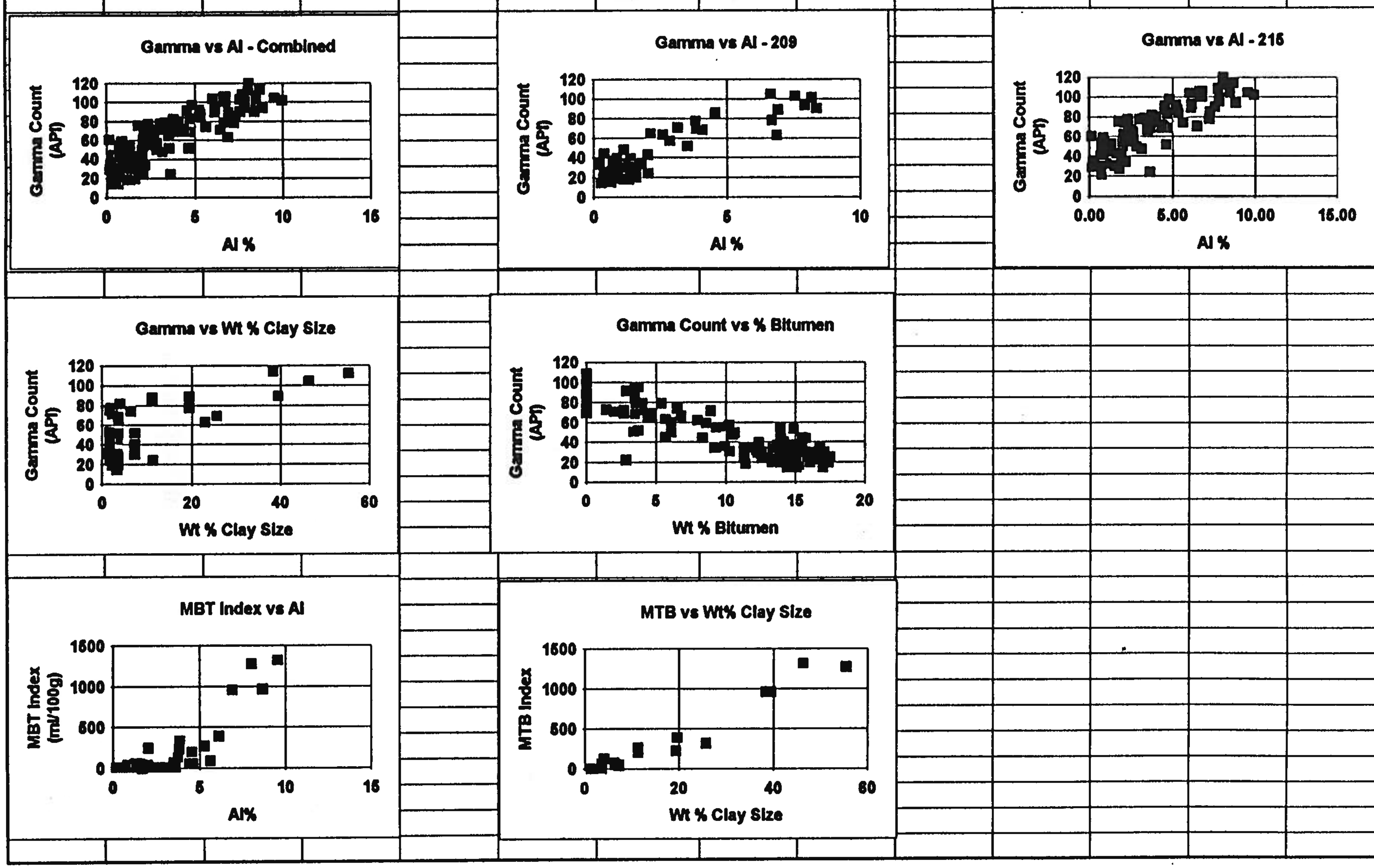


Figure F.6 Miscelleneous Cross Plots
Gamma and MTB Index vs Aluminum and % Clay



Appendix G

Descriptive Statistics

In this section statistical analyses of the elemental concentrations are presented.

Analyses are presented in the following manner:

The concentration of elements concentrations span 8 orders of magnitude. The breadth of the span creates problems with statistical analysis.

The presentations above illustrate different ways of displaying statistical analyses. Each approach has its advantages. The most useful presentations appear to be:

G.2 - to concisely show the range in data.
G.3 - summary and histogram plot for each element by facies.
G.4 - showing the range of concentrations for all elements in each facies.

Figure G.1.1 Distribution of Primary Elements - all data

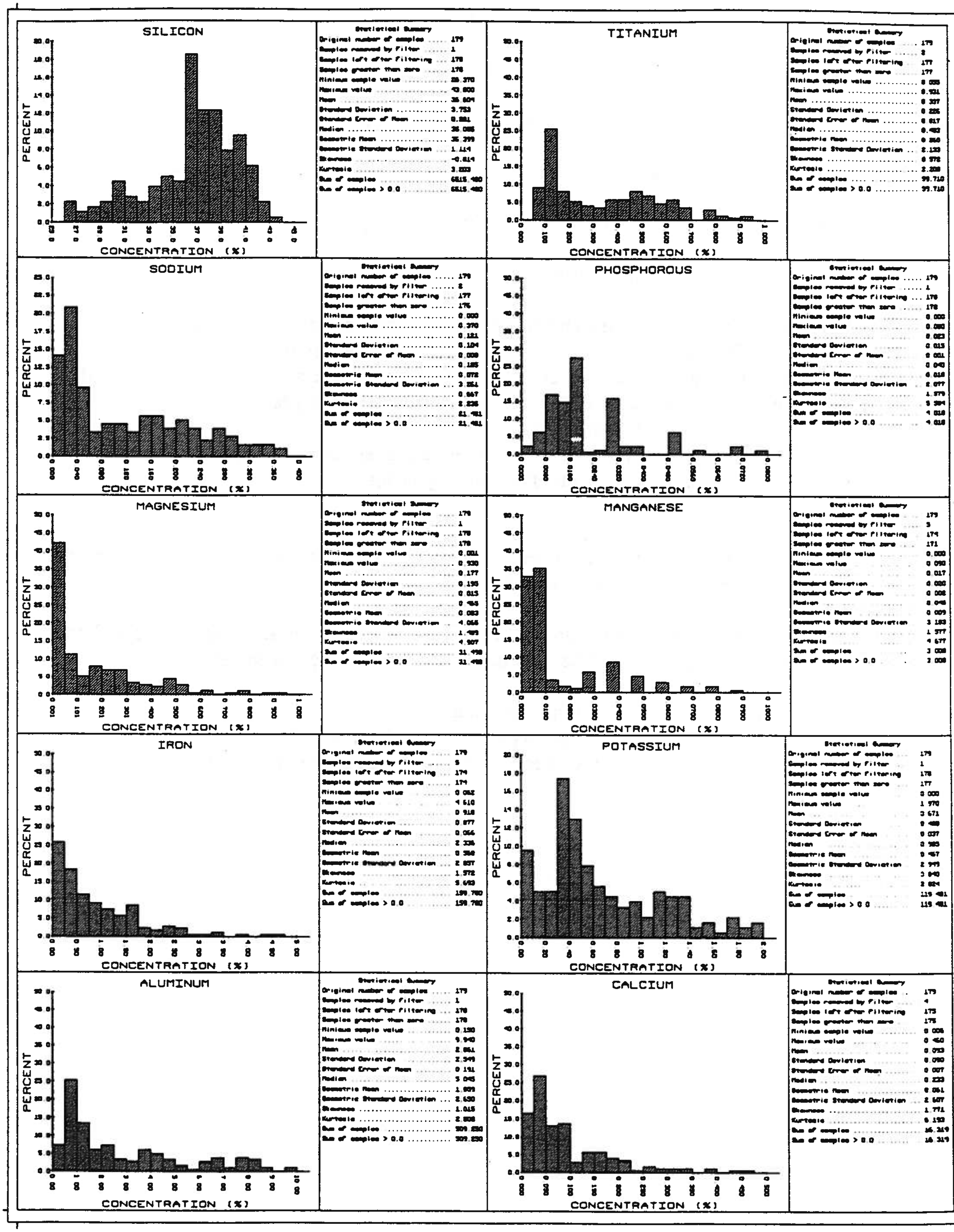


Figure G.1.2 Distribution of Minor Elements - all data

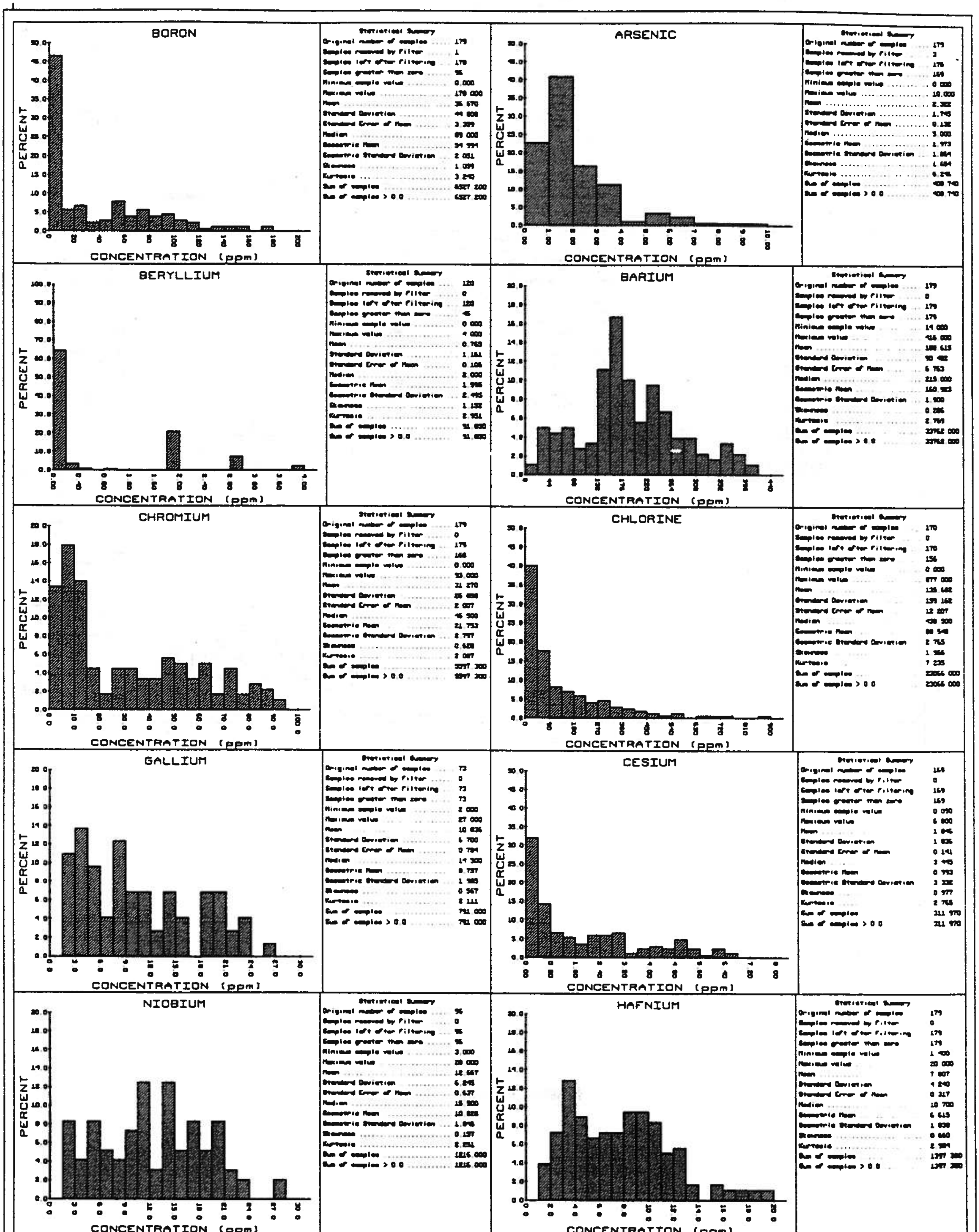


Figure G.1.2 Distribution of Minor Elements - all data.

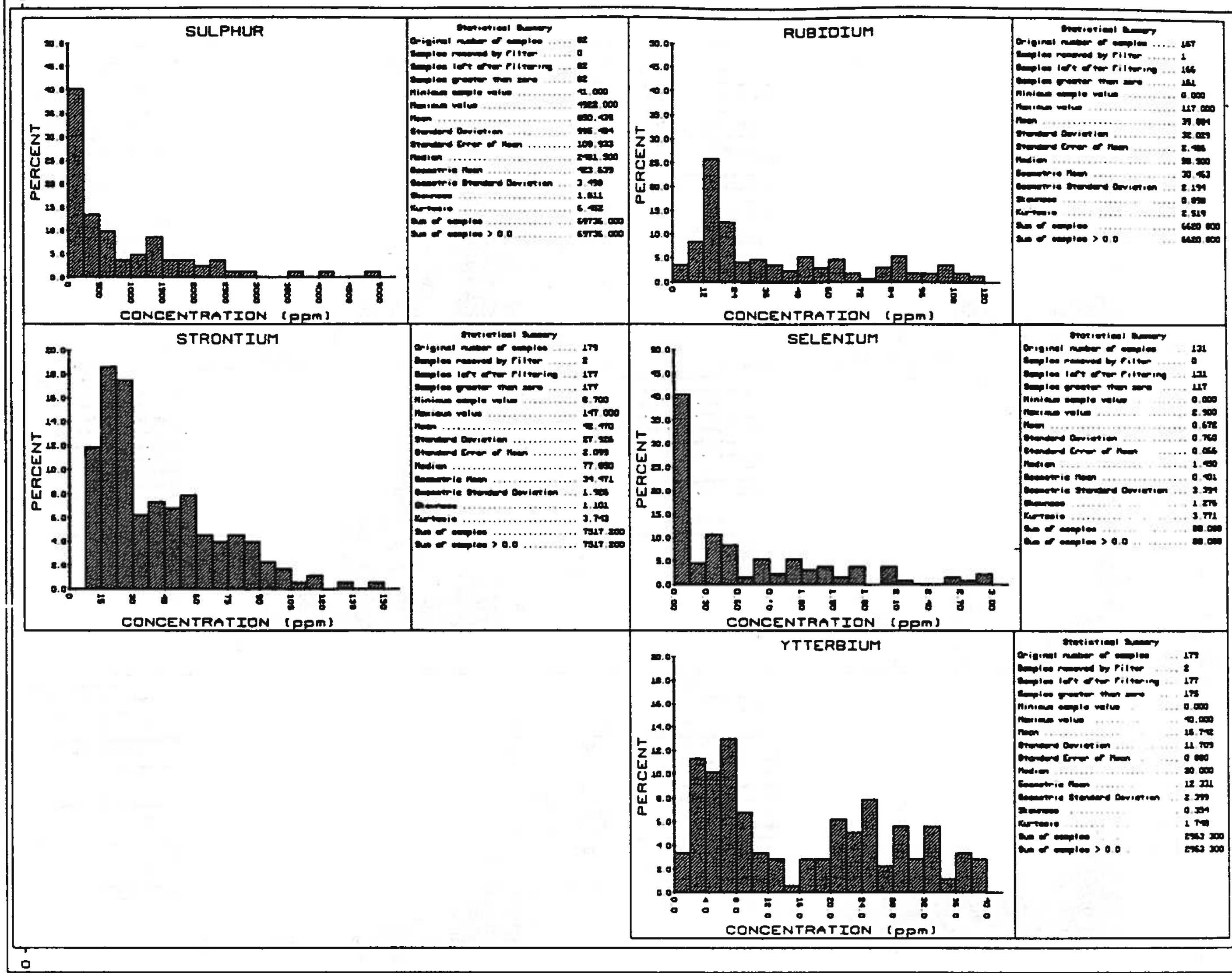


Figure G.1.3 Distribution of Metallic Elements - all data

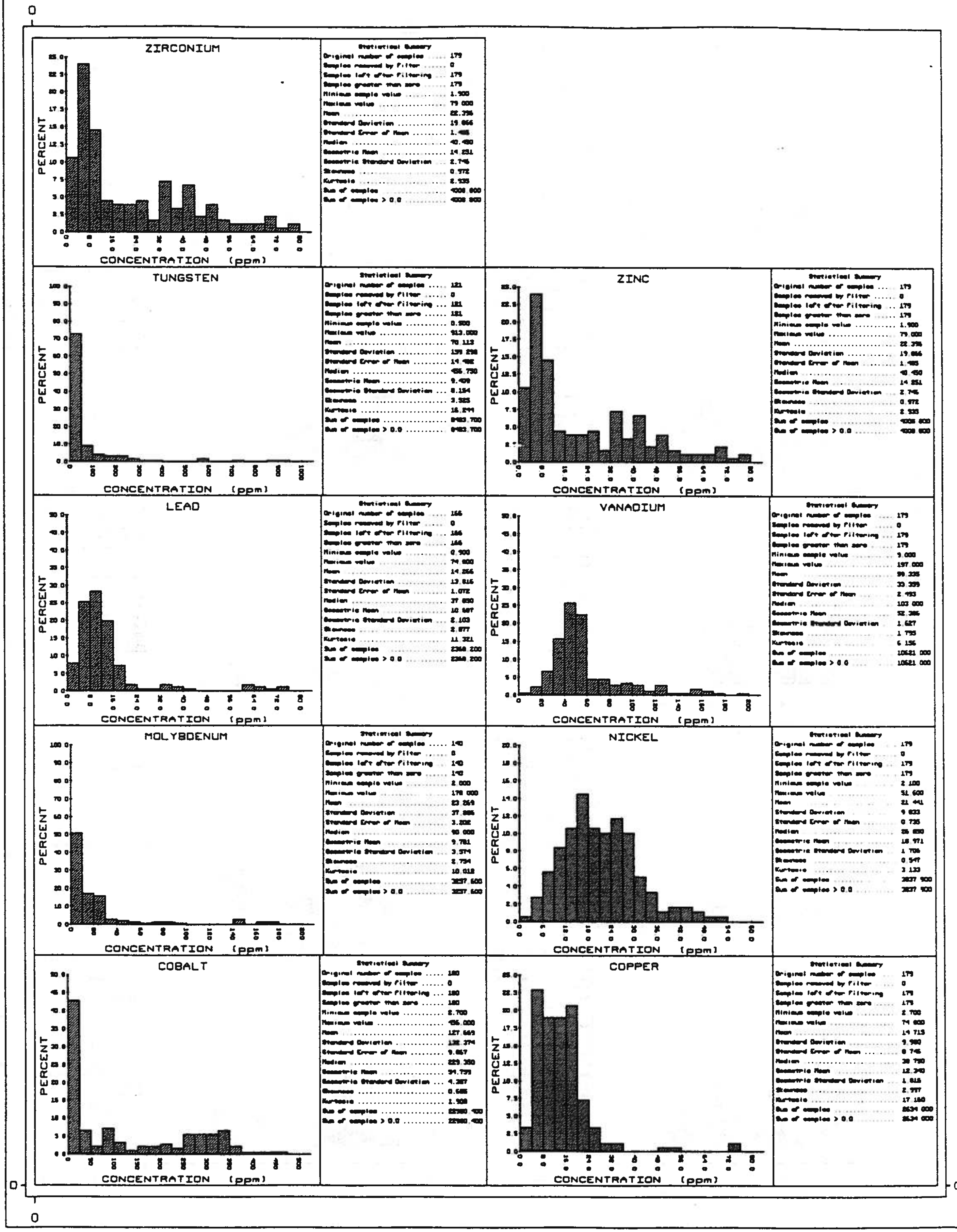


Figure G.1.4 Distribution of Rare Earth Elements - all data

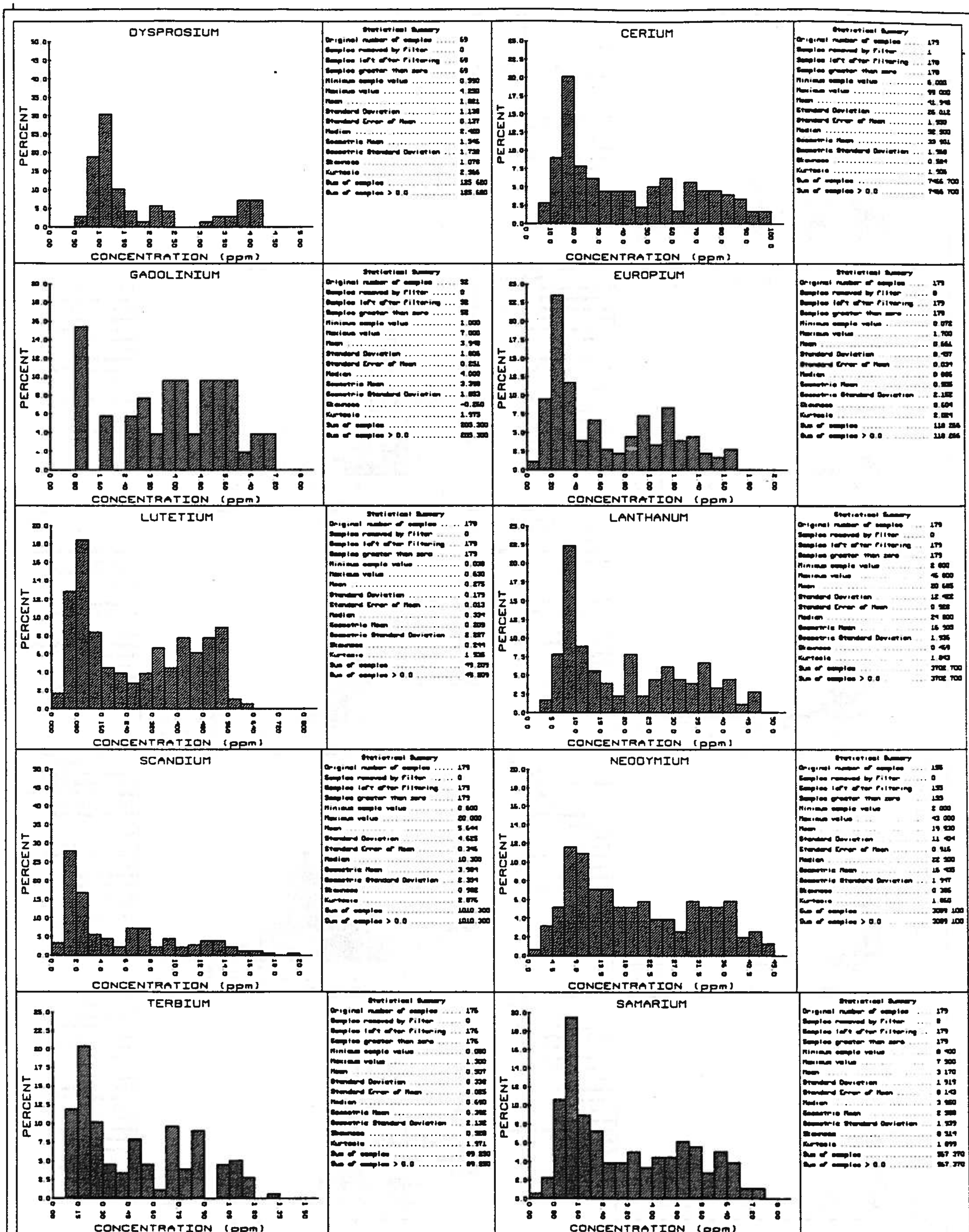


Figure G.1.4 Distribution of Rare Earth Elements - all data

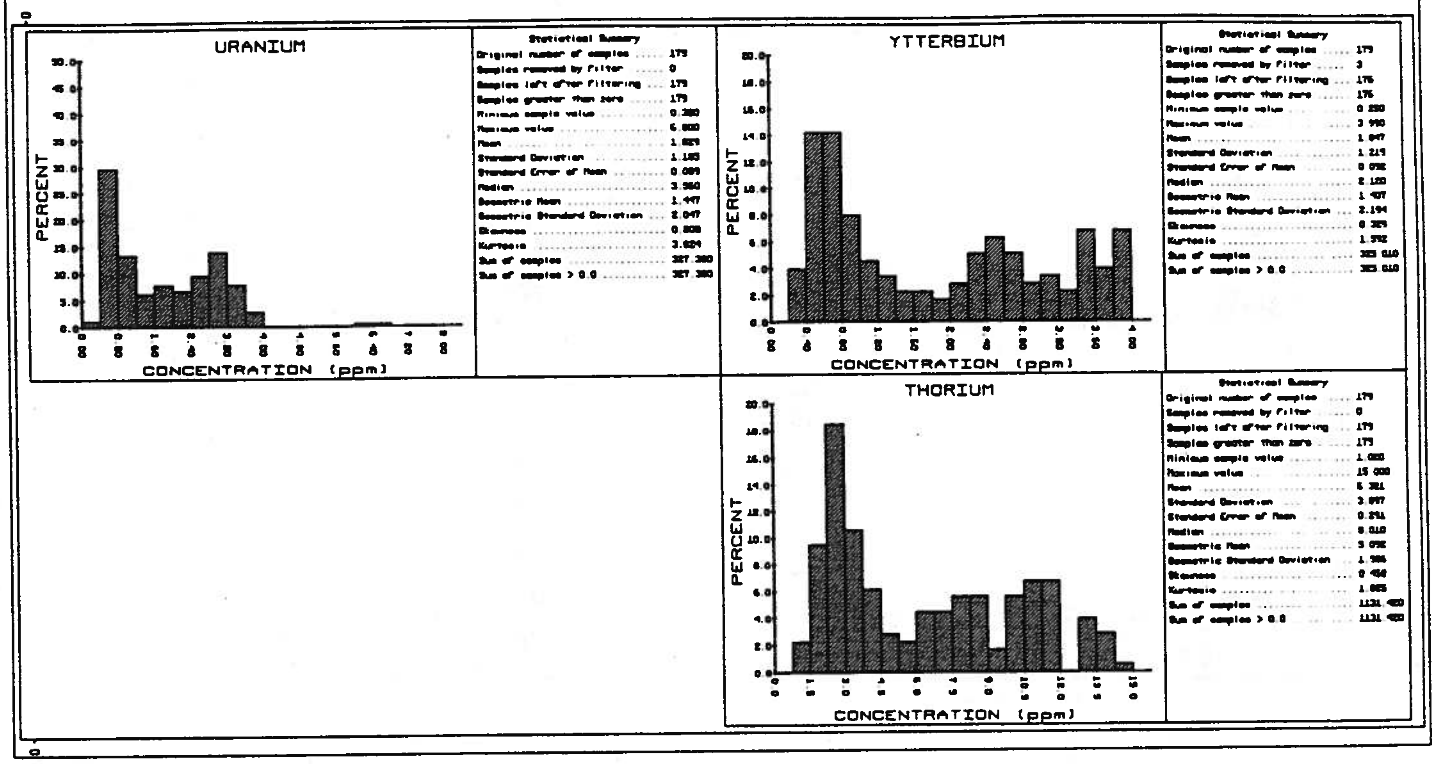


Figure G.1 5 Distribution of Trace Elements - all data

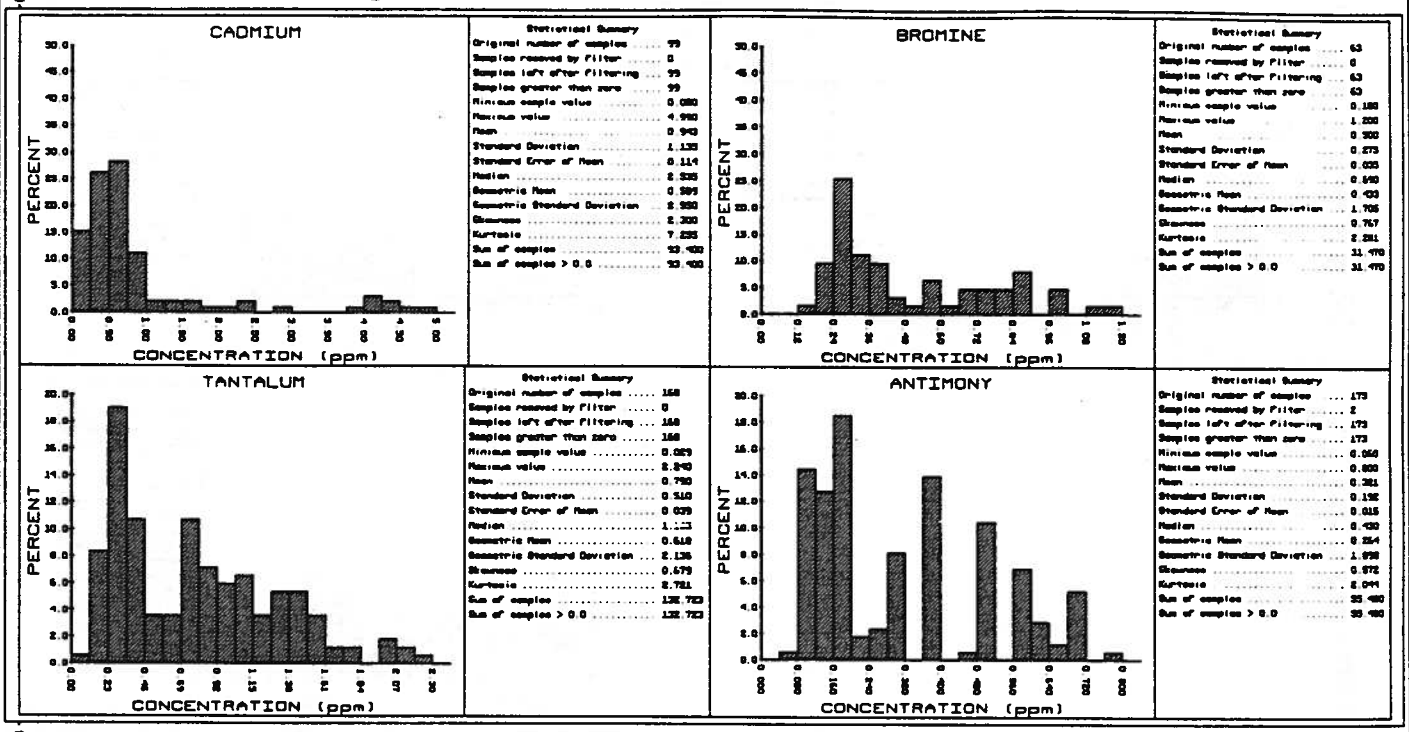


Figure G.1.6 Distribution of Precious Metals - all data

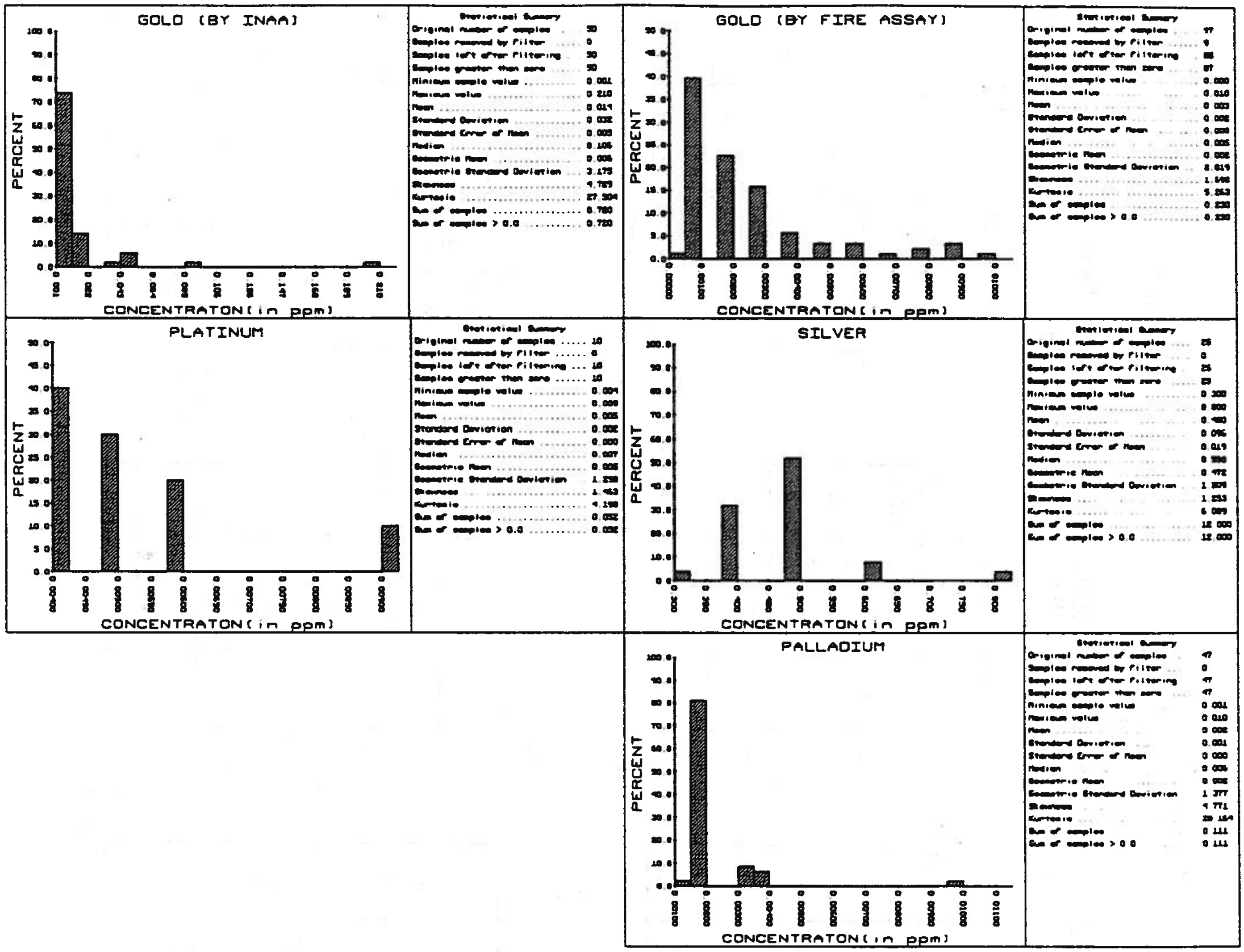


Figure G.2 Mean Elemental Concentration by Facies

Facies	Tidal Channel		Inter Channel		Lower Tidal Flat		Upper Tidal Flat		Salt Marsh		Pro Delta Mud		Fluvial Estuarine		Delta Marsh Mud	
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits
Primary Elements	Total N = 27		Total N = 26		Total N = 16		Total N = 27		Total N = 6		Total N = 16		Total N = 3		Total N =8	
Al (%)	27	0.77 +/- 0.06	26	1.16 +/- 0.13	16	2.19 +/- 0.46	27	3.99 +/- 0.44	6	8.83 +/- 0.64	16	6.65 +/- 0.56	3	0.54 +/- 0.17	8	6.16 +/- 1.47
Ca (%)	27	0.03 +/- 0.01	26	0.07 +/- .016	16	0.06 +/- .02	27	0.25 +/- 0.30	6	0.13 +/- 0.07	16	0.26 +/- 0.07	3	0.02 +/- .006	8	0.14 +/- 0.03
Fe (%)	27	0.21 +/- 0.07	26	0.44 +/- 0.13	16	0.76 +/- 0.16	27	1.33 +/- 0.16	6	2.18 +/- 1.09	16	3.58 +/- 0.99	3	0.15 +/- 0.02	8	1.28 +/- 0.32
K (%)	27	0.40 +/- 0.03	26	0.44 +/- .05	16	0.66 +/- 0.10	27	0.97 +/- 0.09	6	1.70 +/- 0.22	16	1.51 +/- 0.15	3	0.28 +/- 0.27	8	0.99 +/- 0.26
Mg (%)	27	0.03 +/- 0.009	26	0.057 +/- .017	16	0.13 +/- 0.03	27	0.24 +/- 0.03	6	0.52 +/- 0.13	16	0.49 +/- 0.10	3	0.01 +/- 0.004	8	0.38 +/- 0.10
Mn (%)	27	0.006+/- .002	26	0.009 +/- .002	16	0.013 +/- .004	27	0.04 +/- .009	6	0.027 +/- 0.02	16	0.076 +/- .016	3	0.0028 +/- .0004	8	0.0075 +/- .0036
Na (%)	27	0.034 +/- .005	26	0.031 +/- .013	16	0.122 +/- 0.03	27	0.18 +/- 0.02	6	0.33 +/- 0.02	16	0.26 +/- 0.02	3	0.010 +/- .007	8	0.22 +/- 0.05
P (%)	27	0.012 +/- .003	26	0.014 +/- .001	16	0.022 +/- .002	27	0.028 +/- 0.004	6	0.038 +/- .011	16	0.050 +/- 0.008	3	0.010 +/- .002	8	0.022 +/- 0.006
Si (%)	27	38.9 +/- 0.66	26	39.46 +/- 0.49	16	36.5 +/- 0.5	27	35.61 +/- 0.52	6	29.31 +/- 1.40	16	32.07 +/- 1.37	3	38.52 +/- 0.82	8	32.15 +/- 1.98
Ti (%)	27	0.13 +/- .008	26	0.15 +/- .017	16	0.33 +/- 0.05	27	0.41 +/- 0.03	6	0.64 +/- 0.02	16	0.56 +/- 0.03	3	0.066 +/- 0.01	8	0.74 +/- 0.07
Minor Elements																
As	27	1.18 +/- 0.17	26	1.37 +/- 0.13	15	4.0 +/- 1.6	27	3.33 +/- 0.53	6	3.67 +/- 1.1	16	4.12 +/- 0.67	3	1.15 +/- 0.08	7	2.14 +/- 0.5
B	11	20.7 +/- 2.7	2	41	15	58.7 +/- 8.49	27	71.6 +/- 7.5	6	145 +/- 15	16	91.7 +/- 7.2	0	-	0	-
Ba	27	163 +/- 7	26	167 +/- 8.2	15	218 +/- 17	27	252 +/- 11	6	379 +/- 24	16	330 +/- 20	3	125 +/- 35	8	150 +/- 33
Be	0	Not detected	2	2	1	2	9	2	6	3.2 +/- 0.3	16	2.5 +/- 0.4	1	0.4	4	0.21 +/- 0.13
Cl	26	38.6 +/- 9.4	26	39.0 +/- 9.6	14	103 +/- 28	24	163 +/- 59	5	76 +/- 30	14	274 +/- 71	0	-	8	117 +/- 53
Cr	26	8.07 +/- 1.00	26	10.45 +/- 1.47	15	34.2 +/- 6.4	27	48.5 +/- 4.5	6	79 +/- 15	16	69.5 +/- 3.5	2	6.8 +/- 5.8	8	62.0 +/- 12.3
Cs	25	0.28 +/- 0.04	26	0.44 +/- 0.07	15	1.24 +/- 0.30	27	2.43 +/- 0.32	6	5.2 +/- 0.9	16	4.05 +/- 0.41	3	0.21 +/- 0.02	8	4.82 +/- 0.92
Ga	0	Not detected	2	2.5 +/- 1	11	4.0 +/- 0.6	26	9.0 +/- 1.5	6	21.2 +/- 1.4	16	15.5 +/- 1.7	0	-	0	-
Hf	27	4.99 +/- 0.90	26	4.19 +/- 0.58	15	13.6 +/- 2.0	27	12.5 +/- 1.3	6	8.3 +/- 1.4	16	9.92 +/- 1.05	3	2.06 +/- 0.3	8	8.93 +/- 1.45
Nb	11	3.45 +/- 0.41	2	5.5 +/- 1.0	15	9.8 +/- 1.7	27	12.5 +/- 1.2	6	20.7 +/- 1.0	16	18.7 +/- 1.3	0	-	0	-
Rb	27	14.9 +/- 1.2	26	17.6 +/- 1.6	15	31.7 +/- 6.0	27	53.4 +/- 5.9	6	98 +/- 21	16	87.4 +/- 7.5	3	13.0 +/- 3.6	8	81.5 +/- 21.8
S	16	245 +/- 210	24	632 +/- 274	-	Not measured	-	Not measured	-	Not measured	-	Not Measured	3	571 +/- 145	8	2135 +/- 997
Se	17	0.21 +/- 0.15	20	0.16 +/- 0.09	5	1.62 +/- .65	16	1.75 +/- 0.27	3	2.0 +/- 0.7	9	1.55 +/- 0.54	1	0.06	8	0.44 +/- 0.04
Sr	27	18.7 +/- 2.2	26	24.4 +/- 1.3	15	34.4 +/- 6.4	27	54.6 +/- 12.7	6	112 +/- 15	16	79.6 +/- 5.3	3	17.8 +/- 4.2	8	66.3 +/- 9.6
Y	27	5.6 +/- 1.1	26	7.3 +/- 1.2	15	23.7 +/- 3.5	27	26.5 +/- 2.3	6	36.5 +/- 2.6	16	35.9 +/- 1.9	3	3.12 +/- 0.73	8	22.6 +/- 1.3

Note - all concentrations are in ppm unless designated otherwise

Figure G.2 Mean Elemental Concentration by Facies

Facies	Tidal Channel		Inter Channel		Lower Tidal Flat		Upper Tidal Flat		Salt Marsh		Pro Delta Mud		Fluvial Estuarine		Delta Marsh Mud	
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits
Metallic Elements	Total N = 27		Total N = 26		Total N = 16		Total N = 27		Total N = 6		Total N = 16		Total N = 3		Total N =8	
Co	27	134 +/- 45	26	260 +/- 33	16	27.7 +/- 16 5	27	25 7 +/- 8 6	6	19 2 +/- 4 6	16	20 6 +/- 1 6	3	364 +/- 16	8	92 3 +/- 10 5
Cu	27	10 9 +/- 5 1	26	9 48 +/- 2 43	16	16 9 +/- 5 9	27	17 1 +/- 1 5	6	21 5 +/- 2 4	16	17 8 +/- 1 5	3	11 7 +/- 6 2	8	16 7 +/- 2 3
Mo	20	12 2 +/- 2 8	26	21 3 +/- 3 2	7	3 28 +/- 1.33	17	3 11 +/- 0 50	6	3 5 +/- 0 8	11	2 54 +/- 0 3	3	9 52 +/- 5 10	8	130 +/- 30 3
Ni	27	16 5 +/- 3 0	26	16 1 +/- 2 3	15	26 9 +/- 3 0	27	28 3 +/- 1 4	6	36 1 +/- 8 1	16	32 1 +/- 2 9	3	15 3 +/- 1 7	8	20 4 +/- 9 3
Pb	24	8 72 +/- 1.75	26	12 5 +/- 1 3	15	10.3 +/- 1.7	25	12 5 +/- 1 8	6	14 5 +/- 2 1	15	9 6 +/- 1 3	3	5 55 +/- 2 44	8	57 +/- 11
Sn	0	Not Detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected
V	27	36.4 +/- 2.0	26	46 9 +/- 2 0	15	47.7 +/- 3.4	27	54 5 +/- 3 4	6	99 2 +/- 6 2	16	73 1 +/- 7 7	3	36 0 +/- 6 2	8	153 +/- 12
W	6	0 83 +/- 0 18	15	0 81 +/- 0 14	12	129 +/- 162	26	94 9 +/- 68 9	6	18.5 +/- 21 2	15	24 6 +/- 12 1	0	Not measured	8	11 0 +/- 7 6
Zn	27	7.07 +/- 0 87	26	10 2 +/- 1 23	15	24.3 +/- 4 4	27	36 1 +/- 3 5	6	62.6 +/- 16 4	16	53 75 +/- 5 4	3	3.4 +/- 0 3	8	36 9 =/- 8 9
Zr	27	144 +/- 41	26	157 +/- 31	15	529 +/- 83	27	343 +/- 93	6	315 +/- 19	16	112 +/- 59	3	42 +/- 20	8	327 +/- 69
Rare Earth Elements																
Ce	27	22 0 +/- 3 1	26	21 0 +/- 2 1	15	58 +/- 7.6	27	66 5 +/- 5 9	6	88 +/- 19	16	79 4 +/- 4 3	3	12 9 +/- 1 0	8	48 8 +/- 5 6
Dy	16	1 01 +/- 0 08	24	1 31 +/- 0 16	0	Not determined	0	Not determined	6	Not determined	0	Not determined	0	Not detected	8	3 95 +/- 0 21
Eu	27	0 27 +/- 0 08	26	0 310 +/- 0 034	15	0.905 +/- 0 132	27	1 05 +/- 0 09	6	1 49 +/- 0.32	16	1 36 +/- 0 08	3	0.17 +/- 0 03	8	0 76 +/- 0 11
Gd	7	1.48 +/- 0.55	2	1	15	3 77 +/- 0.58	18	4 69 +/- 0 63	6	5.78 +/- 1.32	3	5 07 +/- 0 77	0	Not detected	0	Not detected
La	26	10.8 +/- 1.5	26	10 3 +/- 1 0	15	26 2 +/- 3.3	27	31 1 +/- 2 7	5	40.8 +/- 8 6	16	39 2 +/- 1.8	3	6 67 +/- 0 40	8	26 2 +/- 3 1
Lu	26	0.111 +/- 0.181	26	0 107 +/- 0 01	15	0 40 +/- 0 06	27	0 456 +/- 0 04	6	0.49 +/- 0 08	16	0 50 +/- 0 01	3	0.055 +/- 0 007	8	0 36 +/- 0.02
Nd	25	10 7 +/- 1.3	25	12.3 +/- 1 3	15	24 4 +/- 3.2	27	29 2 +/- 2 7	6	36 +/- 7.6	16	36 2 +/- 1.9	3	5.41 +/- 0 20	3	20 0 +/- 0 8
Sc	27	1 88 =/- 0 75	26	2 12 +/- 0 16	15	4 48 +/- 1.01	26	6 88 +/- 0 77	6	15.7 +/- 2 8	16	12 43 +/- 1 13	3	1.67 +/- 0 32	8	11 2 +/- 1 6
Sm	27	1 62 +/- 0 74	26	1.76 +/- 0 18	15	4 11 +/- 0.56	27	4 90 +/- 0 42	6	6 0 +/- 1.3	16	6 11 +/- 0 36	3	1.05 +/- 0 11	8	3 96 +/- 0 46
Tb	27	0 22 +/- 0 03	24	0.22 +/- 0 03	15	0.66 +/- 0 11	27	0 78 +/- 0 07	6	1.05 +/- 0 22	16	1 06 +/- 0 06	3	0 123 +/- 0 042	8	0.57 +/- 0 06
Th	27	3 19 +/- 0.60	26	2.81 +/- 0 32	15	7 23 +/- 0 11	27	9 16 +/- 0 83	6	12.7 +/- 2 8	16	12 2 +/- 0 5	3	1.75 +/- 0 27	8	9 69 +/- 0 88
U	27	0 73 +/- 0 09	26	0.75 +/- 0 08	-	2 05 +/- 0.30	27	2 4 +/- 0 20	6	3 18 +/- 0 68	16	3 37 +/- 0 10	3	0.44 +/- 0 02	8	3 00 +/- 0 15
Yb	27	0 73 +/- 0 11	26	0.75 +/- 0 09	15	2 59 +/- 0.40	27	3 01 +/- 0 27	3	3.60 +/- 0 65	16	3 69 +/- 0.11	1	0 49 +/- 0 18	8	2.51 +/- 0 14

Note - all concentrations are in ppm unless designated otherwise

Figure G.2 Mean Elemental Concentration by Facies

Facies	Tidal Channel		Inter Channel		Lower Tidal Flat		Upper Tidal Flat		Salt Marsh		Pro Delta Mud		Fluvial Estuarine		Delta Marsh Mud	
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits
Trace Elements	Total N = 27		Total N = 26		Total N = 16		Total N = 27		Total N = 6		Total N = 16		Total N = 3		Total N =8	
Bi	0	Not determined	2	5	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined	8	92 3 +/- 10 5
Br	13	0 30 +/- 0 05	17	0 32 +/- 0 04	0	Not determined	1	0 06	1	0 6	0	Not determined	3	0 35 +/- 0 06	8	16.7 +/- 2 3
Cd	16	0 34 +/- 0 08	26	0 61 +/- 0 08	0	Not determined	9	0 53 +/- 0 05	0	Not determined	7	0 54 +/- 0 06	3	0 17 +/- 0 10	8	130 +/- 30 3
Hg	0	Not determined	2	1	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	NNot determined	8	20.4 +/- 9 3
Ir	0	Not determined	2	0 001	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determoned	8	57 +/- 11
Sb	26	0 13 +/- 0 01	26	0 17 +/- 0 02	15	0 307 +/- 0 048	27	0.43 +/- 0.06	6	0 62 +/- 0 13	16	0.58 +/- 0 04	3	Not detected	0	Not detected
Ta	23	0 29 +/- 0 04	26	0 34 +/- 0.04	14	0 721 +/- 0 155	26	0 87 +/- 0 07	6	1 20 +/- 0 21	16	1.18 +/- 0.07	3	36 0 +/- 6 2	8	153 +/- 12
Precious Metals																
Ag **	0	Not determined	2	450 +/- 100	2	400	11	509 +/- 67	2	500	5	500 +/- 60	0	Not determined	0	Not determined
Au **	0	Not determined	6	4 +/- 2	5	3 0 +/- 1 5	16	7.8 +/- 5.6	3	3 6 +/- 2.3	5	2.2 +/- 0.4	0	Not determined	2	4 5 +/- 7 9
Au* **	0	Not determined	2	2	15	3 0 +/- 1 5	16	7.8 +/- 5 6	6	2 2 +/- 1.6	5	2.2 +/- 0.4	0	Not determined	0	Not determined
Pd **	4	2 0 +/- 0 5	2	3	0	Not determined	11	2 6 +/- 0.5	0	Not determined	13	2.1 +/- 0.1	0	Not determined	0	Not determined
Pt **	2	4.5 +/- 1.0	2	5	5	5 0 +/- 1 0	1	5	0	Not determined	0	Not determined	0	Not determined	0	Not determined

* Au determined by Fire assay method

** reported in ppb

Note - all concentrations are in ppm unless designated otherwise

Figure G.2 Mean Elemental Concentration by Facies

Facies	Overbank Mud		Crevasse Splay		Coal		Fluvial Channel		Fluvial Channel O & W		Fluvial Channel W/S		Channel Breccia	
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits
Primary Elements	Total N = 6		Total N = 11		Total N = 3		Total N = 20		Total N = 3		Total N = 4		Total N = 2	
Al (%)	6	7.83 +/- 1.04	11	2.24 +/- 0.57	3	4.56 +/- 3.56	20	0.79 +/- 0.20	3	0.37 +/- 0.32	4	2.28 +/- 0.87	2	2.48 +/- 1.30
Ca (%)	6	0.29 +/- 0.07	11	0.10 +/- 0.02	3	0.39 +/- 0.44	20	0.032 +/- 0.012	3	0.027 +/- 0.017	4	0.095 +/- 0.085	2	0.045 +/- 0.098
Fe (%)	6	2.45 +/- 0.92	11	0.93 +/- 0.35	3	1.34 +/- 0.50	20	0.35 +/- 0.21	3	0.43 +/- 0.12	4	0.445 +/- 0.060	2	0.62 +/- 0.22
K (%)	6	1.44 +/- 0.22	11	0.21 +/- 0.098	3	0.61 +/- 0.62	20	0.25 +/- 0.07	3	0.070 +/- 0.078	4	0.115 +/- 0.084	2	0.72 +/- 0.22
Mg (%)	6	0.53 +/- 0.13	11	0.112 +/- 0.041	3	0.35 +/- 0.16	20	0.025 +/- 0.013	3	0.030 +/- 0.011	4	0.067 +/- 0.049	2	0.12 +/- 0.08
Mn (%)	6	0.037 +/- 0.016	11	0.006 +/- .002	3	0.006 +/- 0.004	20	.0028 +/- .0005	3	0.01	4	0.01 +/- 0.01	2	0.03
Na (%)	6	0.24 +/- 0.13	11	0.165 +/- 0.047	3	0.39 +/- 0.24	20	0.038 +/- 0.020	3	0.05 +/- 0.02	4	0.122 +/- 0.045	2	0.125 +/- 0.049
P (%)	6	0.041 +/- 0.014	11	0.016 +/- .002	3	0.058 +/- 0.07	20	0.010 +/- .002	3	0.02	4	0.045 +/- 0.023	2	0.02
Si (%)	6	30.75 +/- 1.27	11	37.61 +/- 1.34	3	20.89 +/ 14.02	20	39.15 +/- 0.8	3	40.71 +/- 1.31	4	41.3 +/- 0.6	2	37.02 +/- 0.02
Ti (%)	6	0.68 +/- 0.11	11	0.59 +/- 0.12	3	0.95 +/- 0.35	20	0.19 +/- 0.07	3	0.21 +/- 0.17	4	0.115 +/- 0.088	2	0.24 +/- 0.10
Minor Elements														
As	6	5.14 +/- 2.00	10	3.16 +/- 2.65	3	9.1 +/- 11.8	15	1.12 +/- 0.27	3	1.67 +/- 0.7	4	1.19 +/- 2.3	2	2
B	4	149 +/- 26	4	61 +/- 36	1	339	0	Not determined	3	12.7 +/- 7.9	4	16.7 +/- 6.9	2	29.5 +/- 2.9
Ba	6	239 +/- 21	11	63 +/- 15	3	219 +/- 163	20	96 +/- 24	3	33 +/- 20	4	68 +/- 47	2	225 +/- 29
Be	5	1.66 +/- 0.67	0	Not determined	2	0.66 +/- 0.66	0	Not determined	0	3.2 +/- 0.3	0	Not determined	0	Not determined
Cl	4	288 +/- 65	11	314 +/- 120	3	184 +/- 147	11	150 +/- 71	3	Not determined	4	674 +/- 157	2	114 +/- 33
Cr	6	77 +/- 14	10	28 +/- 6	3	47 +/- 31	12	6.72 +/- 2.87	3	8.07 +/- 5.60	4	27.0 +/- 5.0	2	23.5 +/- 6.8
Cs	6	5.54 +/- 0.90	10	1.66 +/- 0.73	3	2.3 +/- 1.7	20	0.68 +/- 0.47	0	Not determined	1	0.7	2	1.15 +/- 0.49
Ga	4	23 +/- 3	2	5.0 +/- 1.9	1	7	0	Not determined	0	Not determined	4	4.75 +/- 1.47	2	3.5 +/- 2.9
Hf	6	8.28 +/- 1.38	11	8.93 +/- 0.97	3	6.6 +/- 2.5	20	5.01 +/- 0.93	3	4.23 +/- 2.61	4	2.95 +/- 2.32	2	6.95 +/- 0.29
Nb	4	24.5 +/- 4.0	4	14.2 +/- 3.9	1	18	0	Not determined	2	9.5 +/- 4.9	4	8.25 +/- 2.815	2	8.0 +/- 3.9
Rb	6	94.7 +/- 10.7	7	29.4 +/- 12.2	2	30 +/- 19	16	23.3 +/- 12.5	0	Not determined	0	Not determined	2	30.0 +/- 7.9
S	2	2981 +/- 2132	7	1817 +/- 329	2	2254 +/- 478	20	432 +/- 223	0	Not determined	0	Not determined	0	Not determined
Se	5	0.82 +/- 0.49	10	0.62 +/- 0.23	3	0.93 +/- 0.85	15	0.21 +/- 0.07	2	1.05 +/- 0.29	0	Not determined	2	0.8 +/- 0.2
Sr	6	92 +/- 20	11	45.9 +/- 1.4	3	367 +/- 539	20	18.1 +/- 3.2	3	18.3 +/- 10.7	4	53 +/- 15	2	34 +/- 13
Y	6	28.6 +/- 2.7	11	17.3 +/- 3.7	3	22.5 +/- 0.49	20	5.9 +/- 1.3	3	6.0 +/- 6.3	4	5.8 +/- 6.3	2	16 +/- 4

Note - all concentrations are in ppm unless designated otherwise

Figure G.2 Mean Elemental Concentration by Facies

Facies	Overbank Mud		Crevasse Splay		Coal		Fluvial Channel		Fluvial Channel O & W		Fluvial Channel W/S		Channel Breccia			
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits		
Metallic Elements	Total N = 6		Total N = 11		Total N = 3		Total N = 20		Total N = 3		Total N = 4		Total N = 2			
Co	6	46 4 +/- 38 9	11	124 +/- 48	3	60 6 +/- 56 2	20	342 +/- 20	3	13 7 +/- 6 8	4	55 0 +/- 40 8	2	6 3 +/- 1 0		
Cu	6	20 0 +/- 1 5	11	19 4 +/- 7 1	3	18 3 +/- 3 5	20	8 55 +/- 2 23	3	14 3 +/- 4 3	4	38 2 +/- 24 9	2	8 5 +/- 2 9		
Mo	3	96 4 +/- 92 5	11	35 4 +/- 17 6	3	86 +/- 94	20	15.3 +/- 4 3	0	Not determined	4	2 75 +/- 0 94	1	2		
Ni	6	33 1 +/- 9 5	11	16 4 +/- 3 2	3	9 2 +/- 4 9	20	12 6 +/- 2 9	3	16 7 +/- 2 3	4	19.7 +/- 2 6	2	24		
Pb	6	32 6 +/- 18.9	9	20.9 +/- 7 6	3	38 4 +/- 34 4	20	5 37 +/- 1.95	1	8	4	9 25 +/- 1 23	1	8		
Sn	0	Not Detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected	0	Not detected		
V	6	101 +/- 16	11	78 +/- 25	3	123 +/-	20	49 1 +/- 6 2	3	25 3 +/- 7 3	4	28 2 +/- 9 3	2	48 0 +/- 7 8		
W	6	5 9 +/- 3 2	11	94 +/- 56	3	124 +/- 103	8	269 +/- 206	1	110	4	108 +/- 84	0	Not measured		
Zn	6	52 8 +/- 8 9	11	11 9 +/- 4 3	3	17 6 +/- 15 1	20	4 53 +/- 1 00	3	3 33 +/- 2 61	4	4 75 +/- 0 93	2	21 0 +/- 9 8		
Zr	6	144 +/- 107	11	248 +/- 117	3	238 +/- 237	20	179 +/- 34	1	9	4	11 2 +/- 1 8	2	21 5 +/- 8 8		
Rare Earth Elements																
Ce	6	73 2 +/- 4 3	11	30 5 +/- 6 5	3	46 1 +/- 5 9	20	17 0 +/- 2 3	3	8 67 +/- 2 61	4	35.7 +/- 7.22	2	34 0 +/- 5 9		
Dy	0	Not determined	7	3 07 +/- 0 64	2	3 94 +/- 0 07	12	1 40 +/- 0.31	0	Not determined	0	Not determined	0	Not detected		
Eu	6	1.17 +/- 0 08	11	0 479 +/- 0 125	3	0 52 +/- 0 04	20	0 28 +/- 0 10	3	0 153 +/- 0 057	4	0.33 +/- 0.05	2	0 56 +/- 0 11		
Gd	0	Not determined	0	Not determined	0	Not determined	0	Not determimed	0	Not determined	0	Not determined	0	Not detected		
La	6	37 8 +/- 2 5	11	15 8 +/- 3 4	3	26 5 +/- 3 7	20	9 10 +/- 1.25	3	4 27 +/- 1 44	4	19 2 +/- 5.2	2	16 9 +/- 2 94		
Lu	6	0 475 +/- 0.045	11	0.302 +/- 0 04	3	0 32 +/- 0 09	20	0 116 +/- 0.027	3	0 12 +/- 1 44	4	0.08 +/- 0.06	2	0 23 +/- 0 04		
Nd	6	29 8 +/- 3 6	5	14 8 +/- 7 3	1	16	10	9 06 +/- 3.62	3	3 33 +/- 1 32	4	12 5 +/- 3.0	2	15 0 +/- 2 0		
Sc	6	12 83 +/- 0 79	11	6 82 +/- 2.54	3	10 7 +/- 3 6	20	2 65 +/- 0.38	3	1.03 +/- 0 43	4	2 72 +/- 1.21	2	3 45 +/- 1 08		
Sm	6	5.55 +/- 0 50	11	2 51 +/- 0 60	3	3 20 +/- 0 68	20	1 40 +/- 0 18	3	0 567 +/- 0 173	4	1 75 +/- 0.29	2	2 55 +/- 0 49		
Tb	6	0 83 +/- 0 04	11	0 447 +/- 0 105	3	0 47 +/- 0 06	20	0 236 /- 0.072	2	0 2	4	0 25 +/- 0.06	2	0 45 +/- 0 10		
Th	6	12 0 +/- 1 0	11	5.91 +/- 1.04	3	8 32 +/- 2 19	20	3 06 +/- 0 52	3	1 9 +/- 0 8	4	4 10 +/- 1 75	2	5 30 +/- 0 59		
U	6	3 07 +/- 0 28	11	2 98 +/- 1 10	3	3 06 +/- 0 78	20	0 93 +/- 0 21	3	0 867 +/- 0 397	4	1 62 +/- 0 97	2	1 50 +/- 0 39		
Yb	6	3.22 +/- 0.16	11	2 03 +/- 0.32	3	2 22 +/- 0 71	20	0 81 +/- 0 18	3	0 767 +/- 0 523	4	0 54 +/- 0 41	2	1 55 +/- 0 21		

Note - all concentrations are in ppm unless designated otherwise

Figure G.2 Mean Elemental Concentration by Facies

Facies	Overbank Mud		Crevasse Splay		Coal		Fluvial Channel		Fluvial Channel O & W		Fluvial Channel W/S		Channel Breccia			
Element	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits	Number of Samples	Mean +/- Confidence Limits		
Trace Elements	Total N = 6		Total N = 11		Total N = 3		Total N = 20		Total N = 3		Total N = 4		Total N = 2			
Bi	0	Not determined	1	6	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined		
Br	1	1	8	0 73 +/- 0 11	2	0 93 +/- 0 07	12	0 51 +/- 0 16	0	Not determined	4	0 85 +/- 0 17	0	Not determined		
Cd	6	1 93 +/- 1 37	8	1 36 +/- 0 40	3	2 47 +/- 2 18	15	0 35 +/- 0 14	0	Not determined	0	Not determined	0	Not determined		
Hg	0	Not determined	0	Not detected	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined		
Ir	0	Not determined	0	Not detected	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determoned		
Sb	6	0 64 +/- 0 07	11	0 40 +/- 0 08	3	0 62 +/- 0 23	20	0 174 +/- 0 044	2	0 15 +/- 0.10	4	0 15 +/- 0 06	2	0 3		
Ta	6	1 34 +/- 0 33	11	1 39 +/- 0 29	3	1 47 +/- 0 72	20	0 638 +/- 0 232	2	0 55 +/- 0 29	3	0 50 +/- 0 30	2	0 55 +/- 0 10		
Precious Metals																
Ag **	2	400	0	Not determined	0	Not determined	0	Not determined	1	500	0	Not determined	1	300		
Au **	0	Not determined	5	17 3 +/- 11 3	1	3	4	11 4 +/- 4 4	0	Not determined	4	16 +/- 20	0	Not determined		
Au* **	4	1 75 +/- 0 9	4	1 5 +/- 0 5	1	0 4	0	Not determined	3	1 7 +/- 1 3	4	36 +/- 32	0	Not determined		
Pd **	4	2	4	2	1	1	0	Not determined	3	2	4	4 +/- 4	2	2		
Pt **	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined	0	Not determined		

* Au determined by Fire assay method

** reported in ppb

Note - all concentrations are in ppm unless designated otherwise

Figure G.3.1 Statistics of the concentration of selected elements by facies
Aluminum

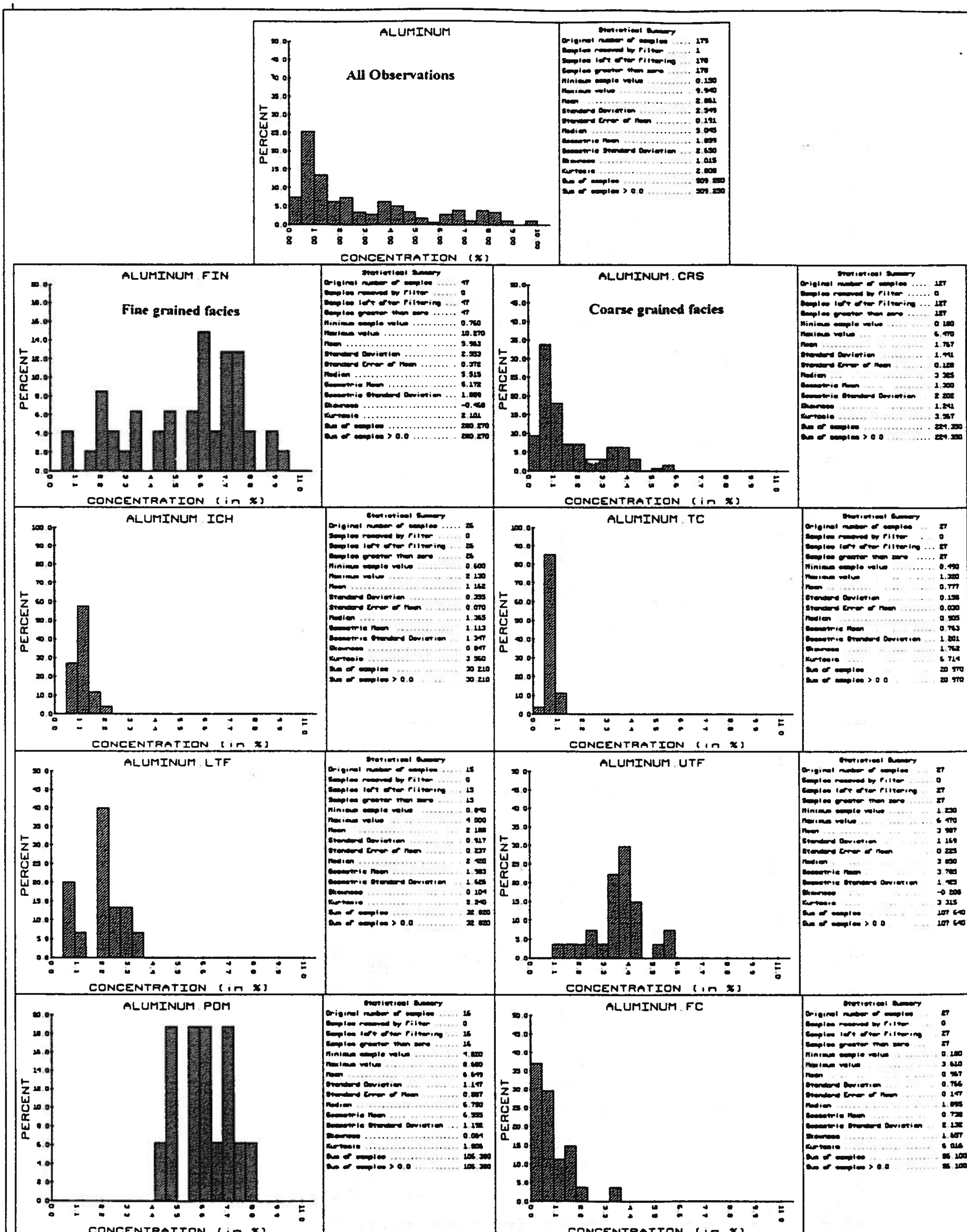


Figure G.3.2 Statistics of the concentration of selected elements by facies
Barium

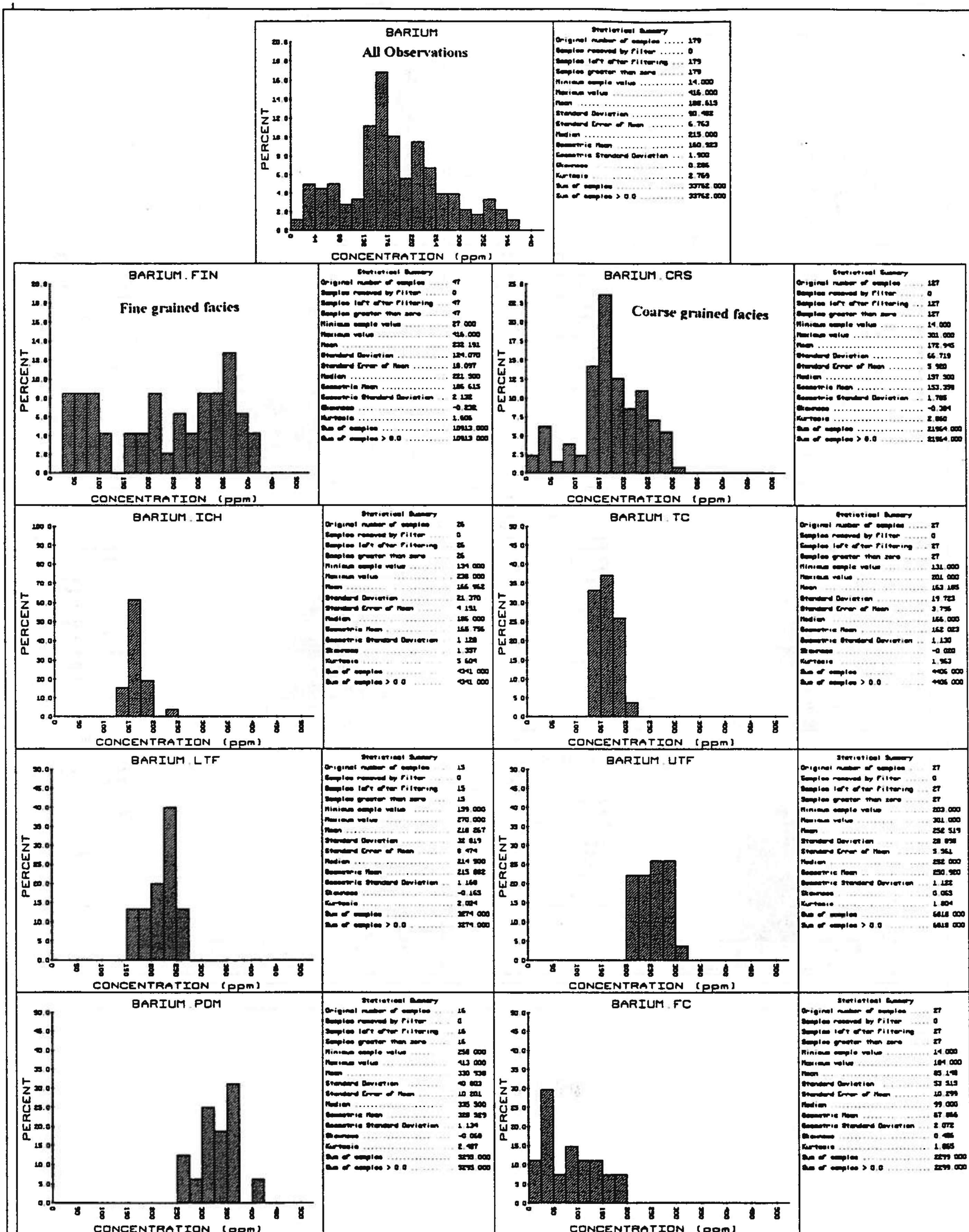


Figure G.3.3 Statistics of the concentration of selected elements by facies
Boron

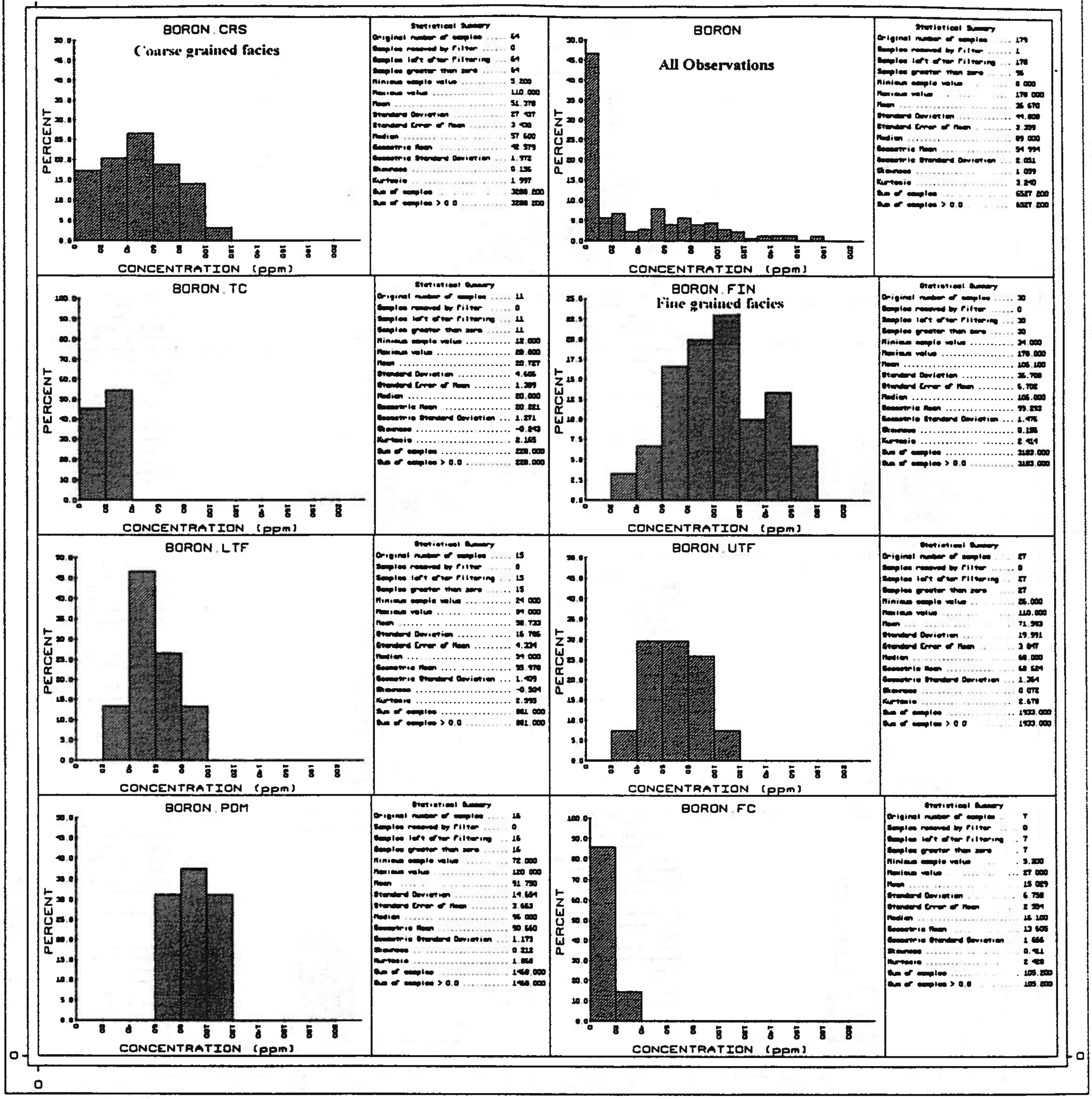


Figure G.3.4 Statistics of the concentration of selected elements by facies
Chlorine

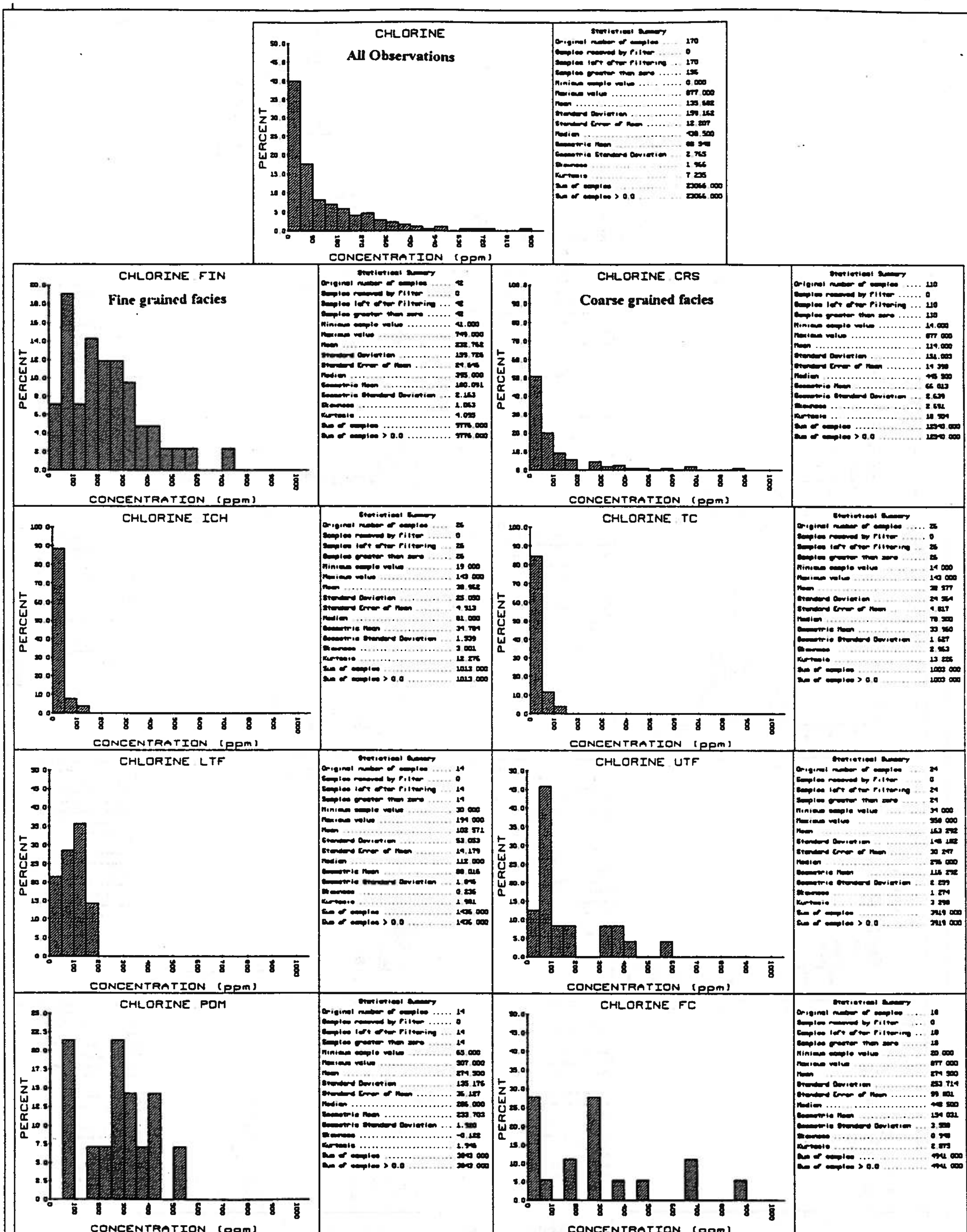


Figure G.3.5 Statistics of the concentration of selected elements by facies
Cobalt

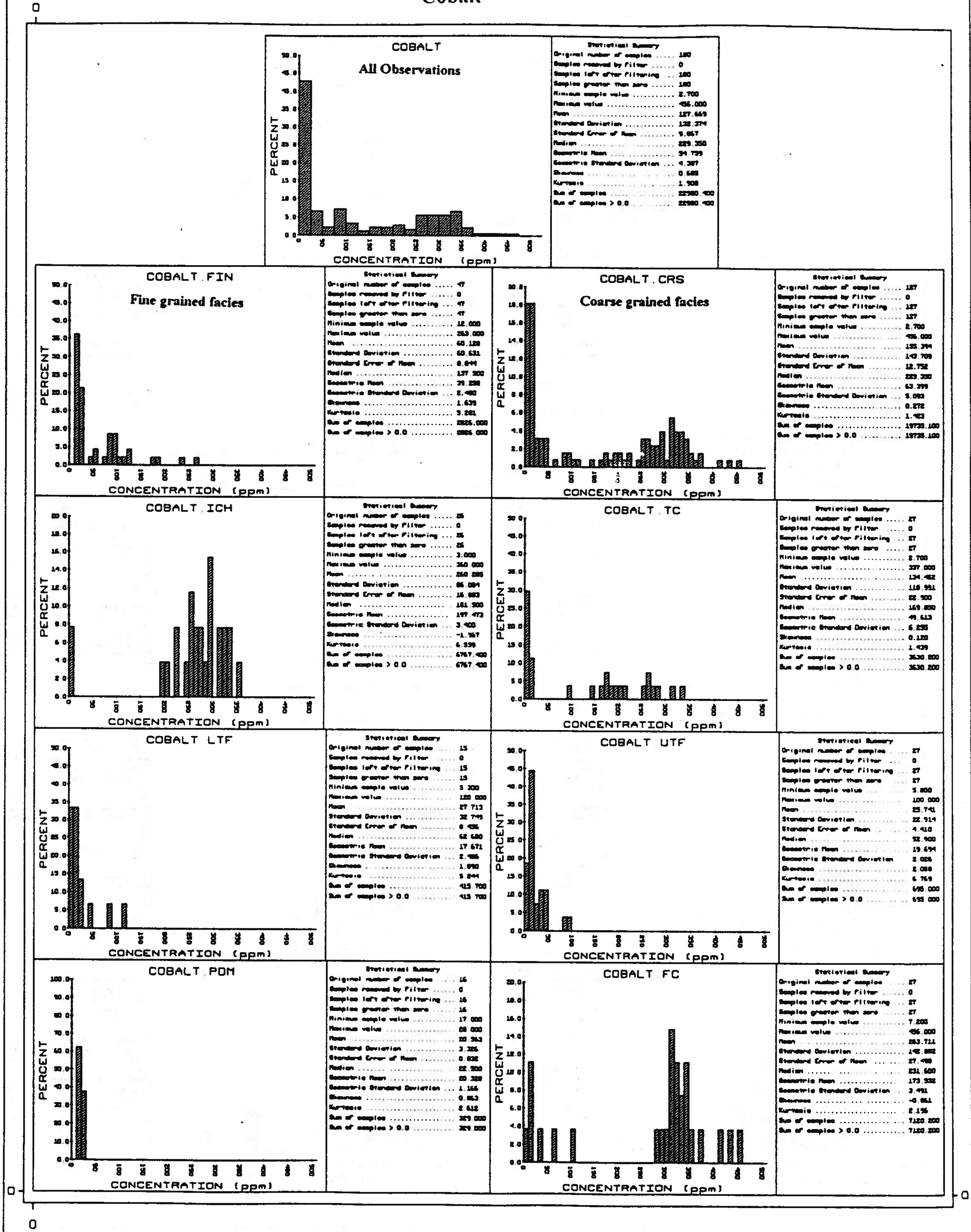


Figure G.3.6 Statistics of the concentration of selected elements by facies
Nickel

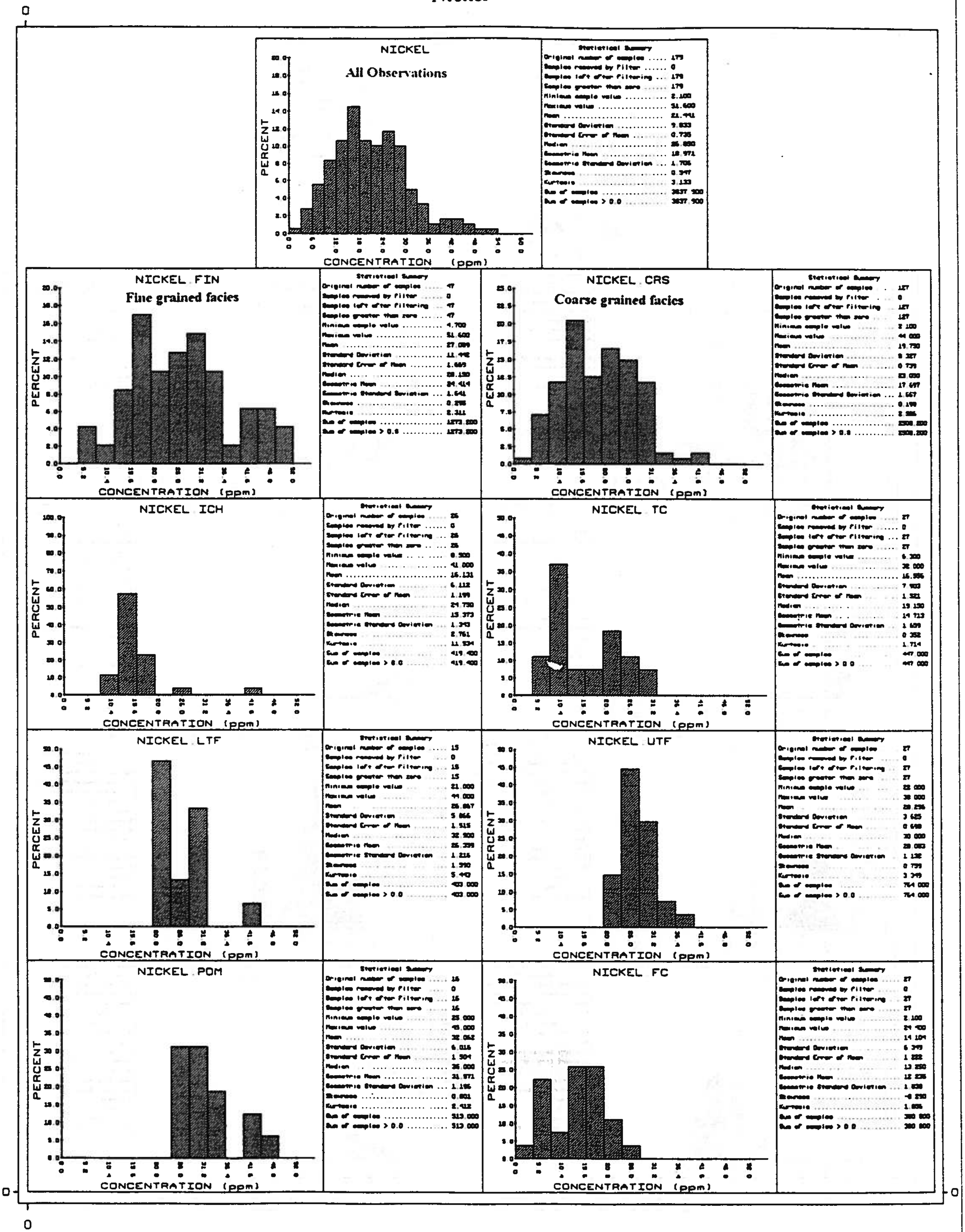


Figure G.3.7 Statistics of the concentration of selected elements by facies
Sodium

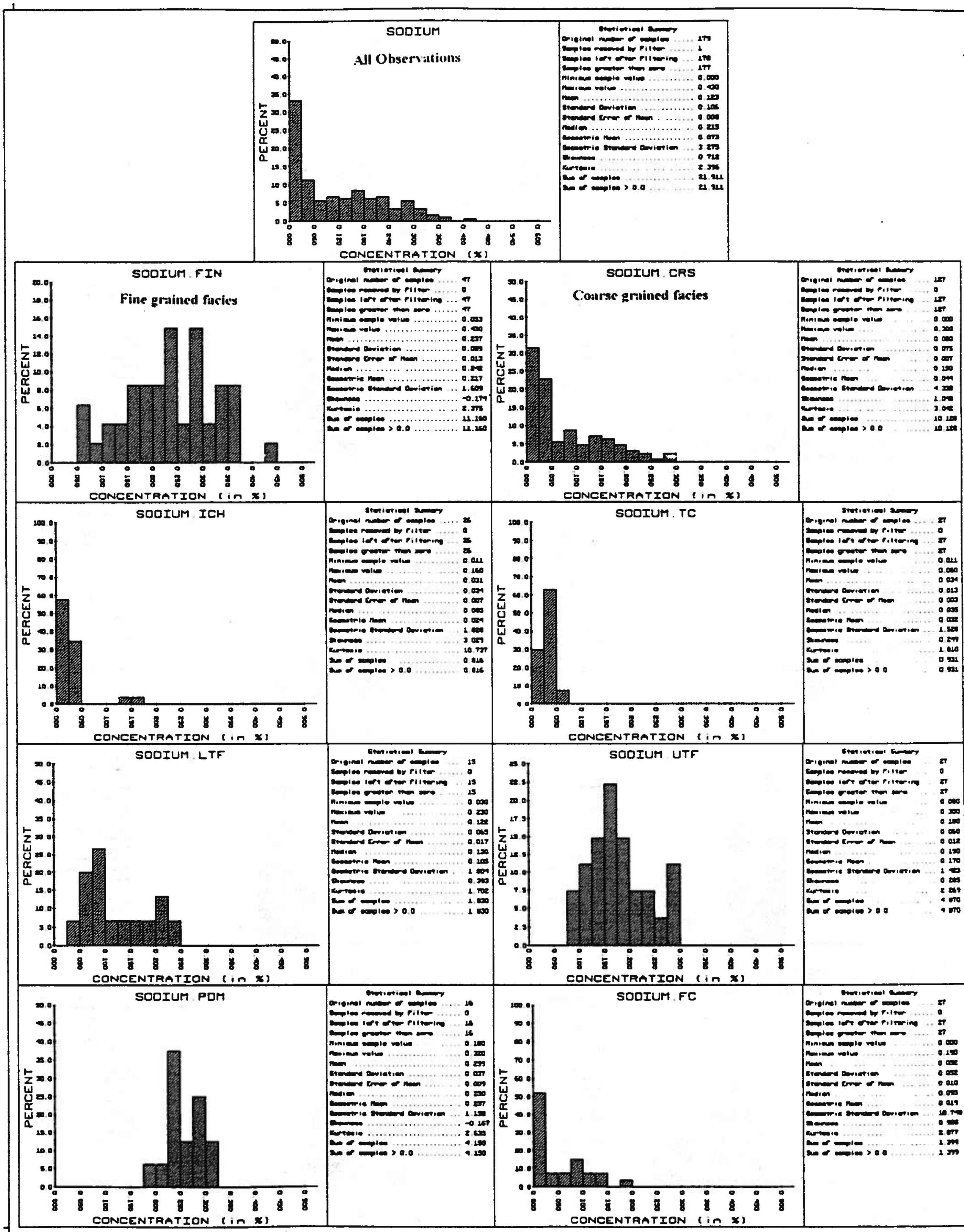


Figure G.3.8 Statistics of the concentration of selected elements by facies
Titanium

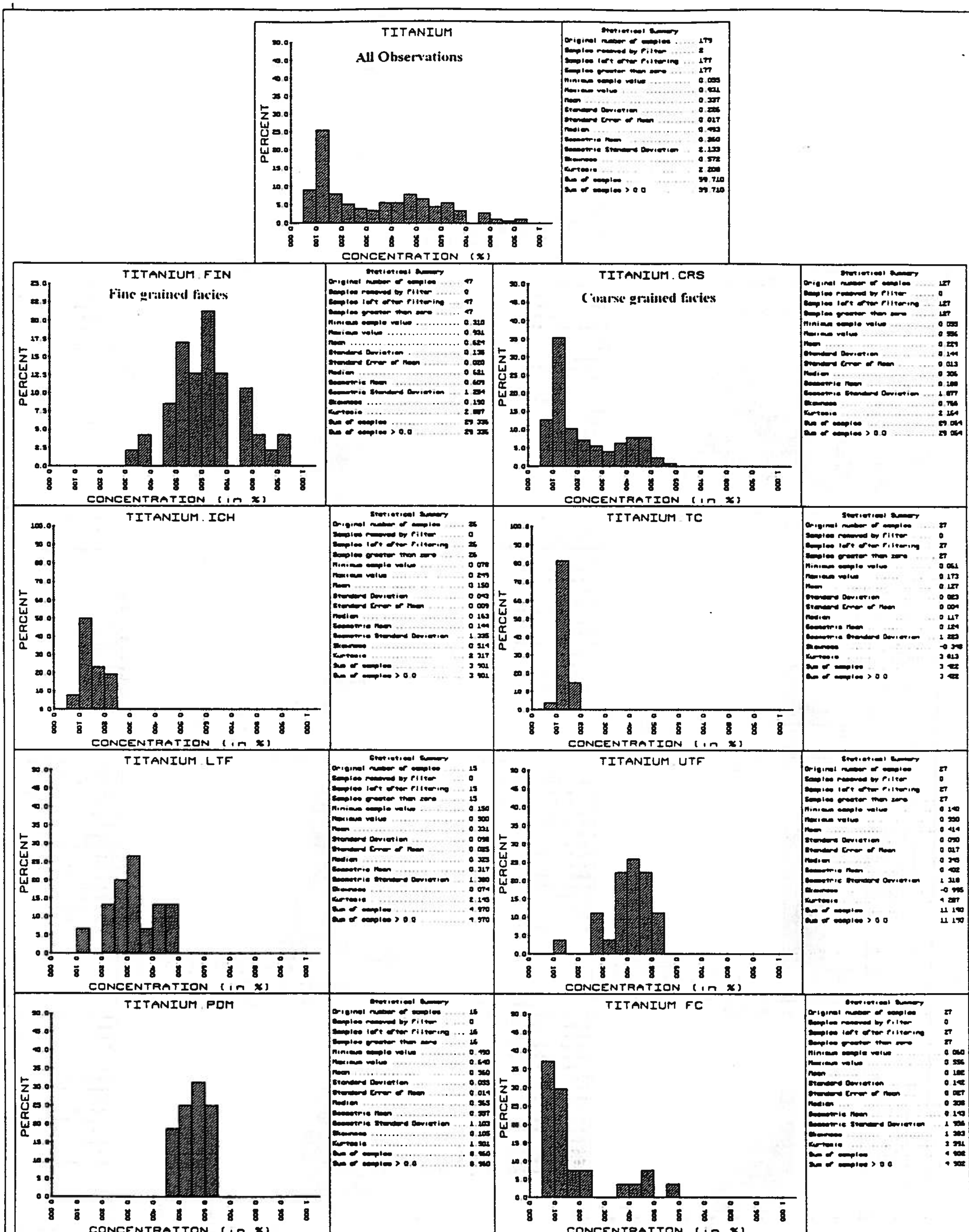


Figure G.3.9 Statistics of the concentration of selected elements by facies Vanaduim

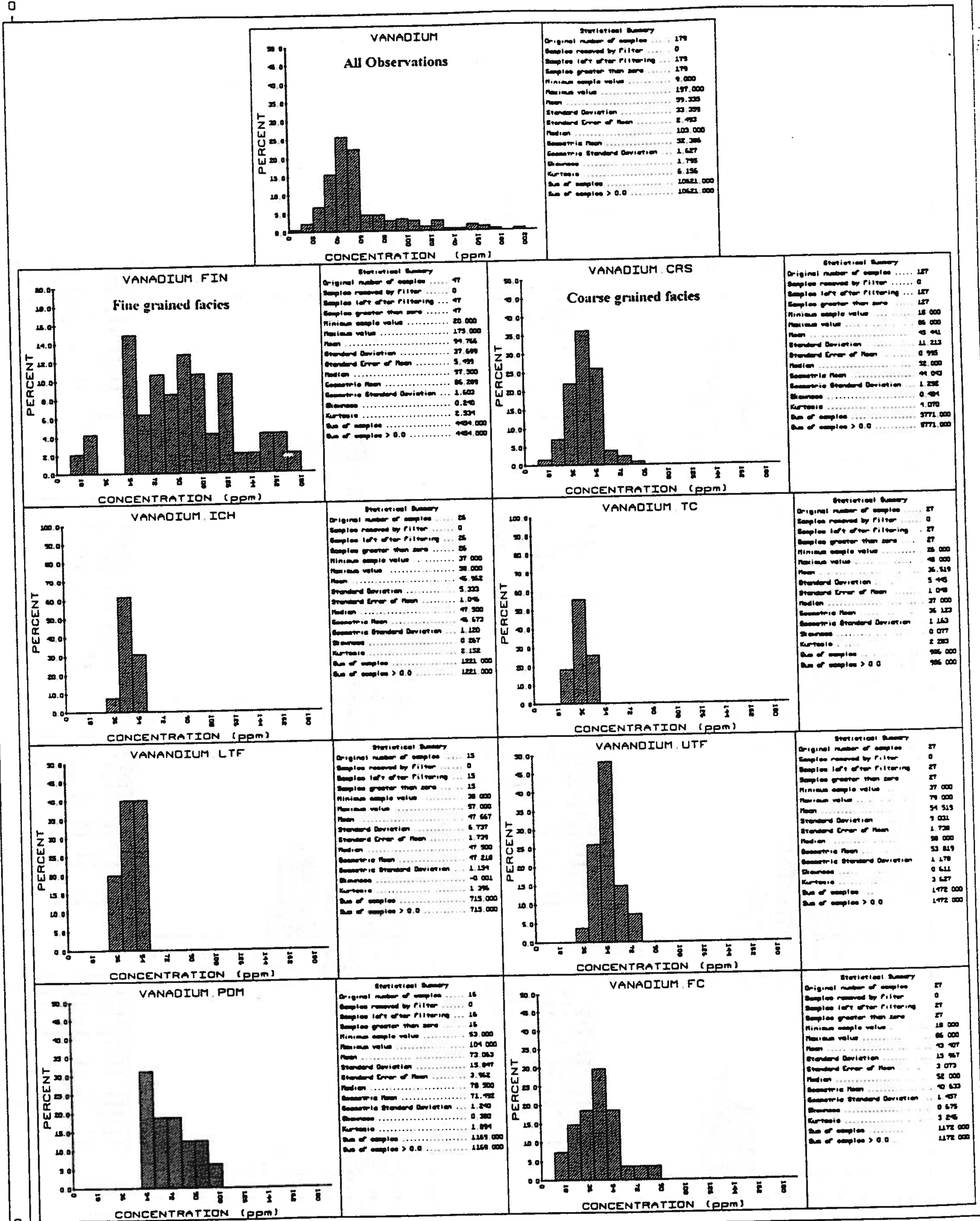


Figure G.4.1 Mean and Range Of Elemental Concentrations by Facies
Tidal Channel

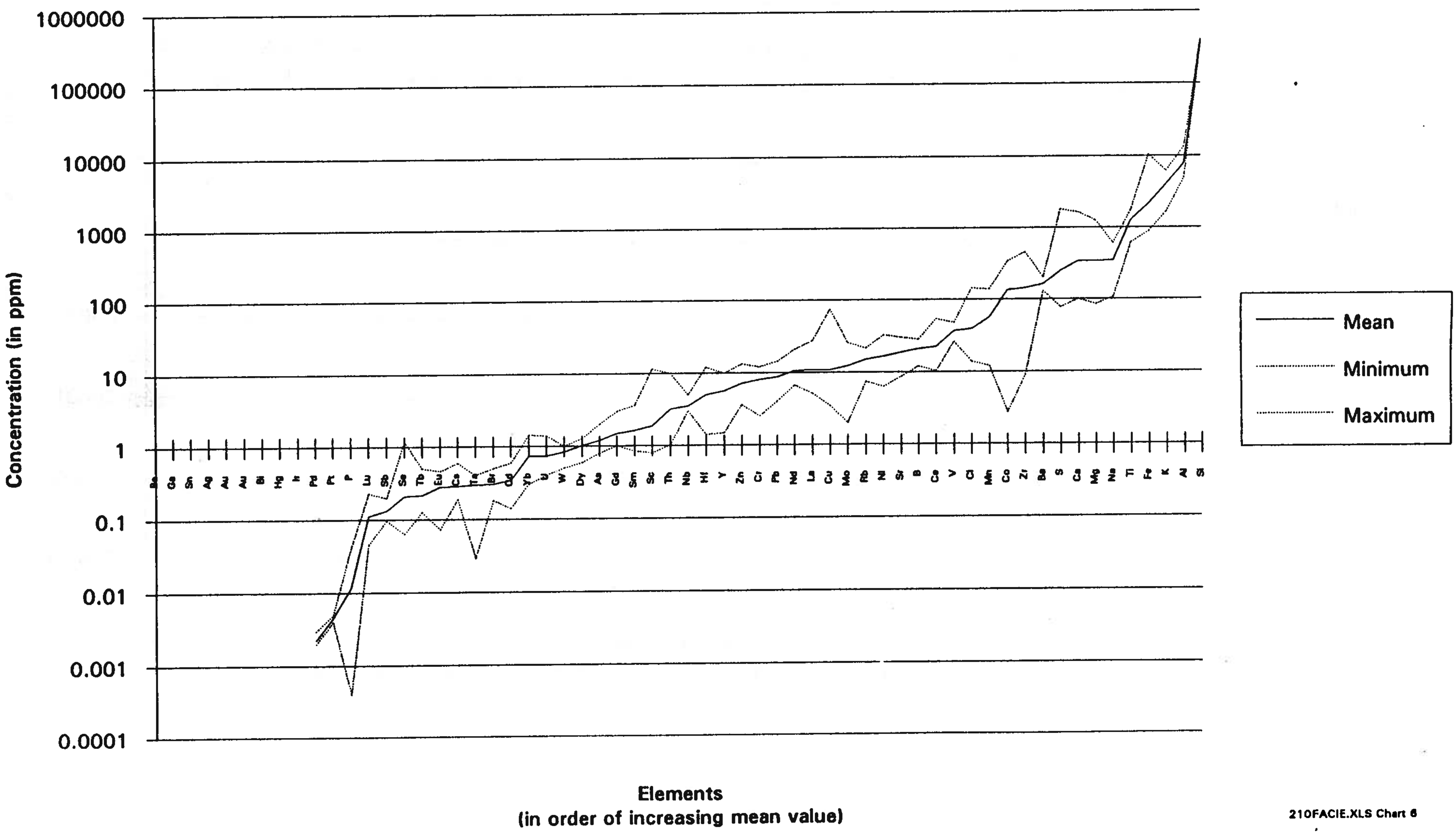


Figure G.4.2 Mean and Range Of Elemental Concentrations by Facies
Interchannel

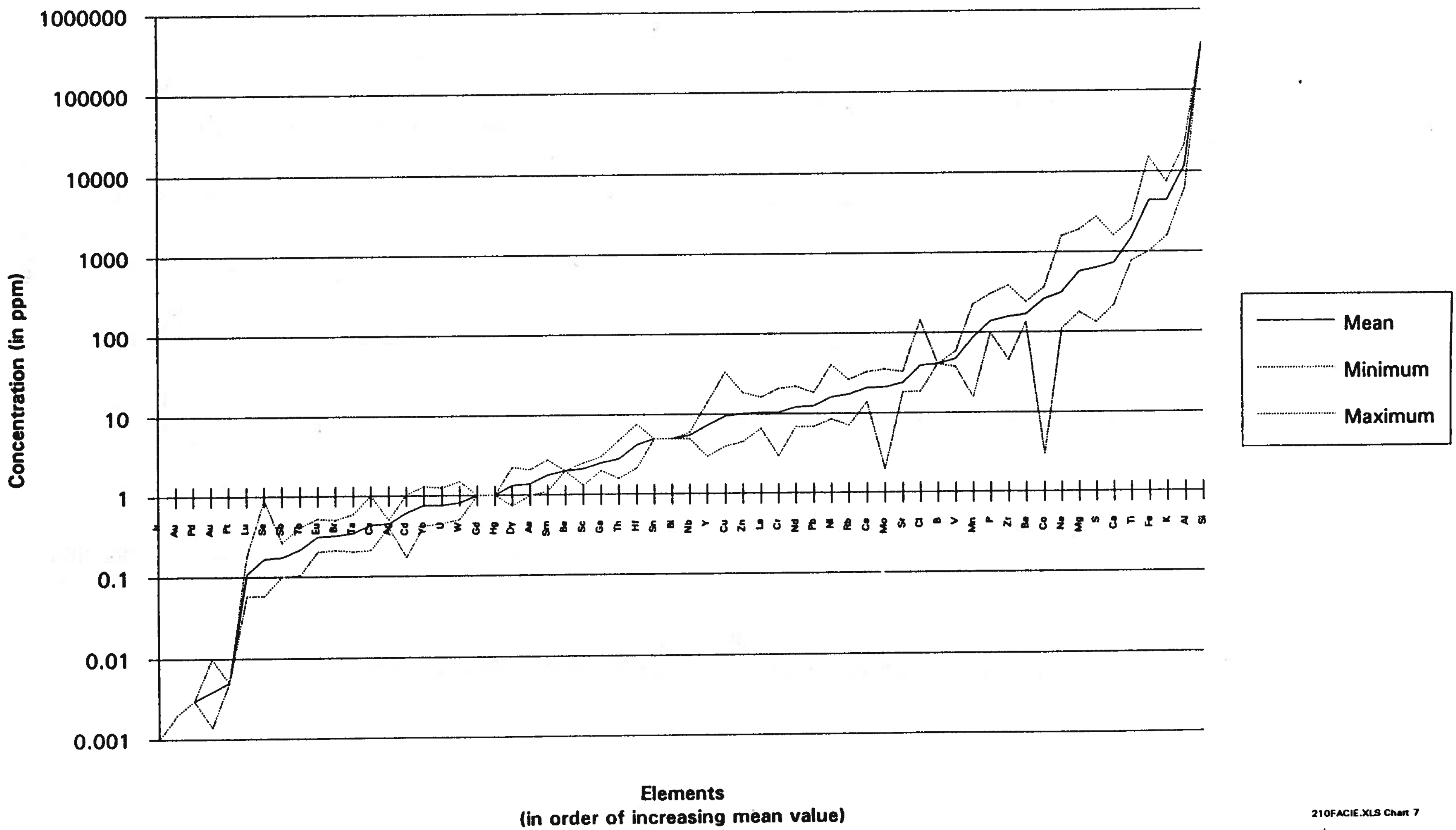
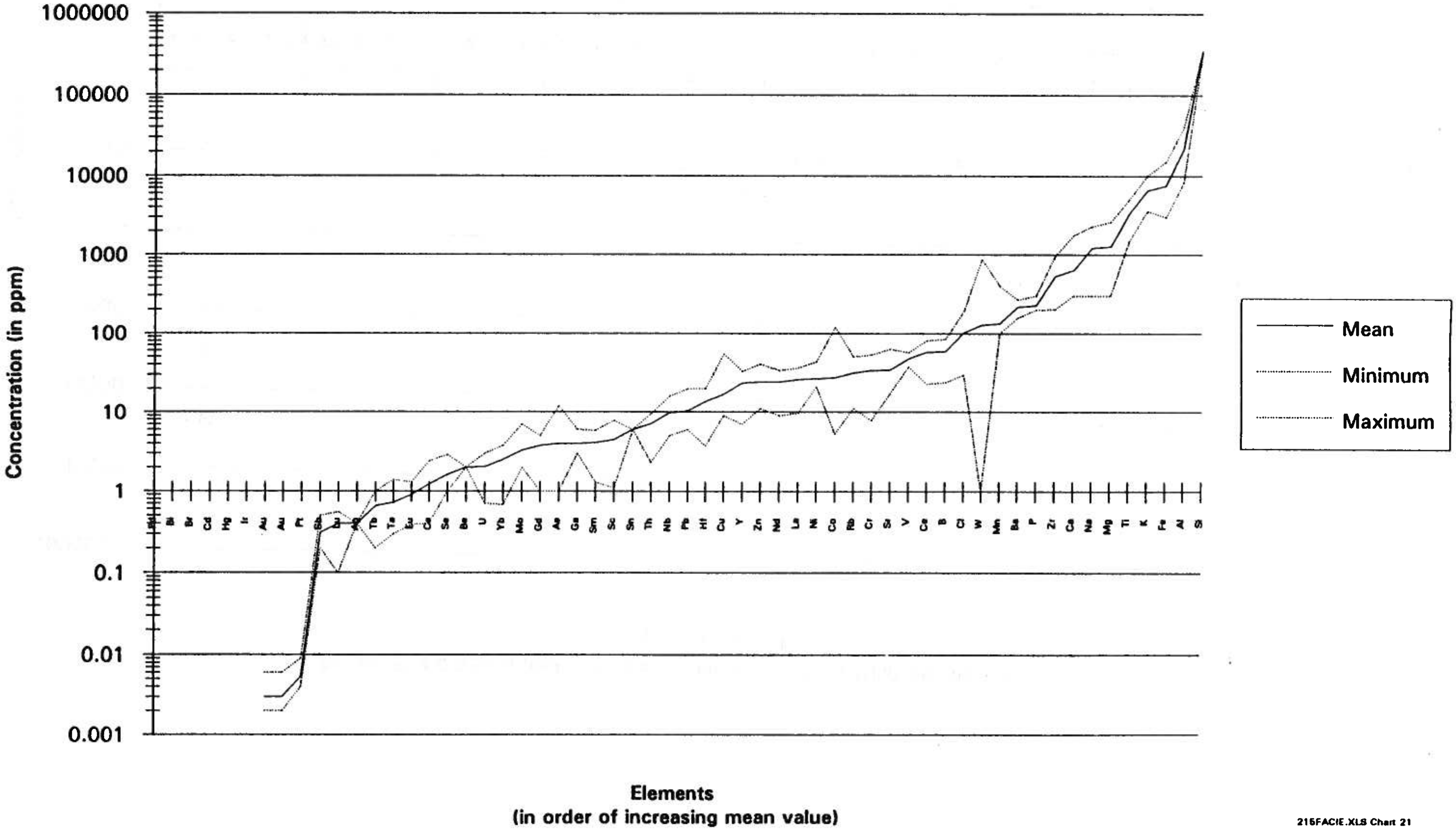
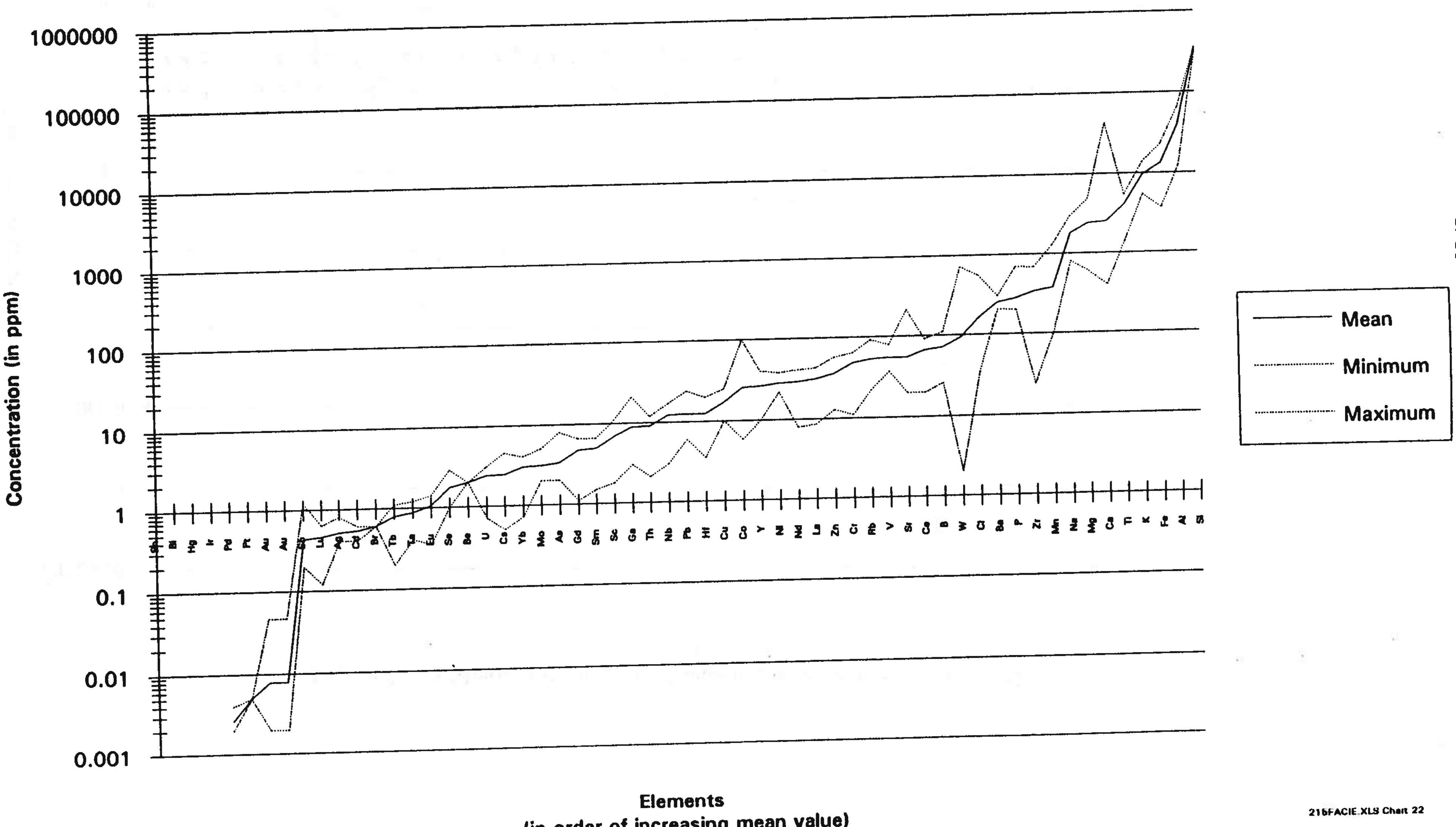


Figure G.4.3 Mean and Range Of Elemental Concentrations by Facies
Lower Tidal Flat



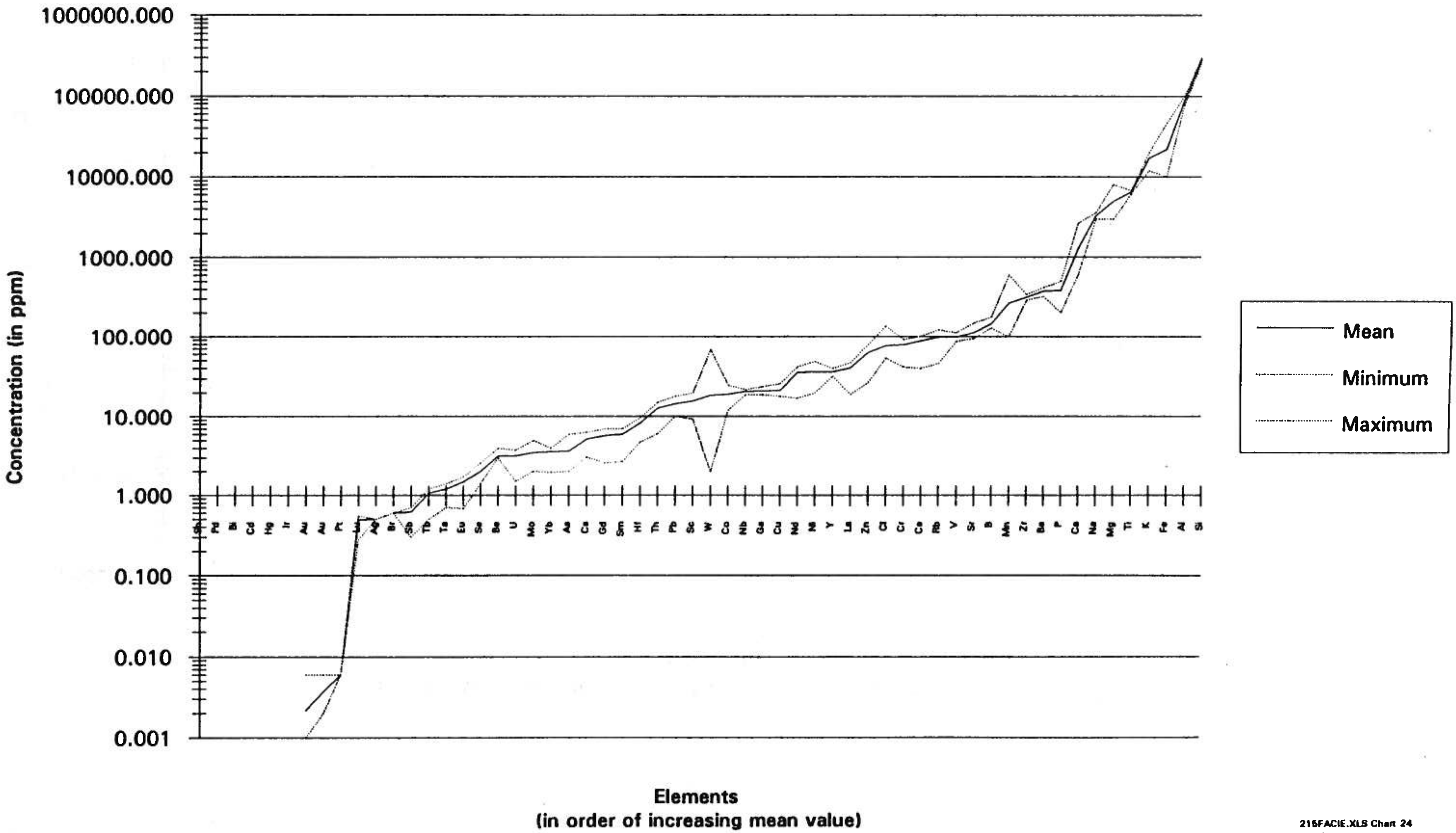
215FACIE.XLS Chart 21

Figure G.4.4 Mean and Range Of Elemental Concentrations by Facies
Upper Tidal Flat



21bFACIE.XLS Chart 22

Figure G.4.5 Mean and Range Of Elemental Concentrations by Facies
Salt Marsh



215FACIE.XLS Chart 24

Figure G.4.6 Mean and Range Of Elemental Concentrations by Facies
Pro Delta Mud

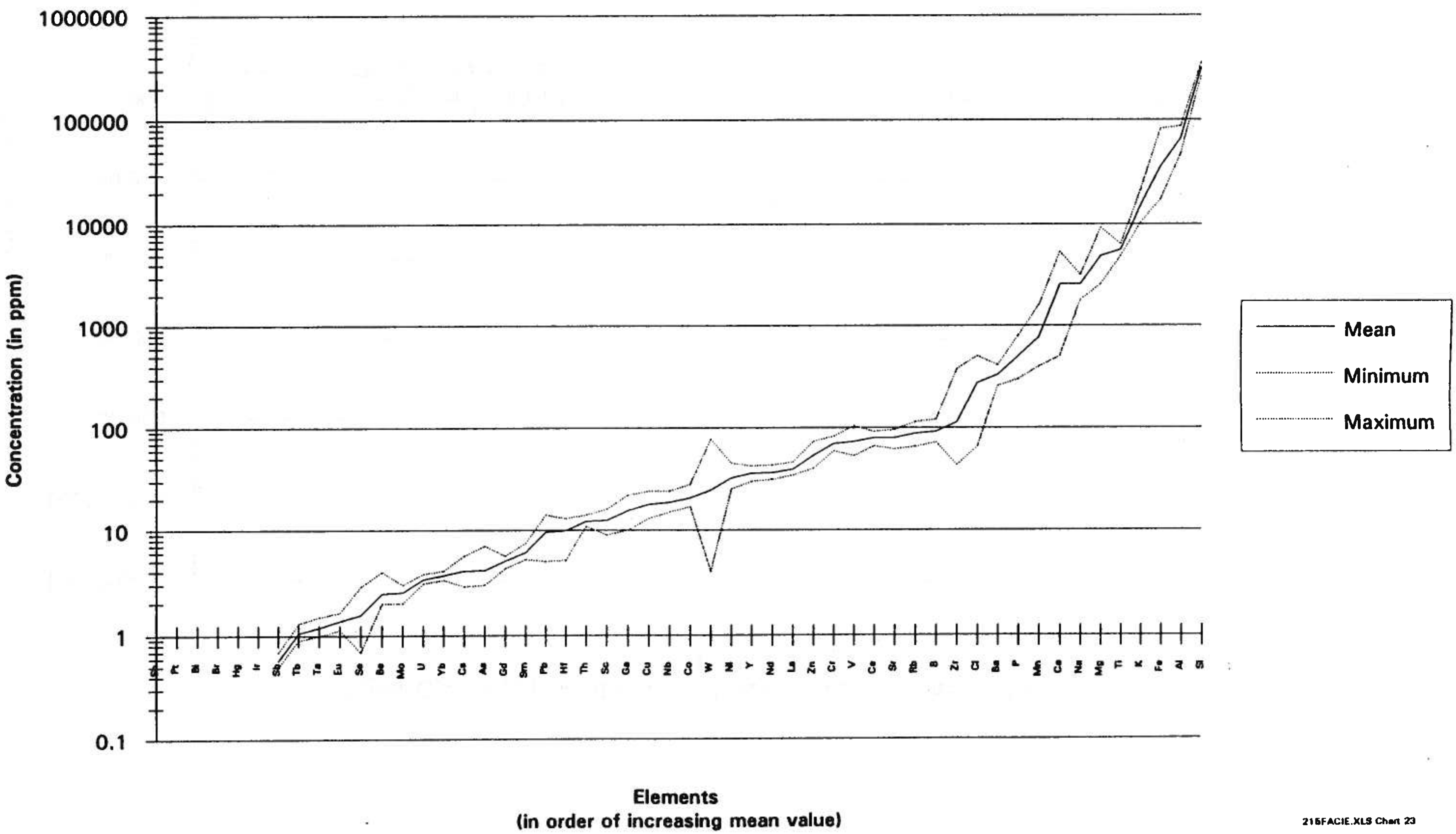


Figure G.4.7 Mean and Range Of Elemental Concentrations by Facies
Fluvial Estuarine

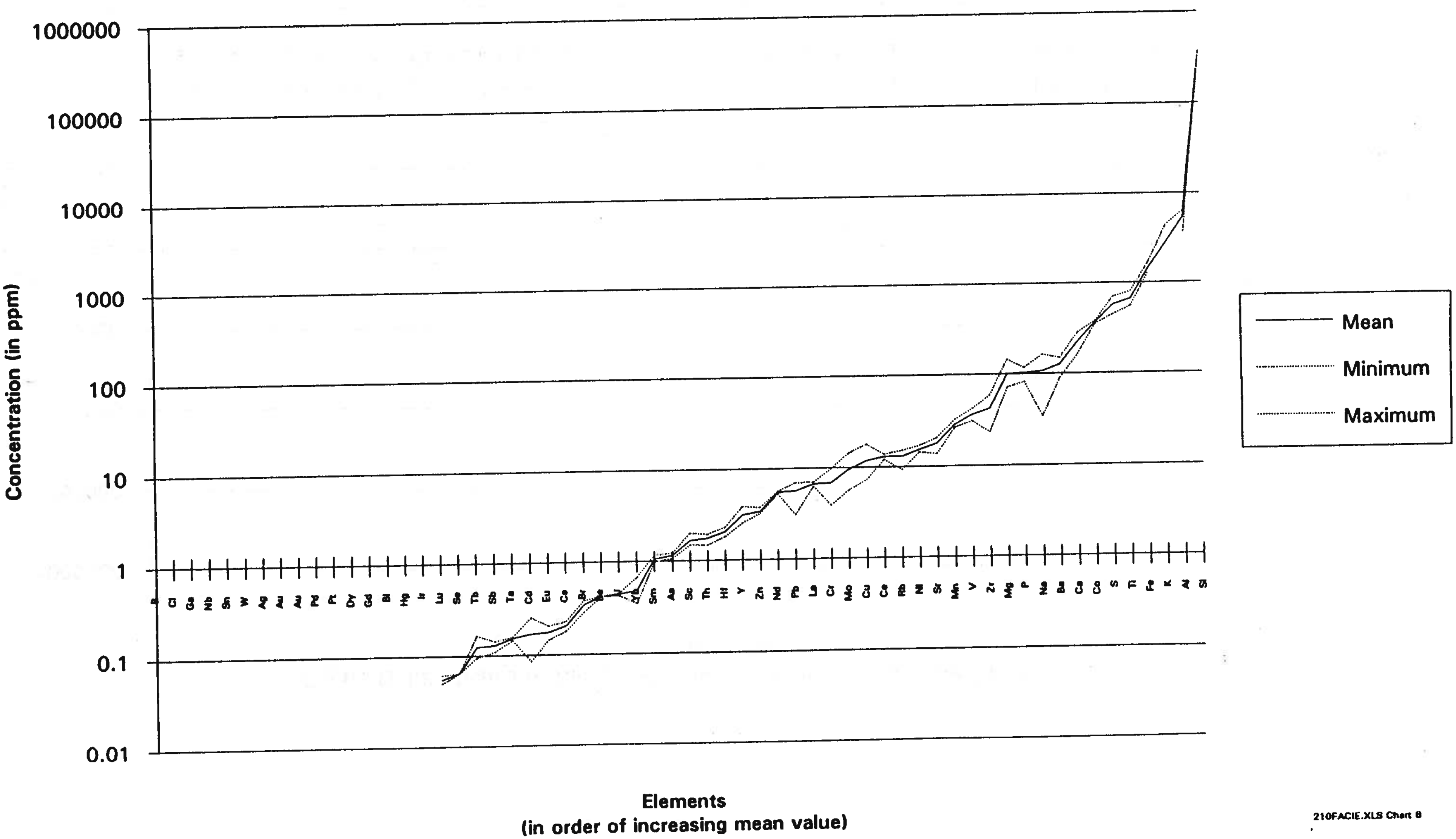


Figure G.4.8 Mean and Range Of Elemental Concentrations by Facies
Delta Marsh Mud

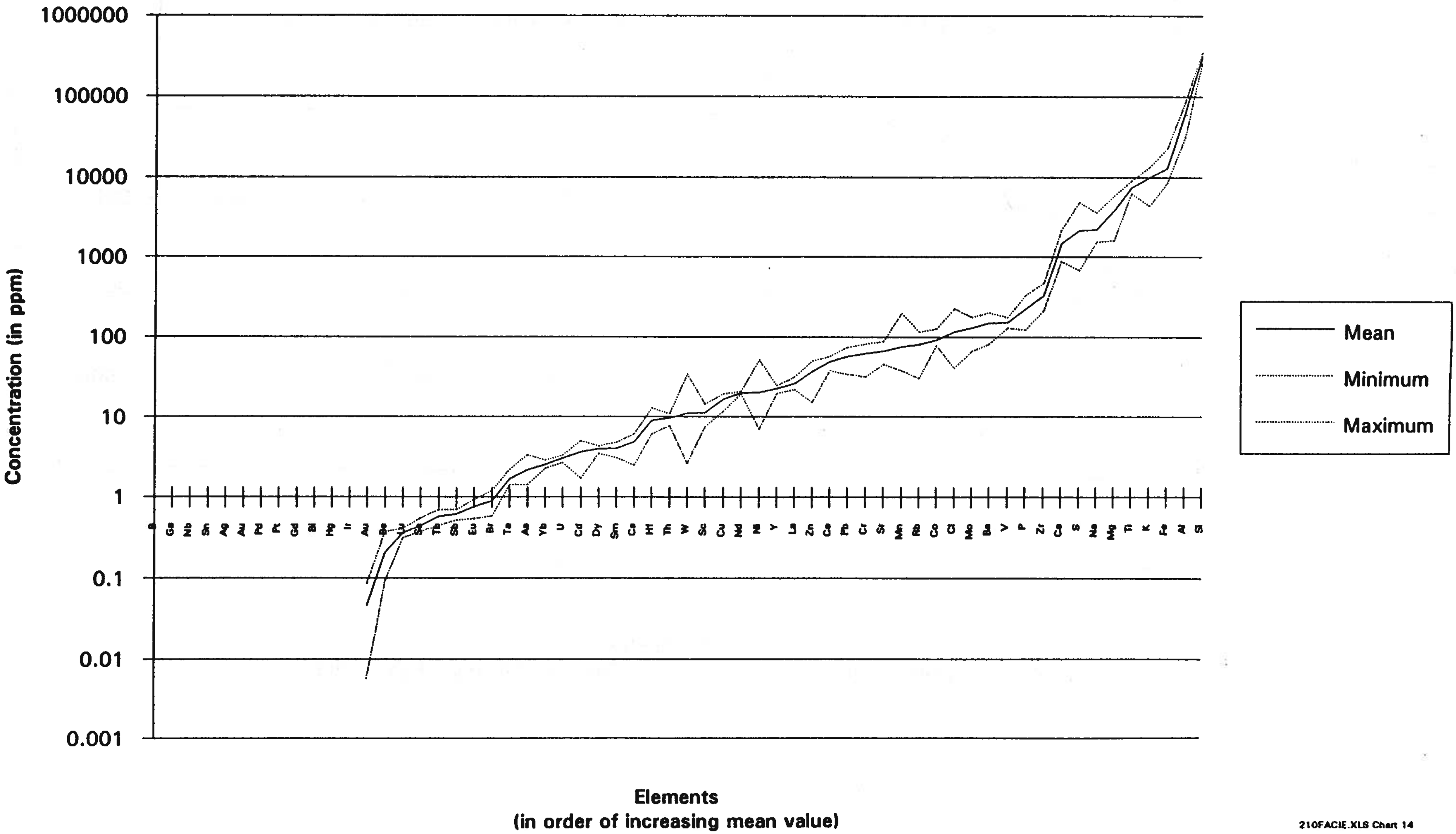
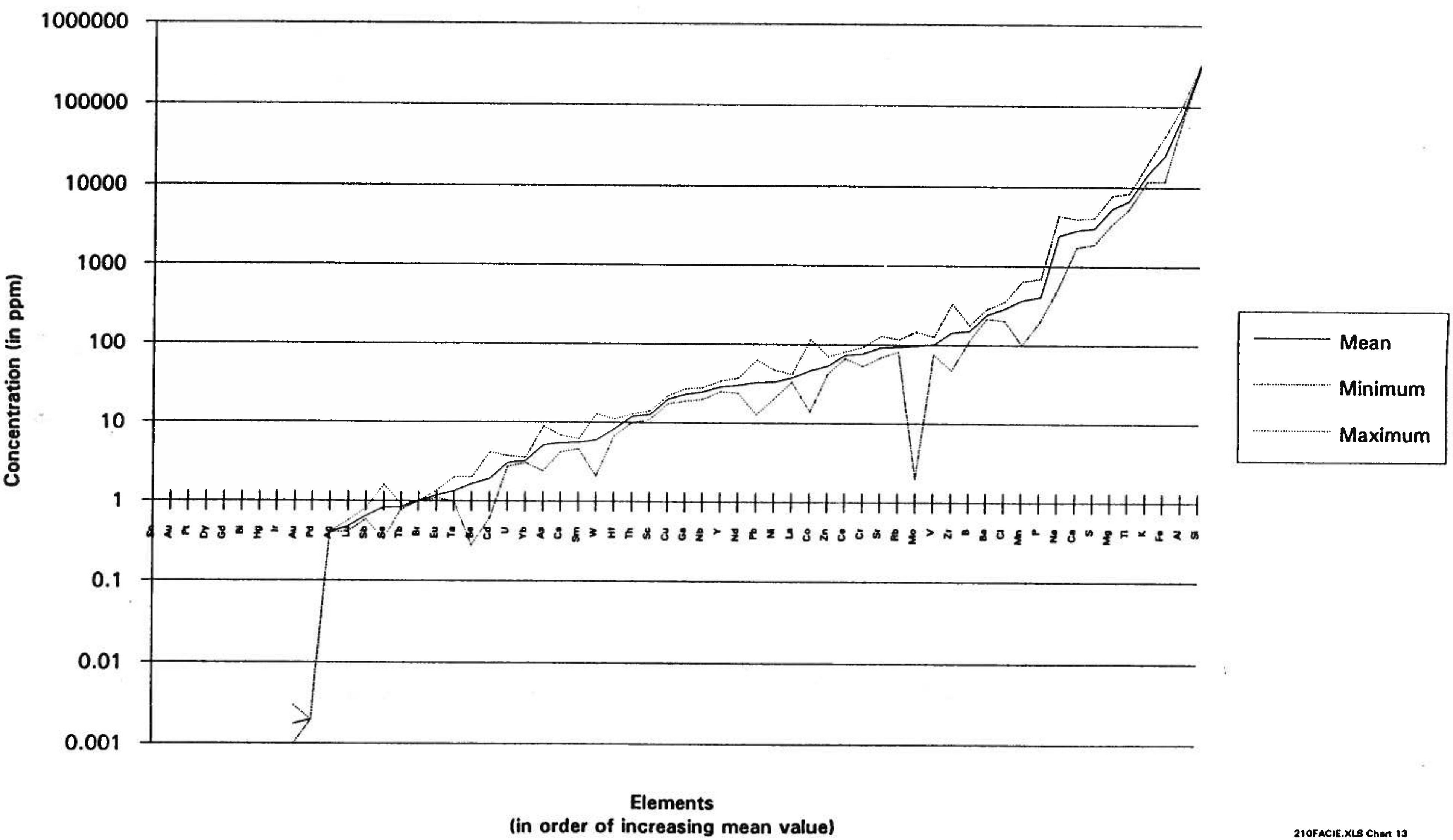


Figure G.4.9 Mean and Range Of Elemental Concentrations by Facies
Overbank Mud



210FACIE.XLS Chart 13

**Figure G.4.10 Mean and Range Of Elemental Concentrations by Facies
Crevasse Splay**

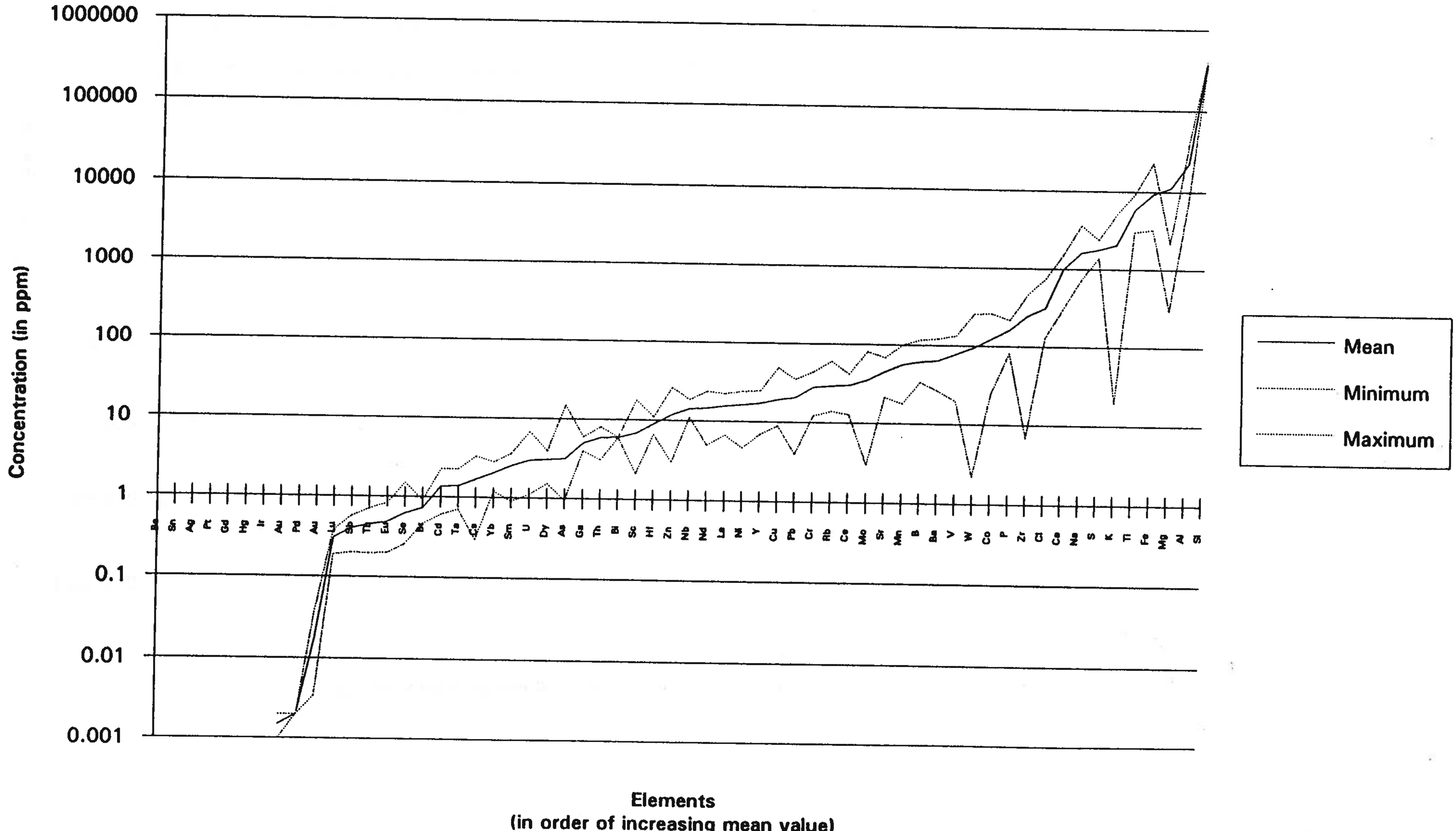
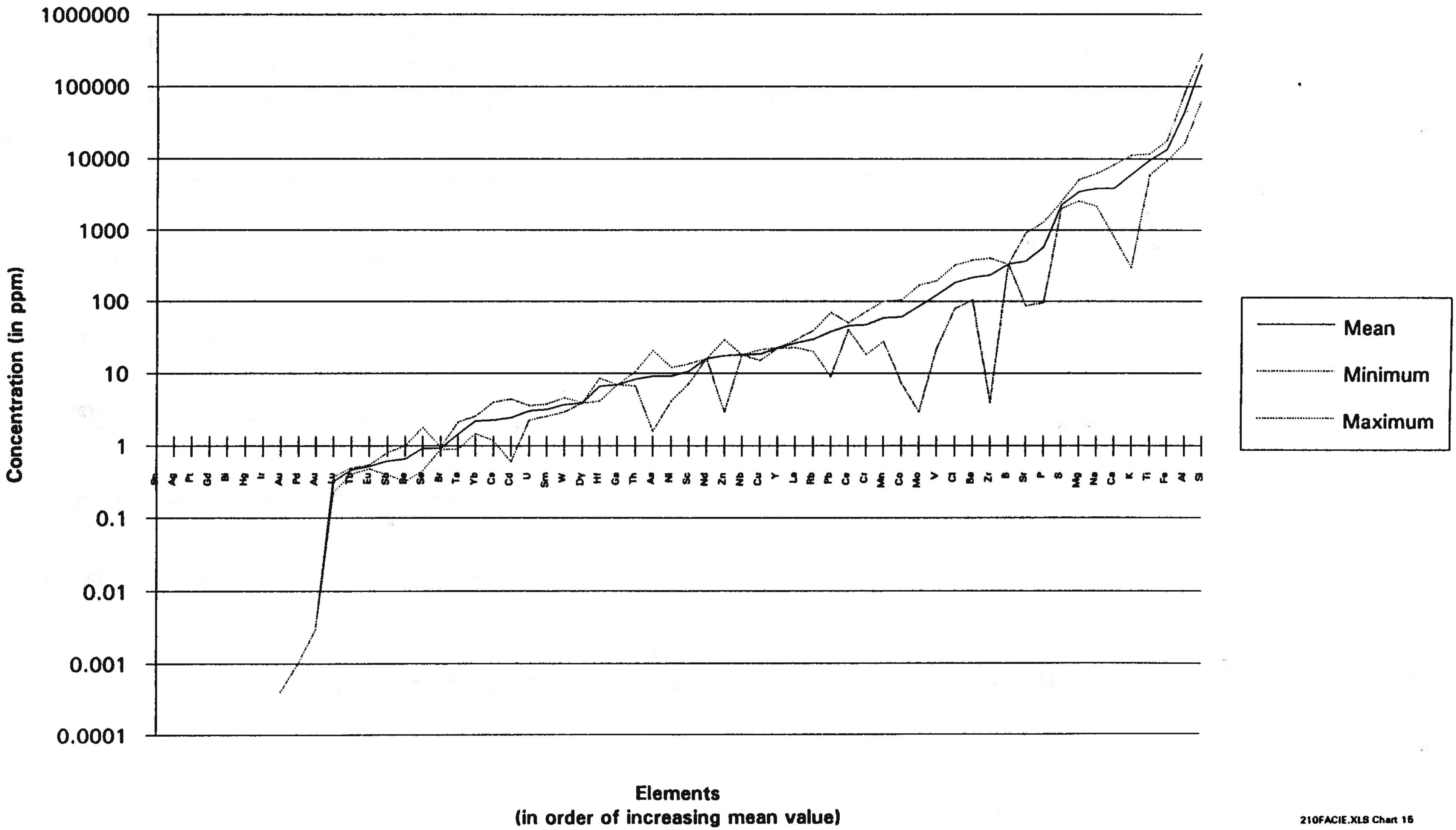
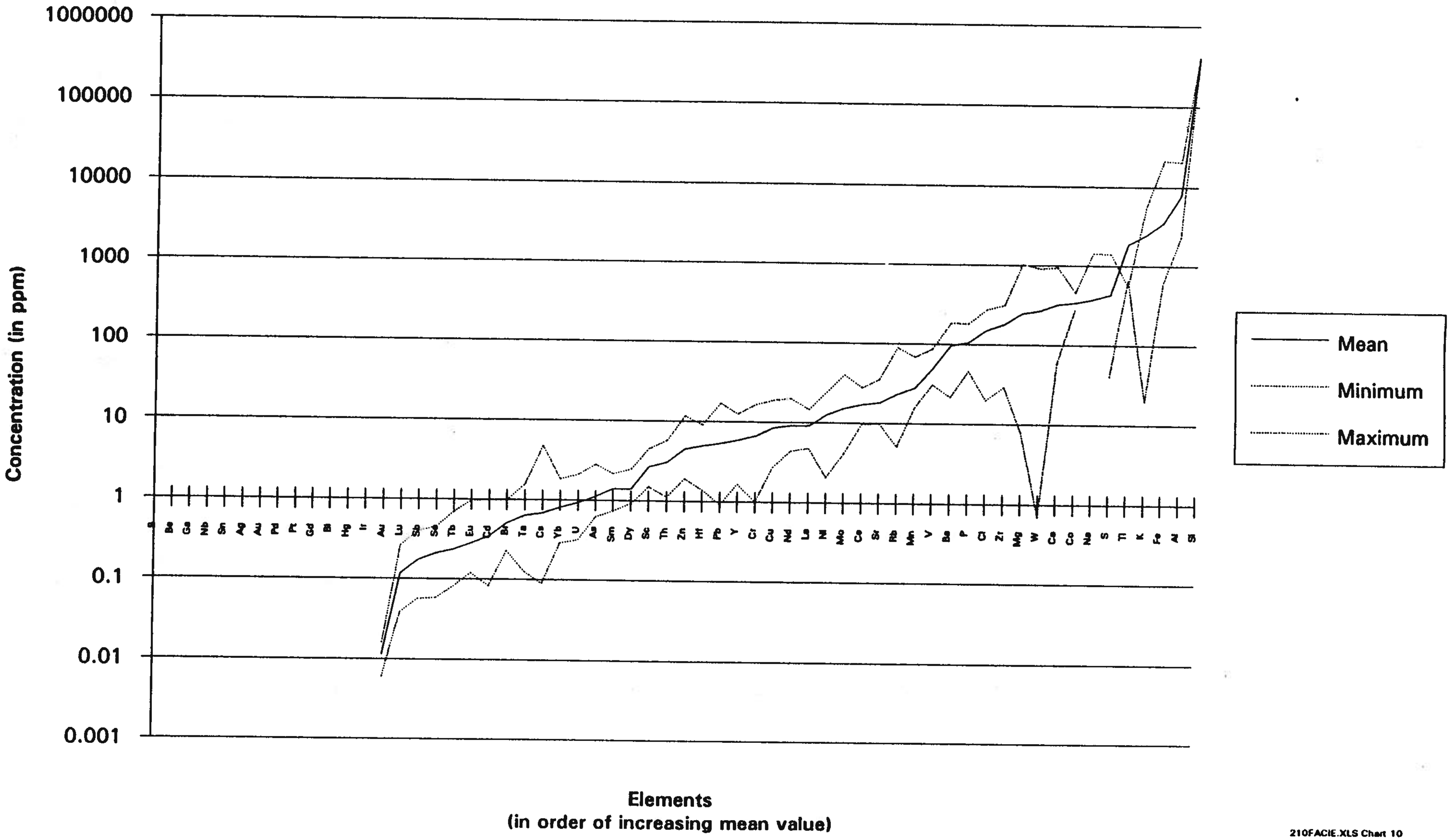


Figure G.4.11 Mean and Range Of Elemental Concentrations by Facies
Coal



210FACIE.XLS Chart 15

Figure G.4.12 Mean and Range Of Elemental Concentrations by Facies
Fluvial Channel Sands



210FACIE.XLS Chart 10

Figure G.4.13 Mean and Range Of Elemental Concentrations by Facies Fluvial Channel (Oil and Water)

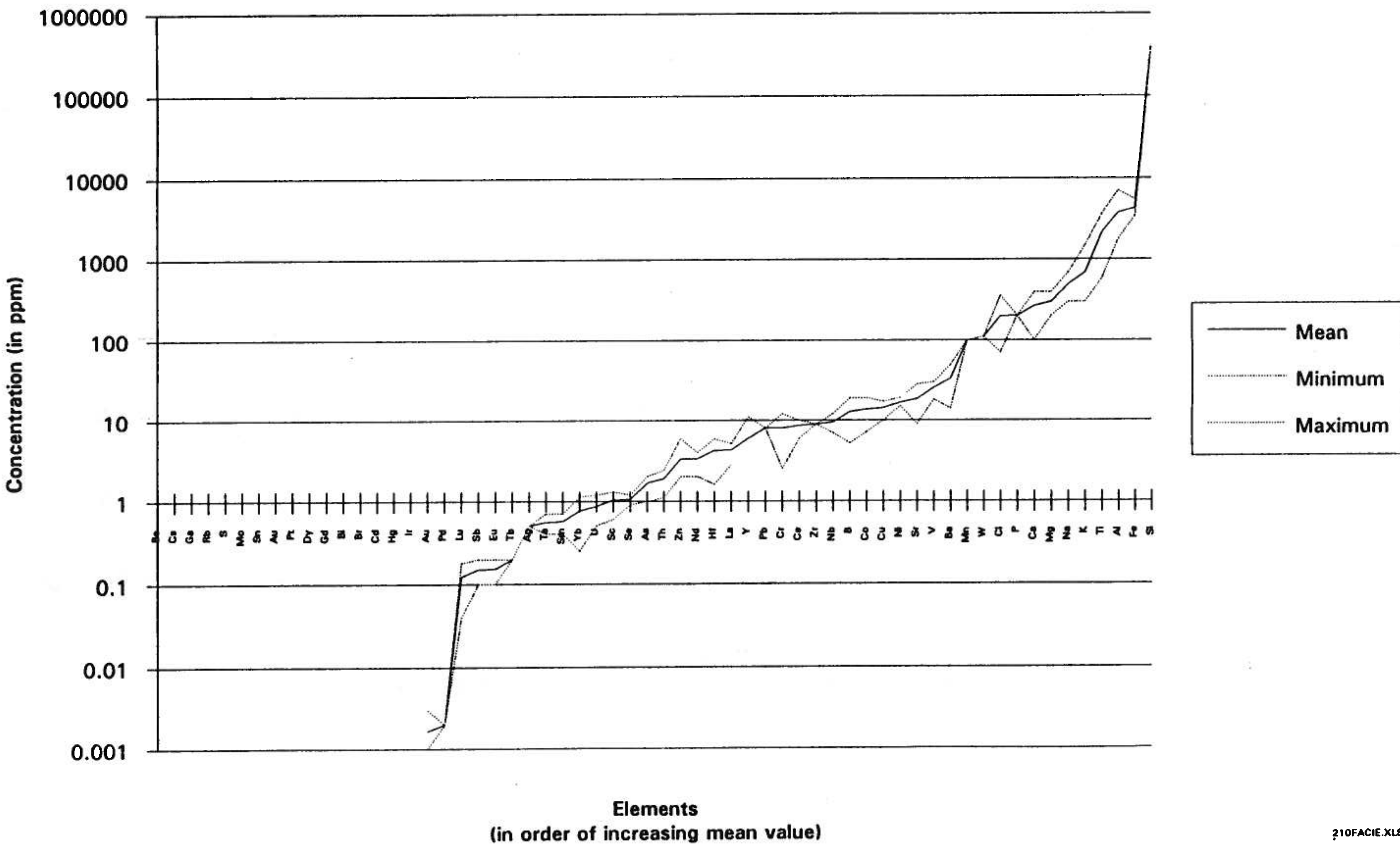
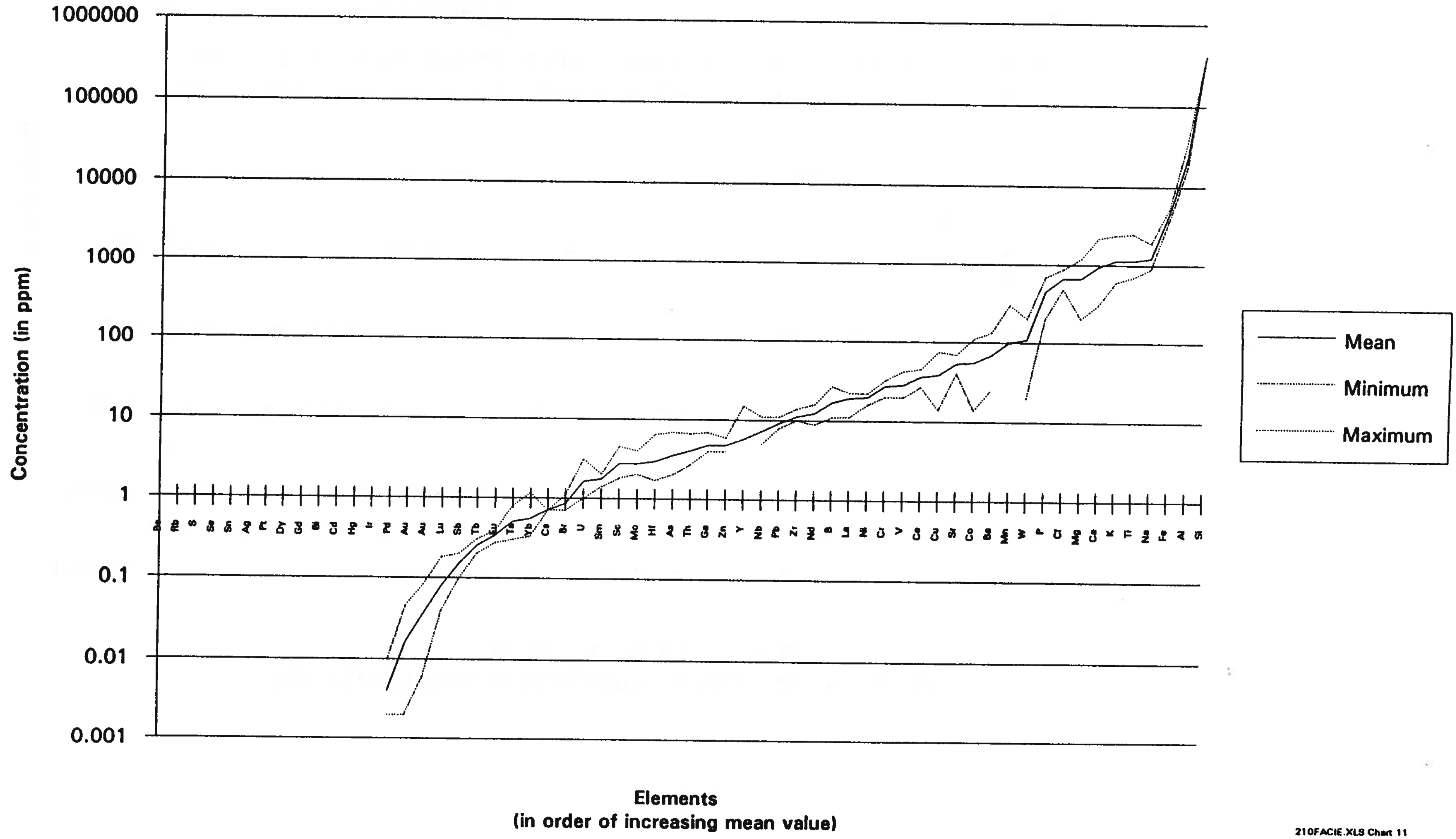
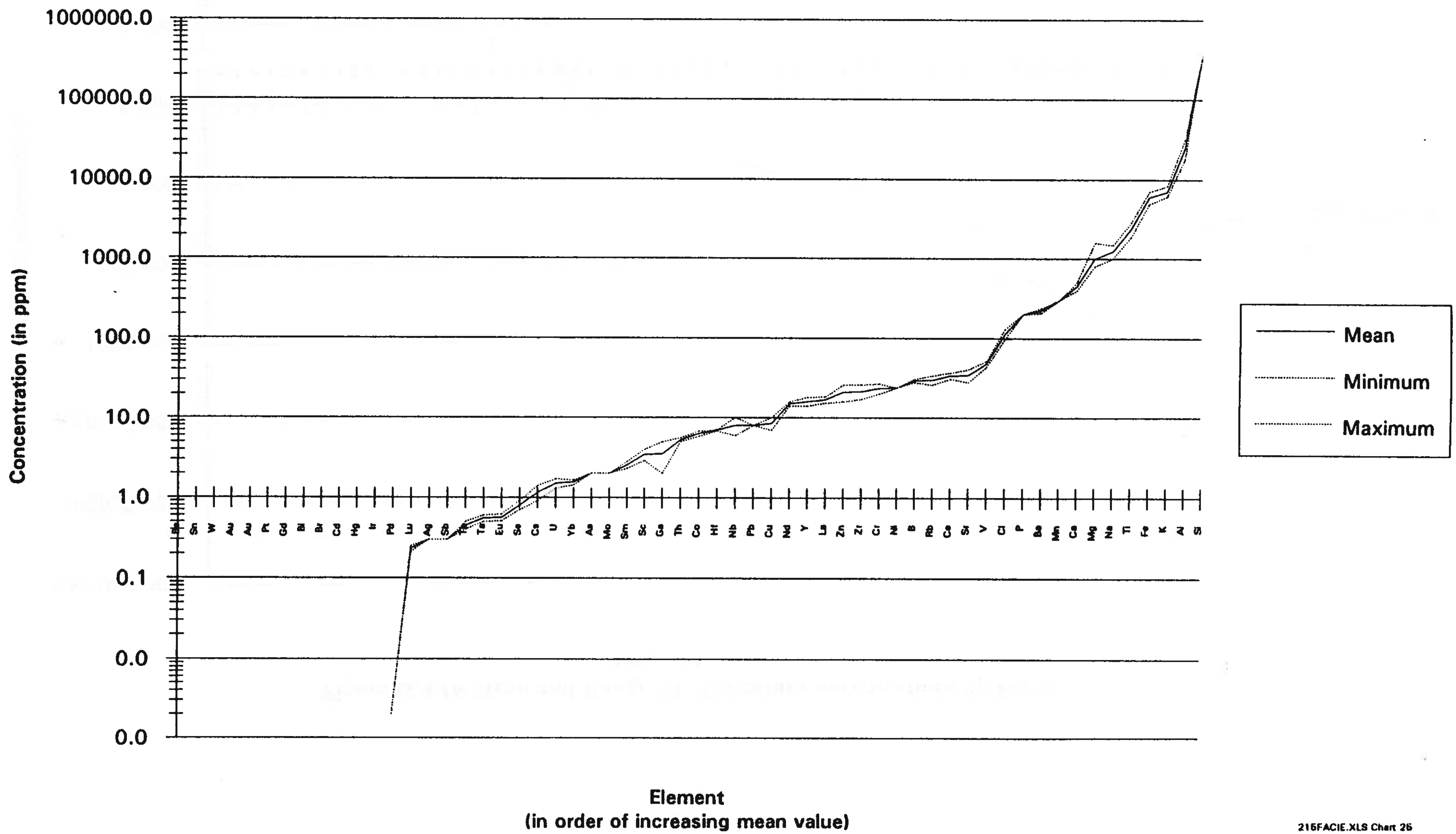


Figure G.4.14 Mean and Range Of Elemental Concentrations by Facies
Fluvial Channel (Water Sands)



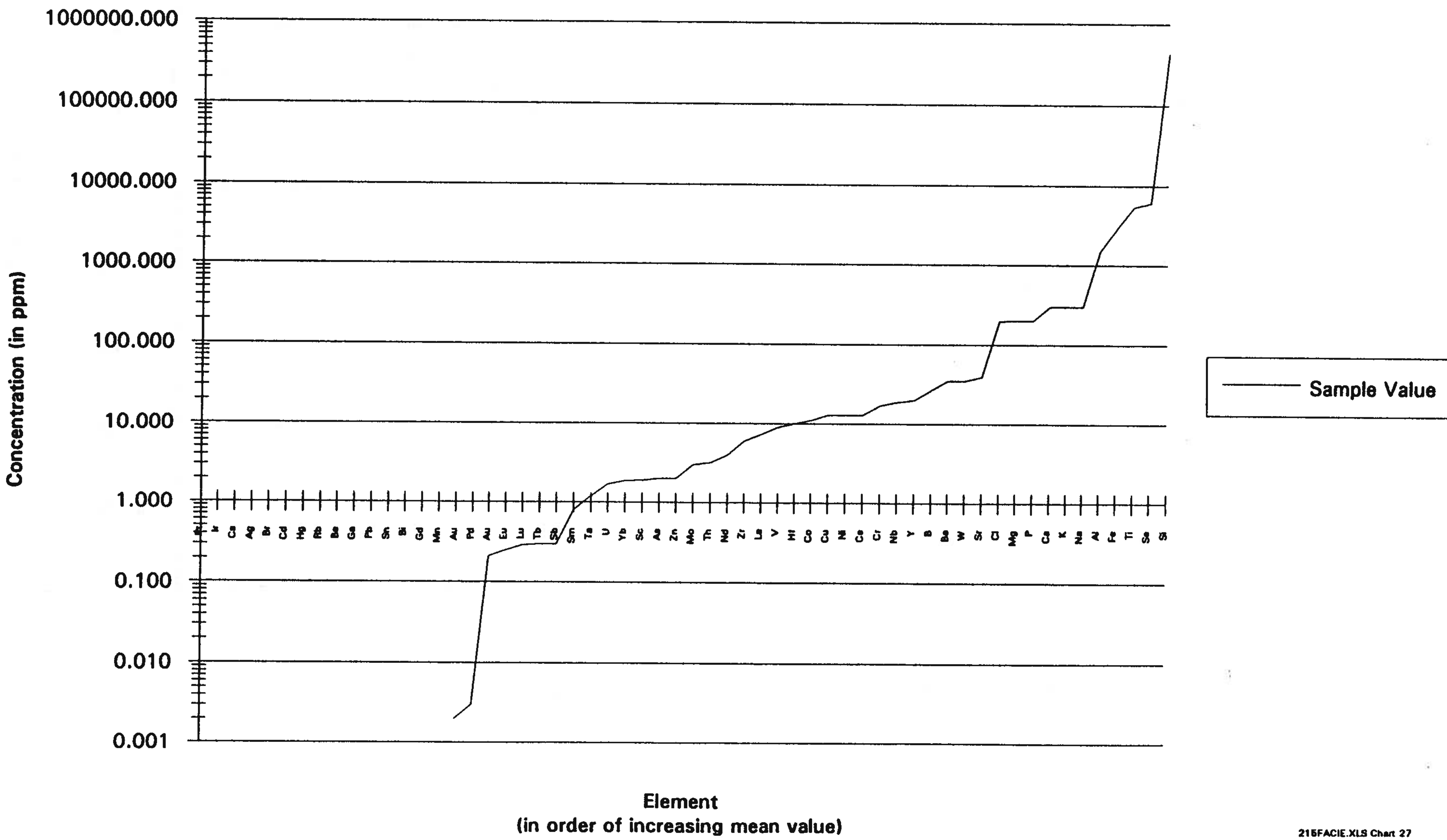
210FACIE.XLS Chart 11

Figure G.4.15 Mean and Range Of Elemental Concentrations by Facies
Channel Breccia



215FACIE.XLS Chart 26

Figure G.4.16 Mean and Range Of Elemental Concentrations by Facies
Siltstone



215FACIE.XLS Chart 27

Figure G.5.1 Comparison of the Mean Concentration of Elements by Facies
Primary Elements

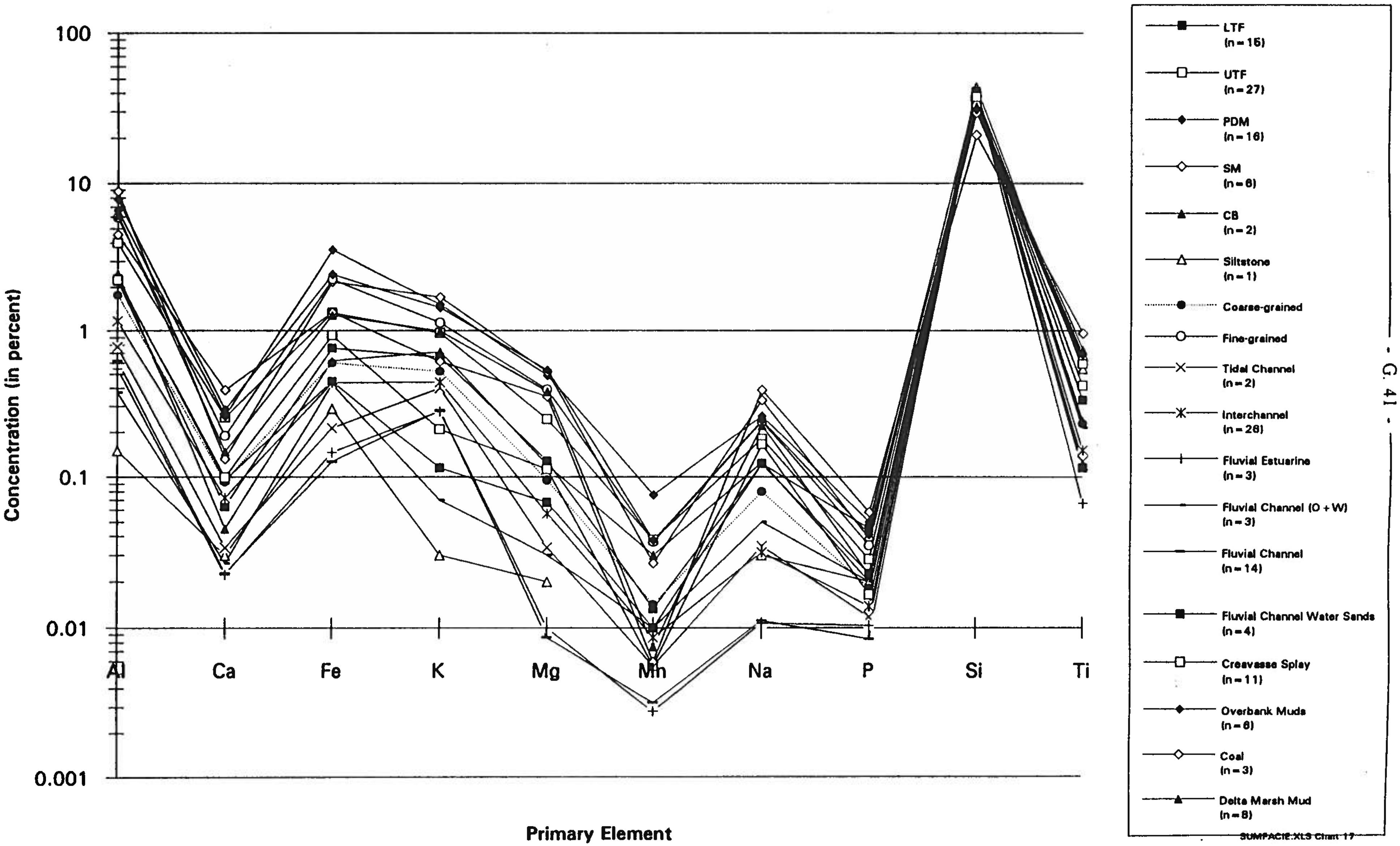


Figure G.5.2 Comparison of the Mean Concentration of Elements by Facies
Minor Elements

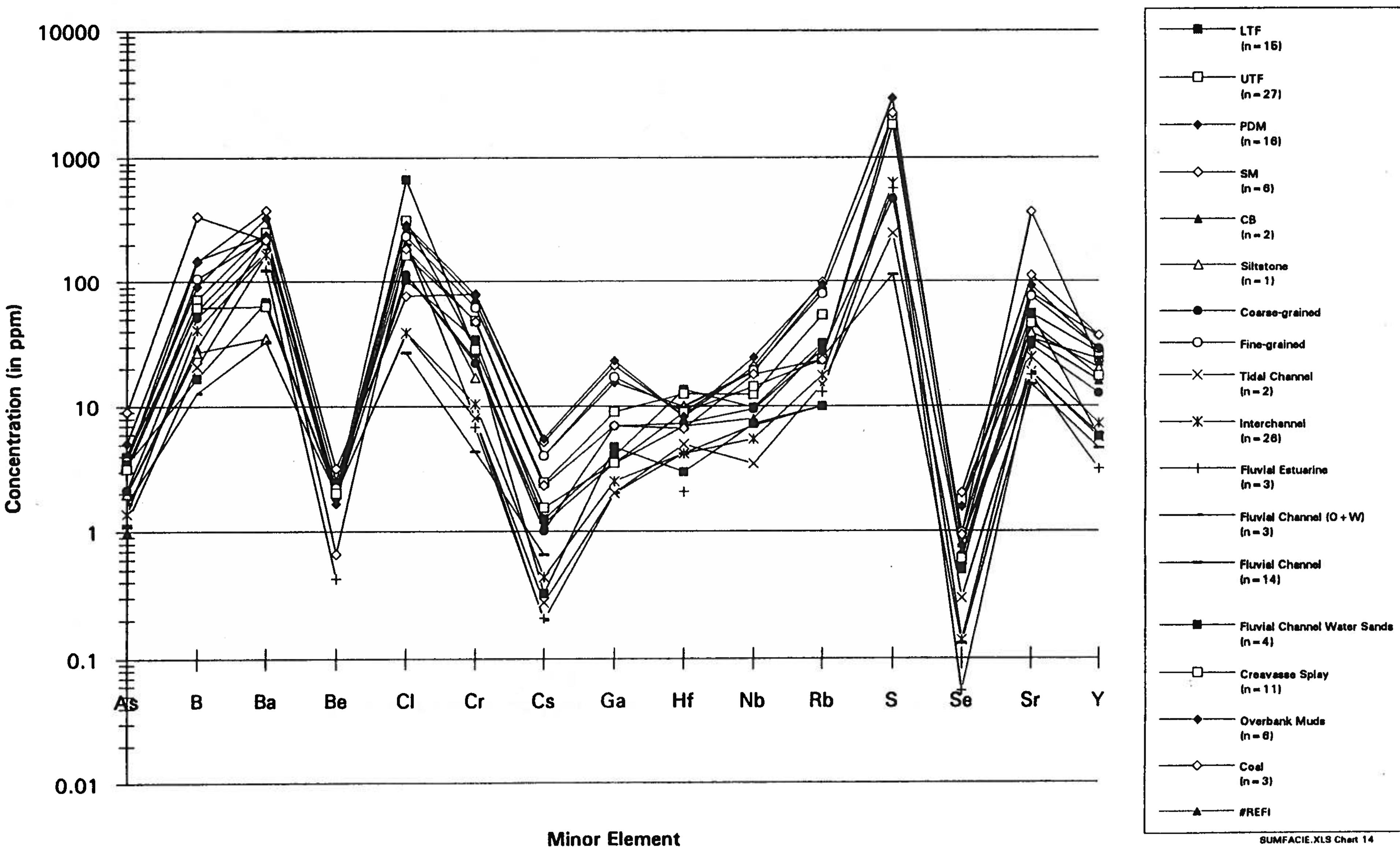


Figure G.5.3 Comparison of the Mean Concentration of Elements by Facies
Metallic Elements

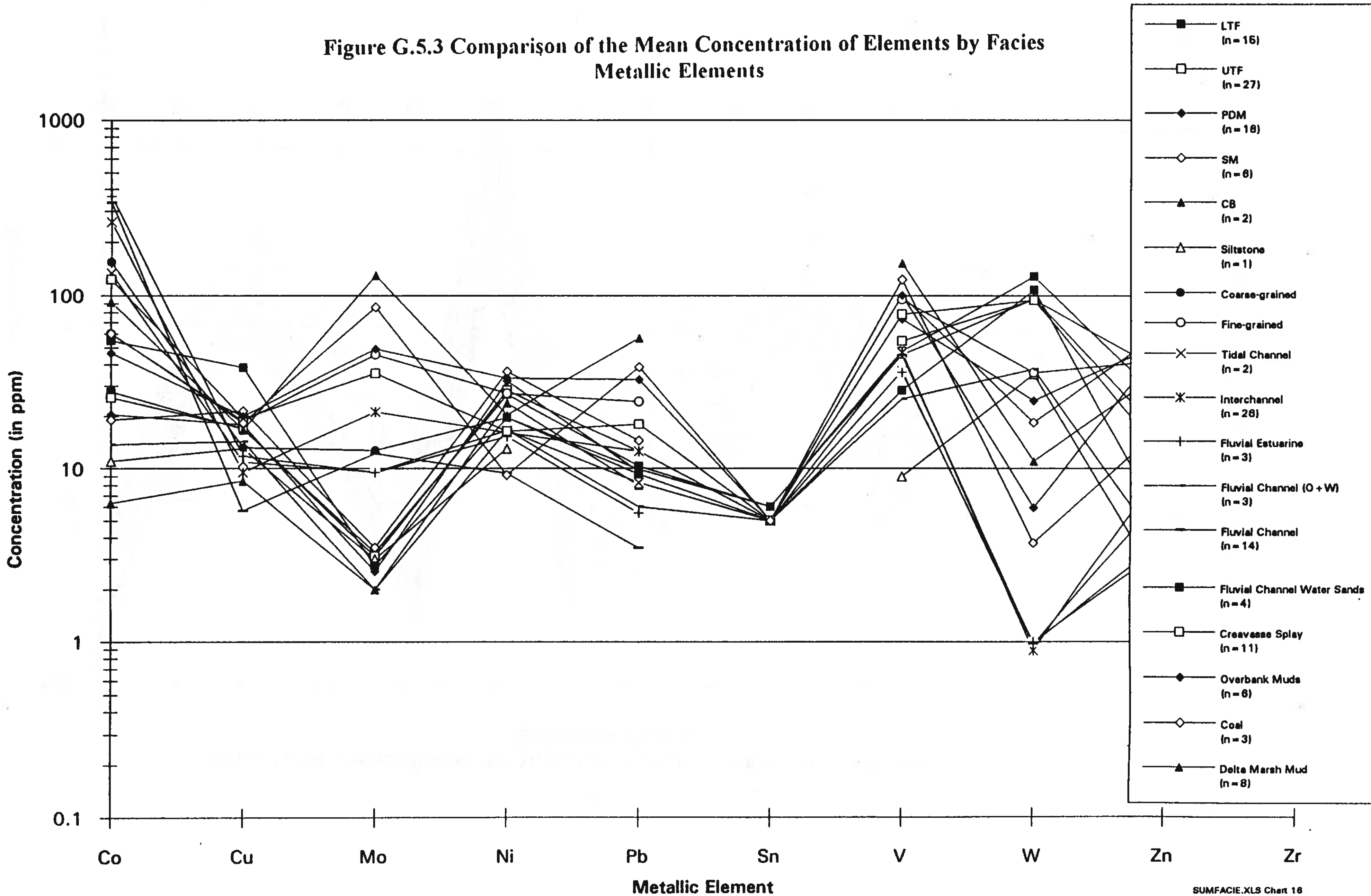


Figure G.5.4 Comparison of the Mean Concentration of Elements by Facies
Rare Earth Elements

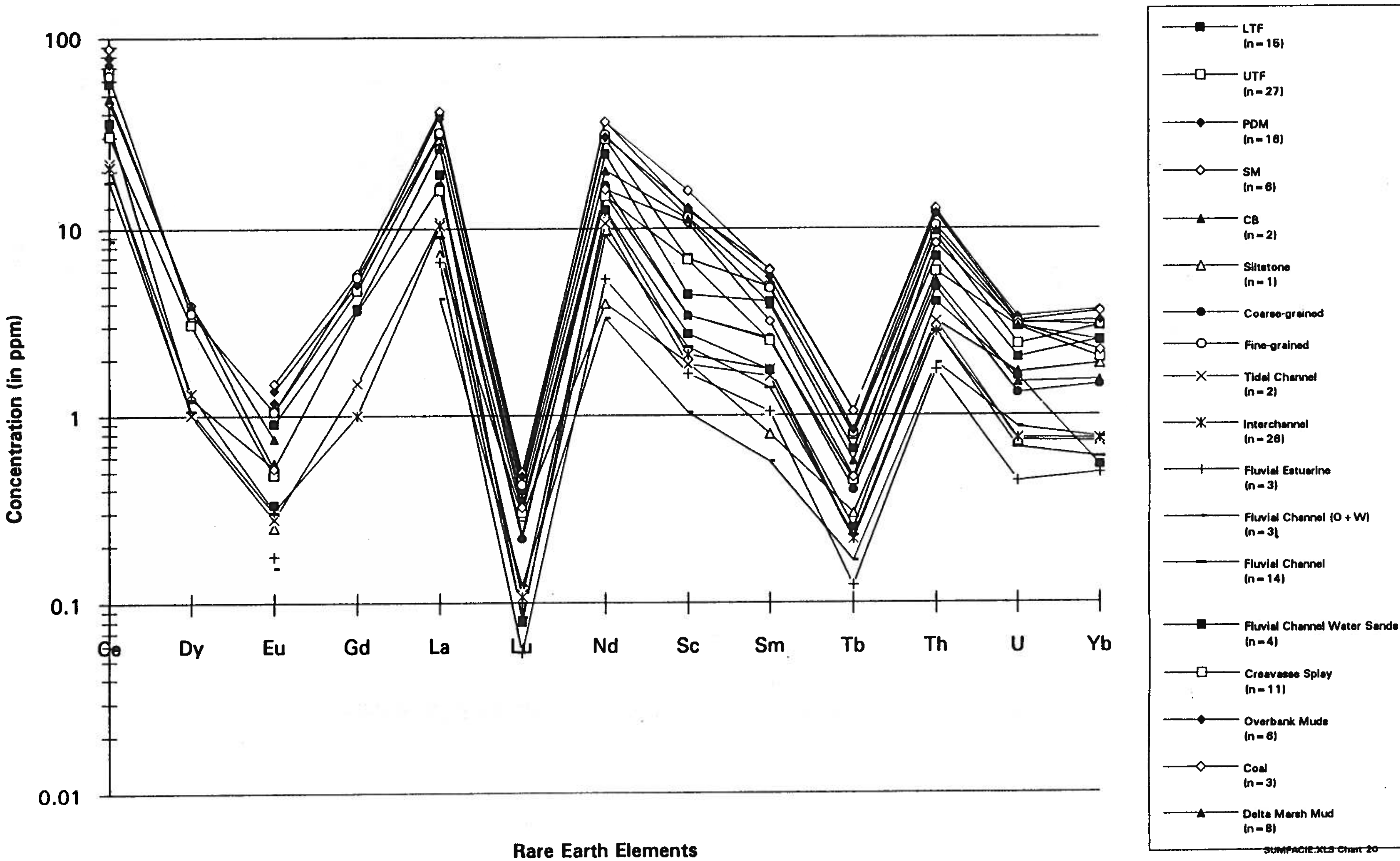


Figure G.5.5 Comparison of the Mean Concentration of Elements by Facies Trace Elements

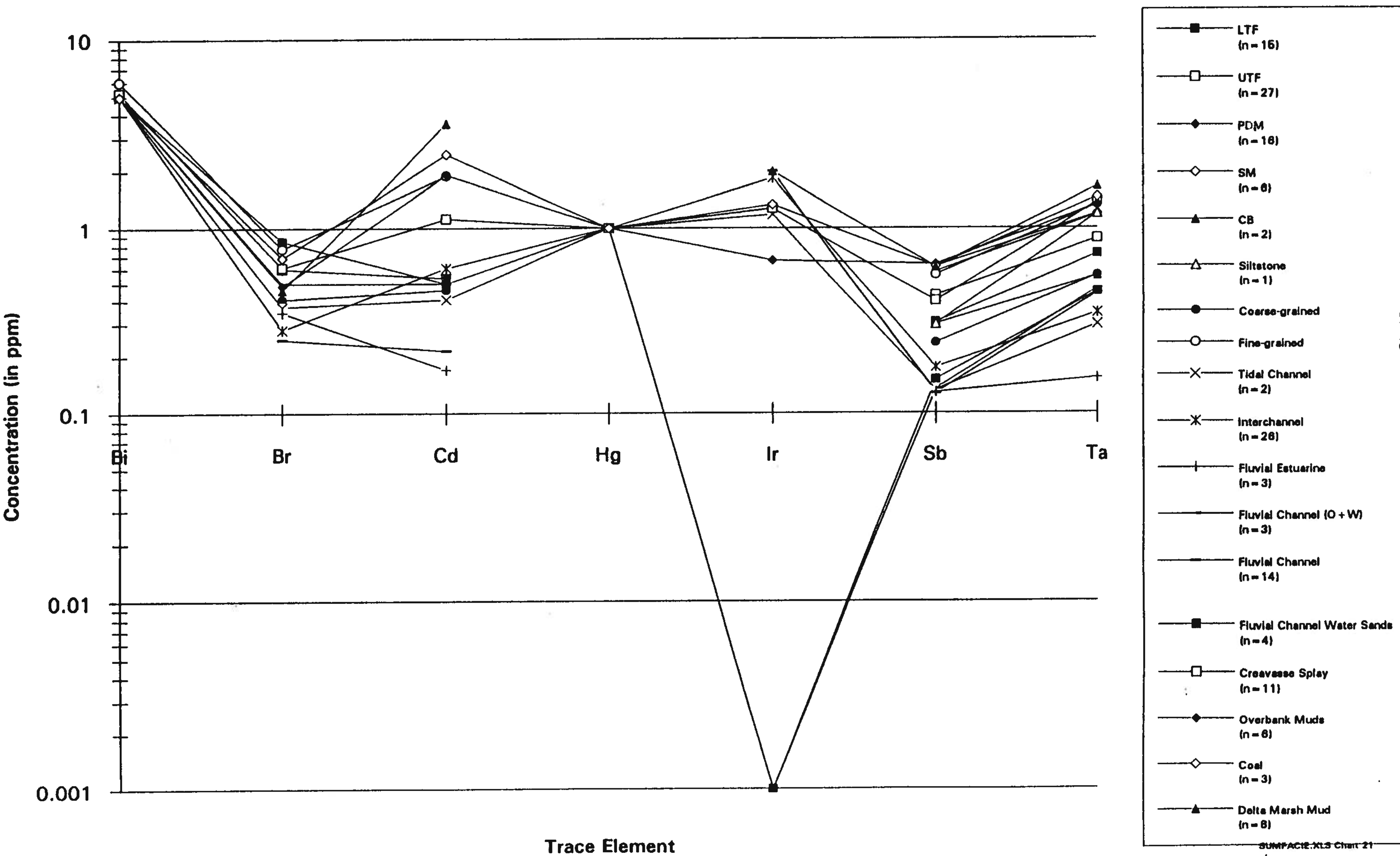
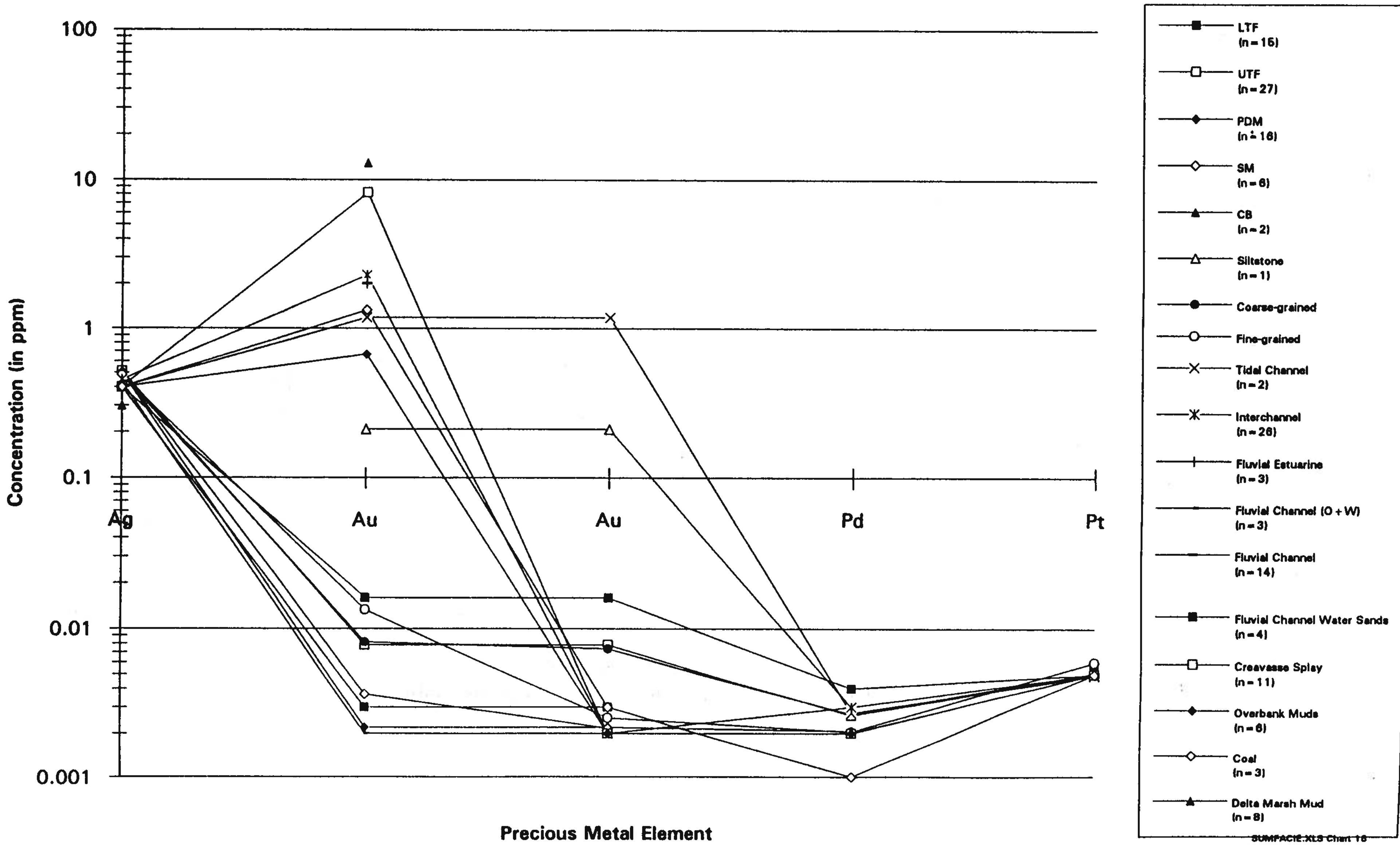


Figure G.5.6 Comparison of the Mean Concentration of Elements by Facies
Precious Metals



Appendix H

Plots and Correlations

Appendix H

Plots and Correlations

In this appendix plots and correlations are used to reveal characteristics that traditional statistical analyses cannot.

1. Cross Plots

Cross plots between various elemental concentrations are used to determine if correlations exist or not.

Figure H.1 plots all elements analyzed vs. Aluminum.

Figure H.2 plots various elements vs. each other to determine if there is a relationship between them. (V vs. Ni, Cl vs. Na, U vs. Th, Lu vs. La, K and Zr vs. Ti)

2. Gamma Count and Methylene Blue Index Plots

Figure H.3 shows plots of various features against the Gamma count and the MTB Index. Aspects shown - clay content, aluminum content and bitumen content. The data base used in Figure H.3 was restricted to samples on which the clay content and MTB index was determined.

Figure H.4 shows plots of elemental concentrations vs. the Gamma count using the entire data base. Concentrations plotted: Al, K, Ti, Bitumen, Th, U, Cl and Hf.

3. Bitumen related Plots

Figure H.5 plots elemental concentrations vs. bitumen. Three groups of elements are represented
- elements reported to be totally organically bound: (Ni, V, Mo, Rb, Se);
- elements reported to be predominantly organically bound: (As, Co, Cr, Fe, Ga, Na, Sb, Sc and Th);
- elements reported to be totally inorganically bound (Al, Ce, Cs, K, La);

4. Duplicate Analyses

H.6 plots of duplicate analyses of a given element vs. depth for independent methods of analysis. Both neutron activation and ICP methods of analysis were performed on Al, Ba, Cr, Fe, Na, and Mn. The purpose of the plots is to determine if the concentrations detected follow the same trend.

5. Particle Size Analysis

Figure H.7 shows the amount of clay sized material detected by different methods of analysis. Indications from traditional methods and hydrometer methods are compared.

6. Bore Hole Logs linking bore hole information and elemental concentrations.

Figure H.8 shows a suite of plots of elemental concentrations, stratigraphic data and geophysical logs vs. depth for the two core holes.

Figure H.1(a) Primary Elements vs Aluminum Cross Plots

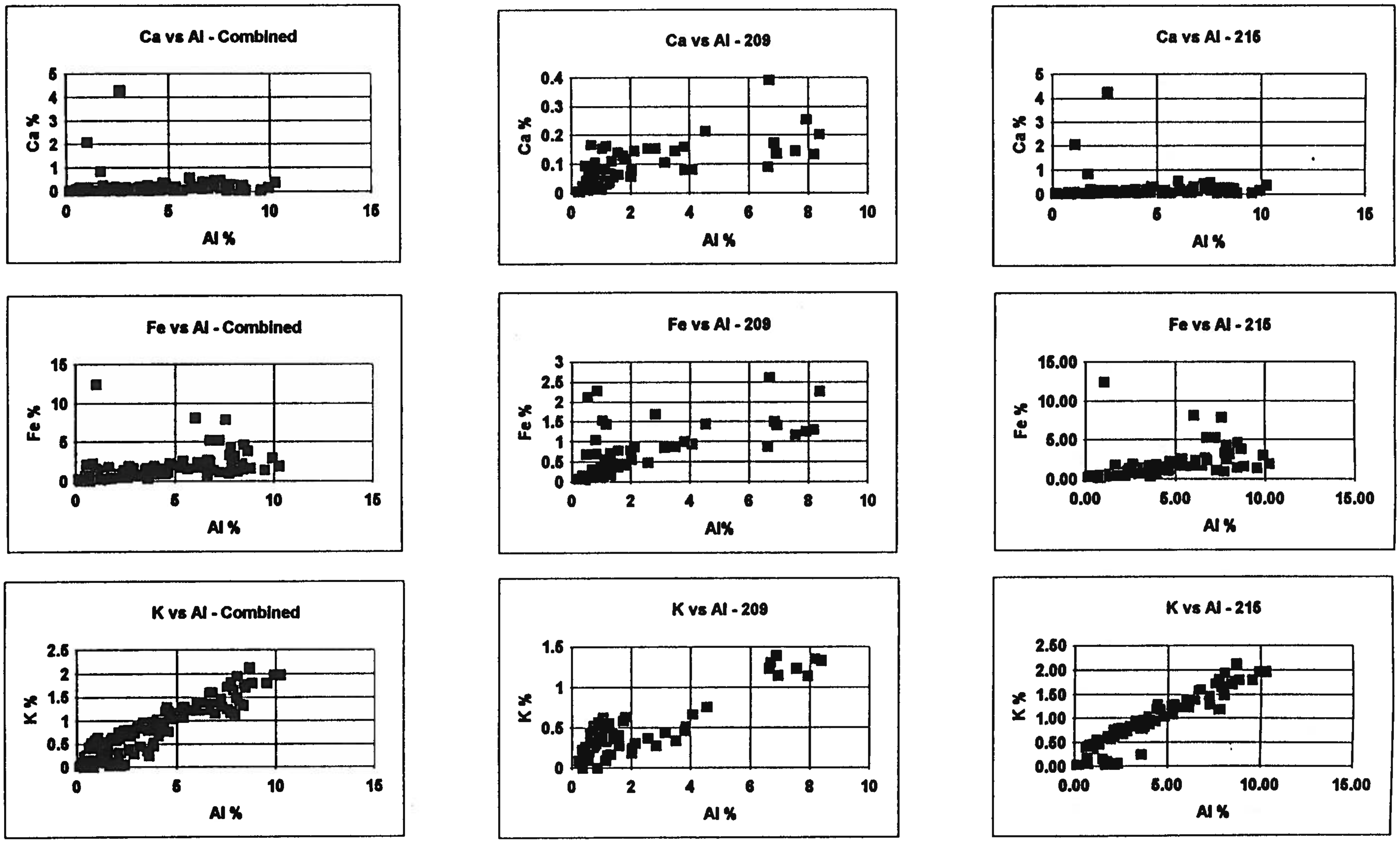


Figure H.1(a) Primary Elements vs Aluminum Cross Plots

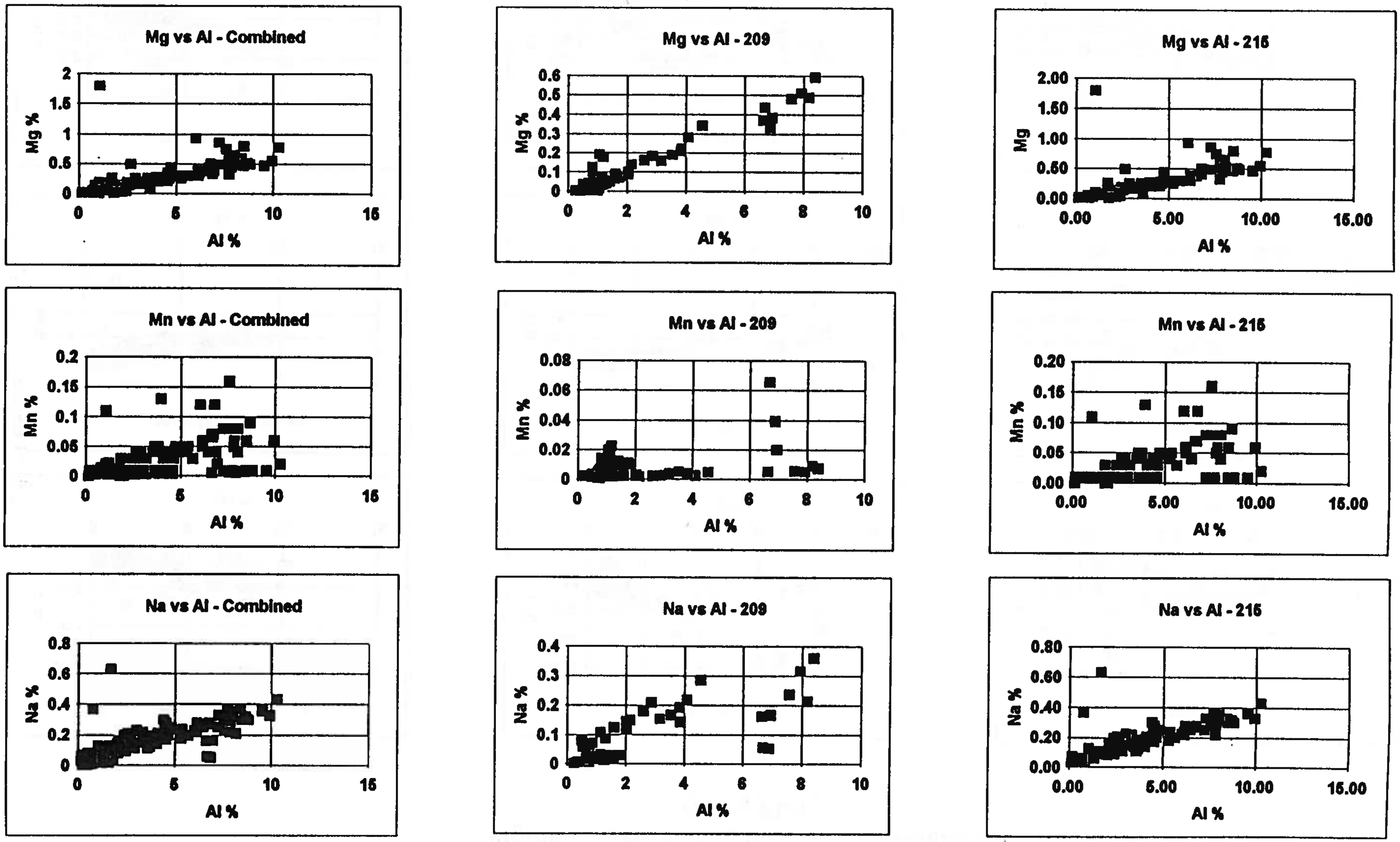


Figure H.1(a) Primary Elements vs Aluminum Cross Plots

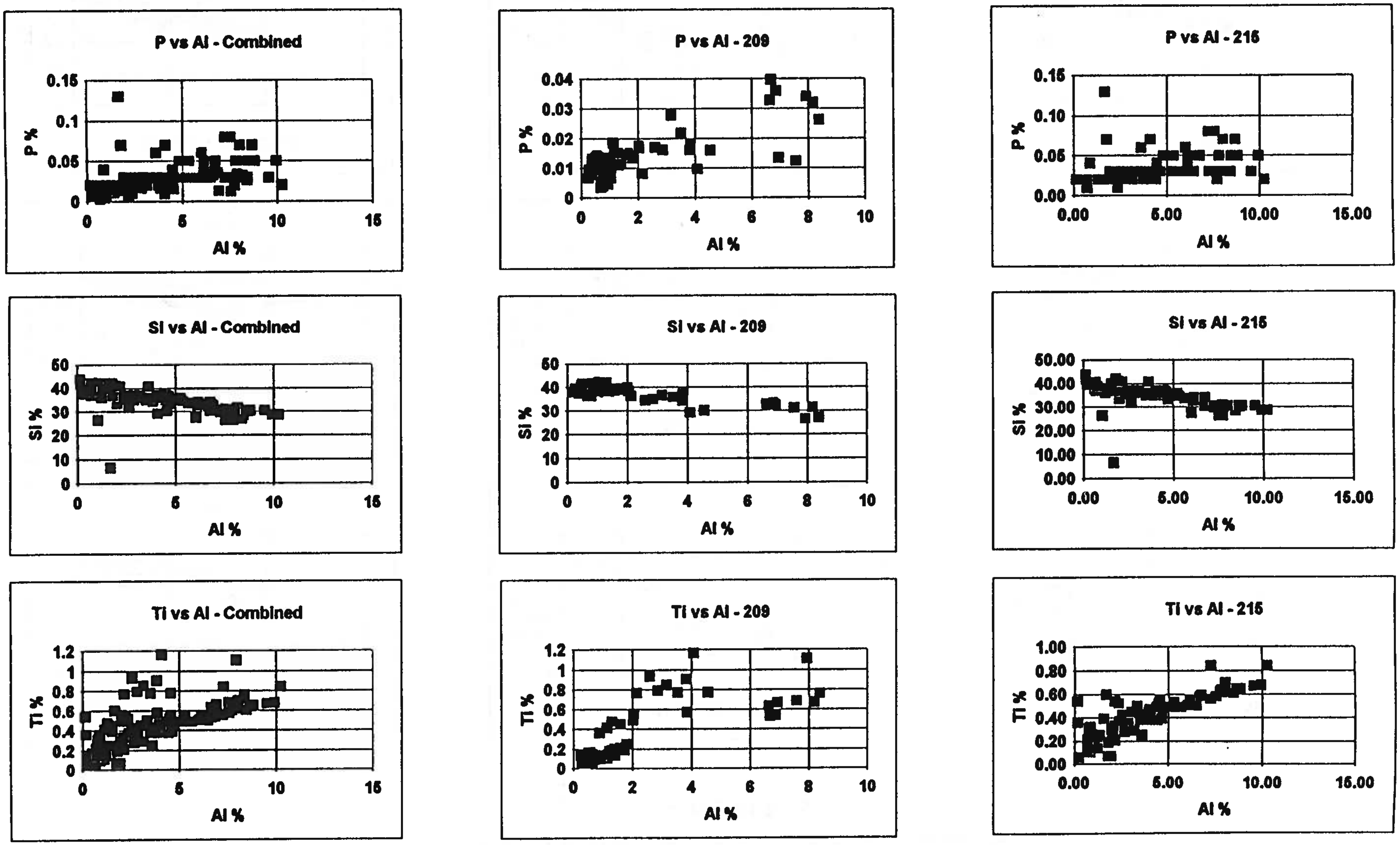


Figure H.1 (b) Minor Elements vs Aluminum Cross Plots

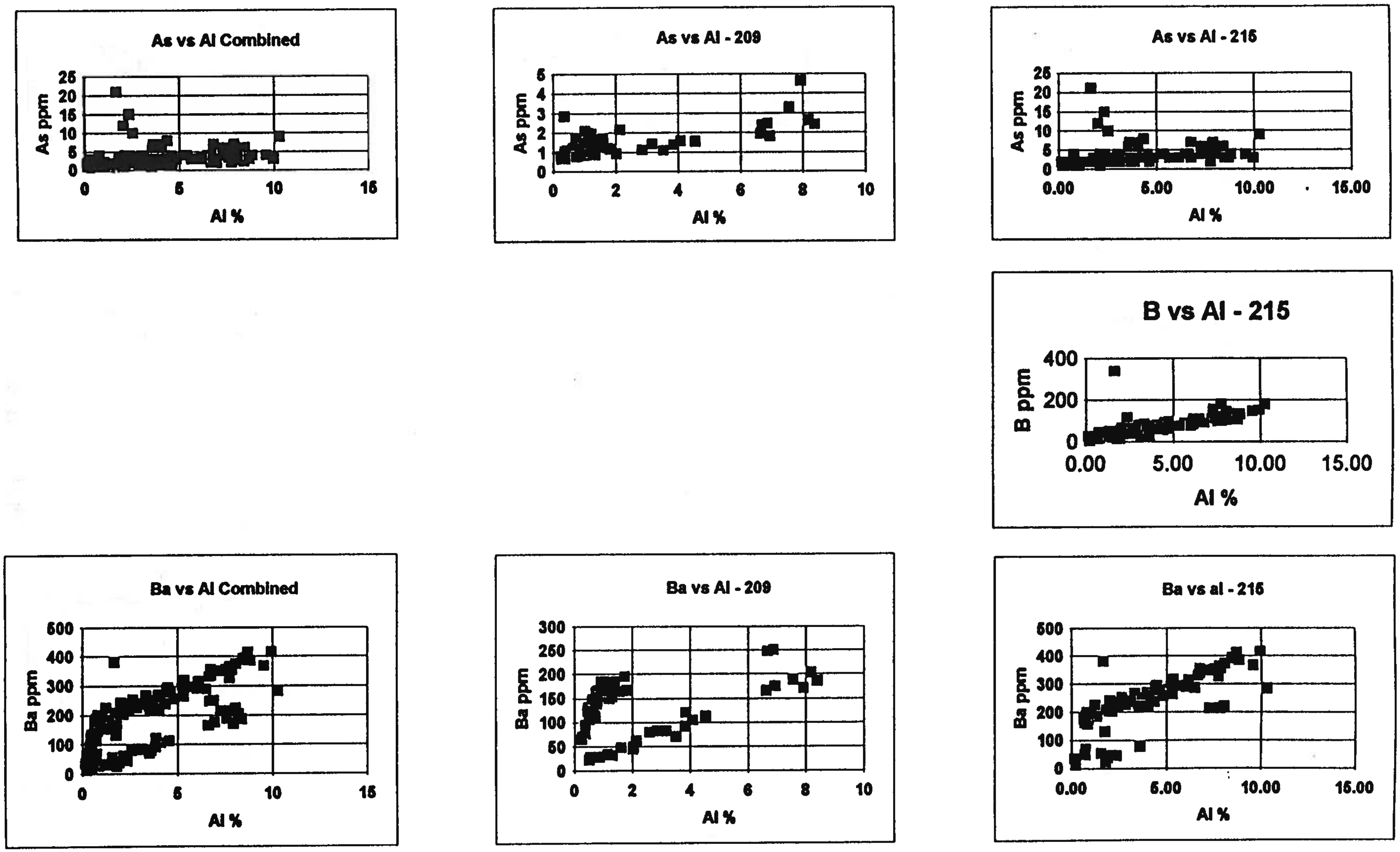


Figure H.1 (b) Minor Elements vs Aluminum Cross Plots

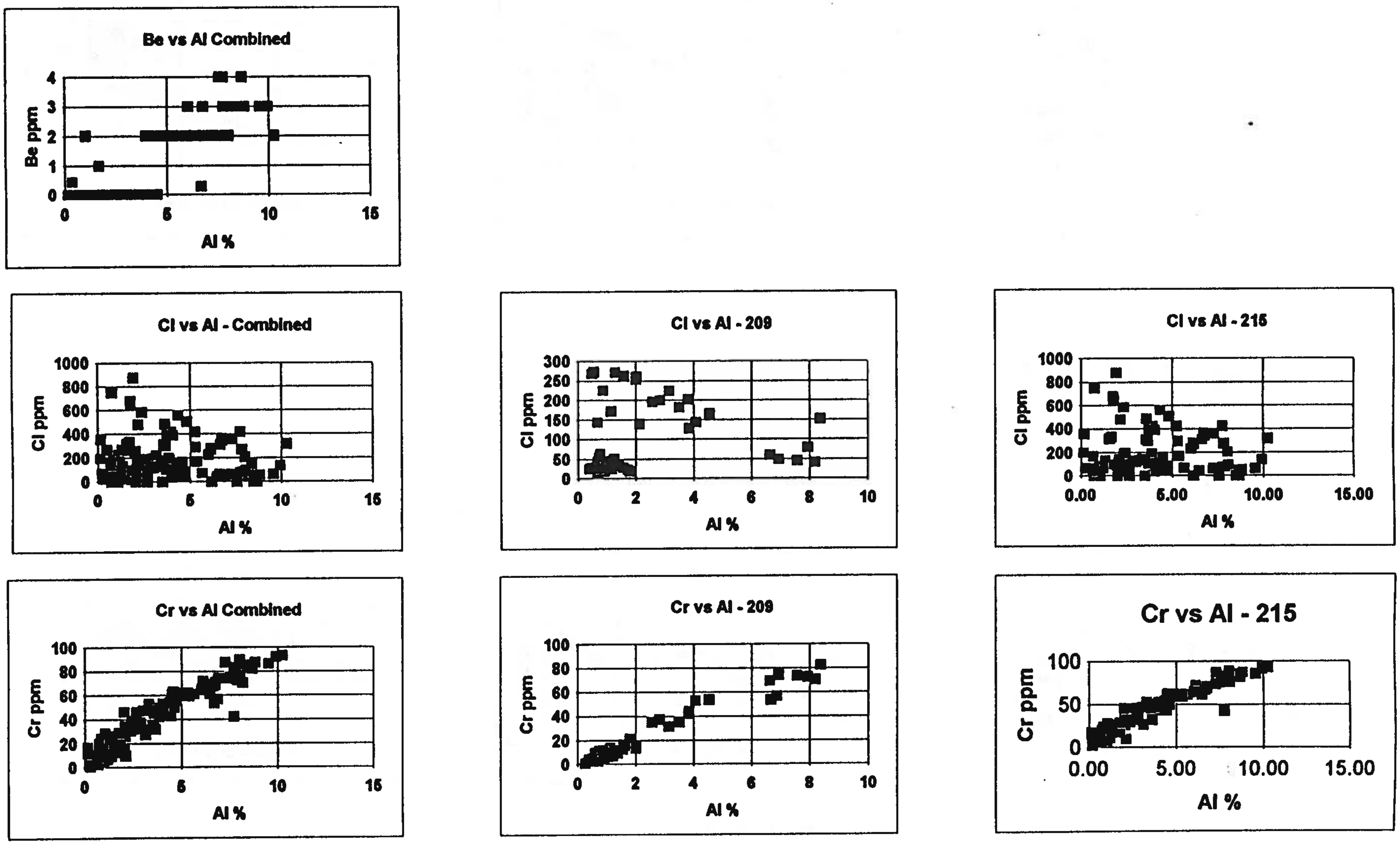


Figure H.1 (b) Minor Elements vs Aluminum Cross Plots

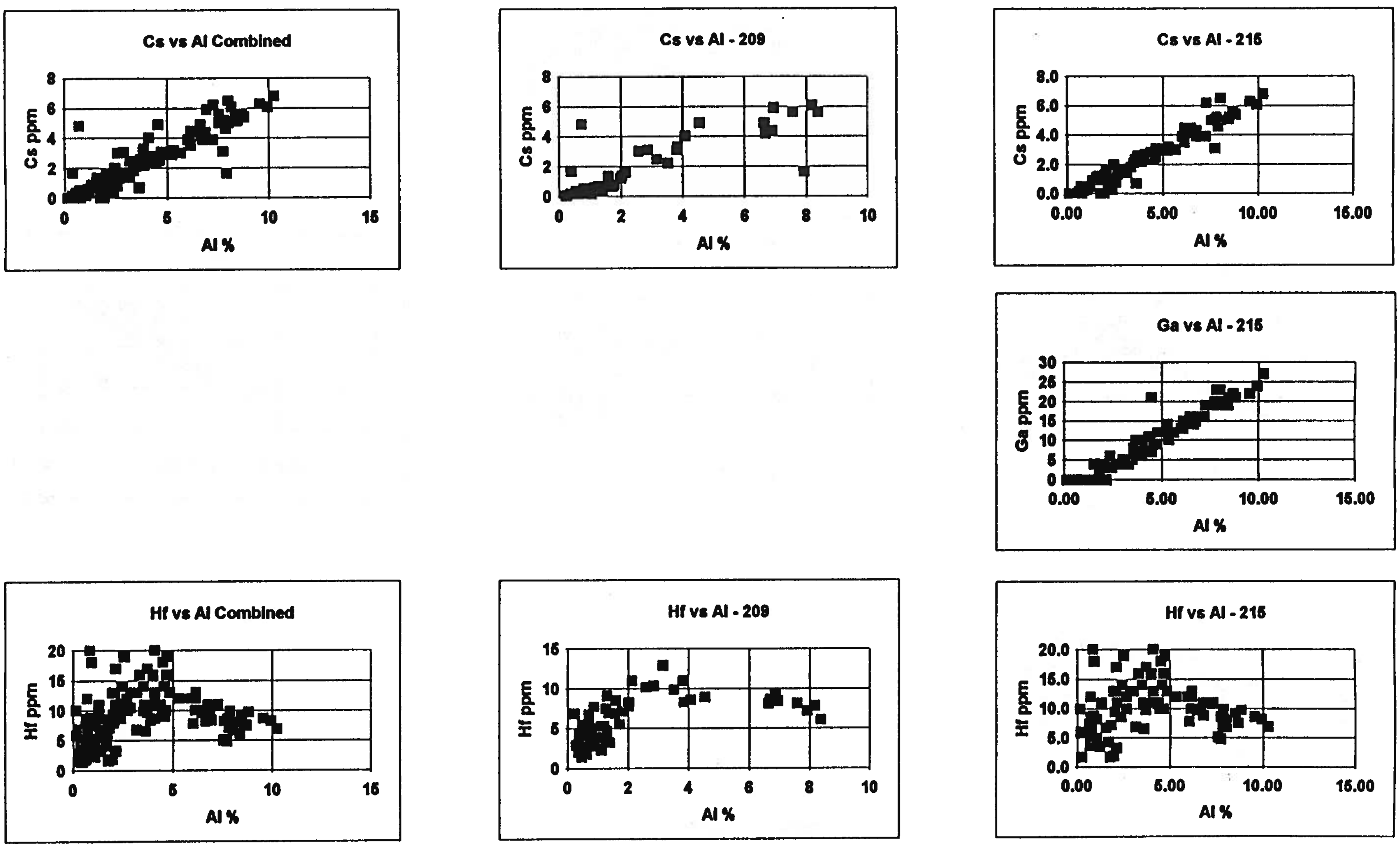


Figure H.1 (b) Minor Elements vs Aluminum Cross Plots

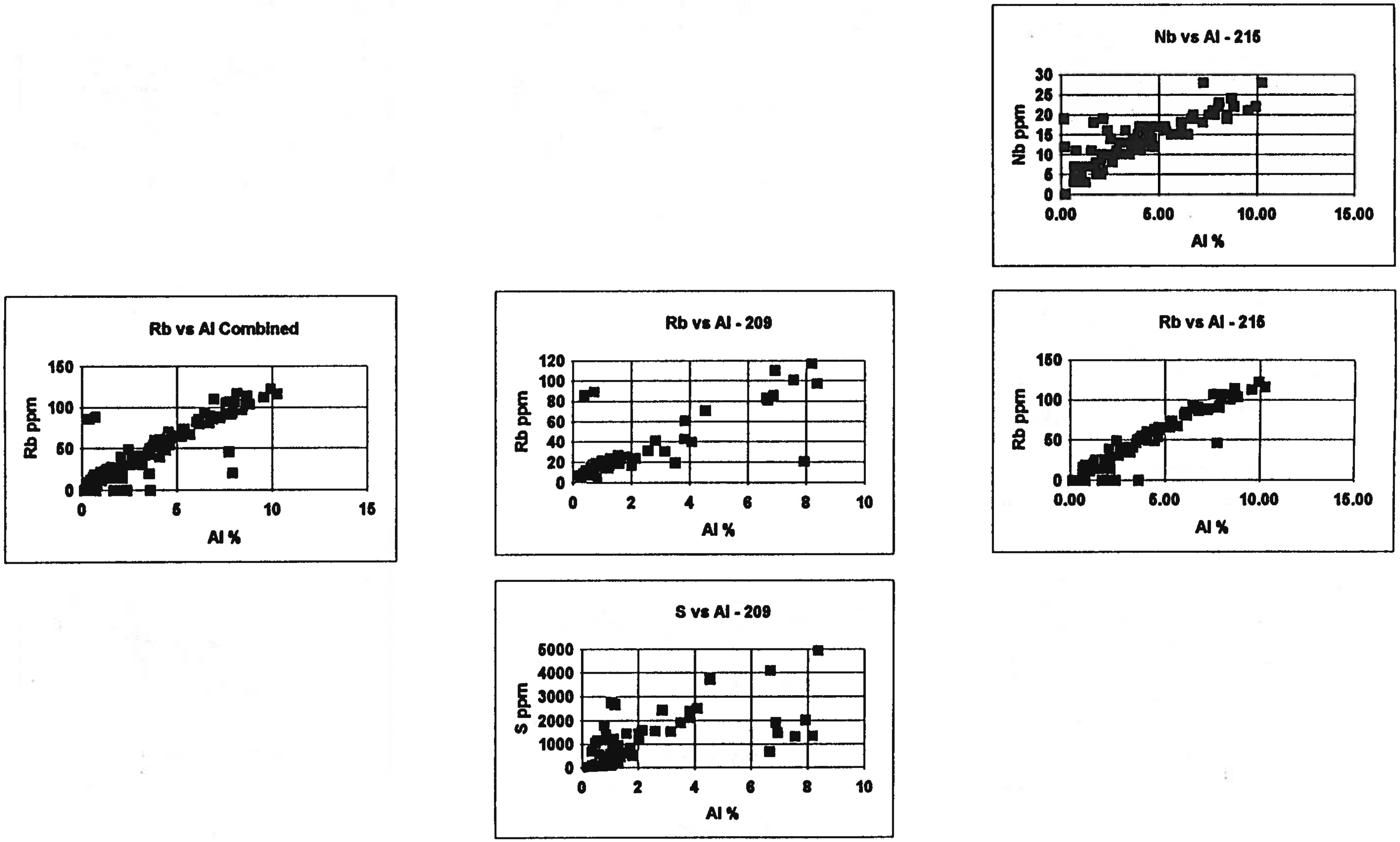


Figure H.1 (b) Minor Elements vs Aluminum Cross Plots

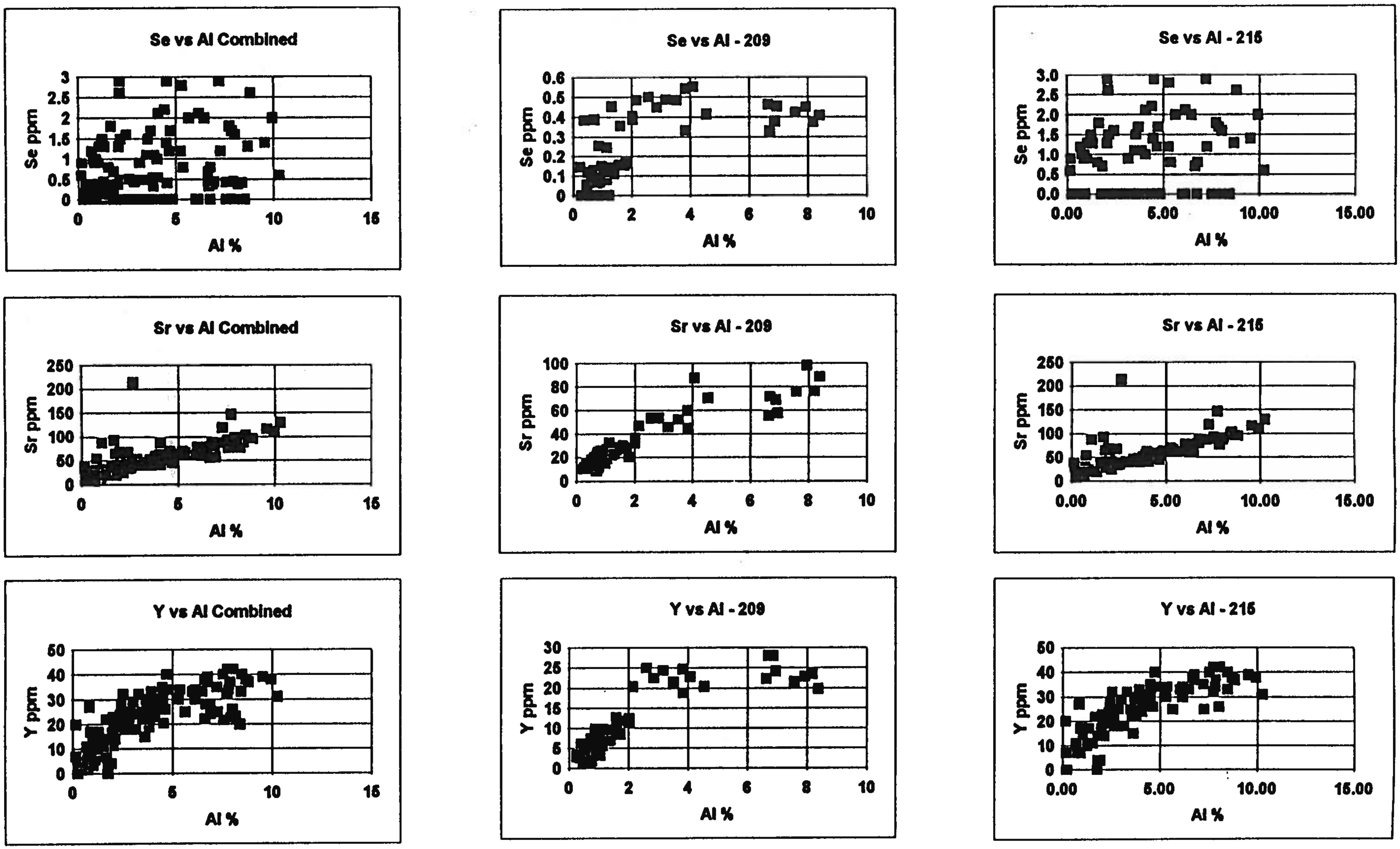


Figure H.1 (c) Trace Elements vs Aluminum Cross Plots

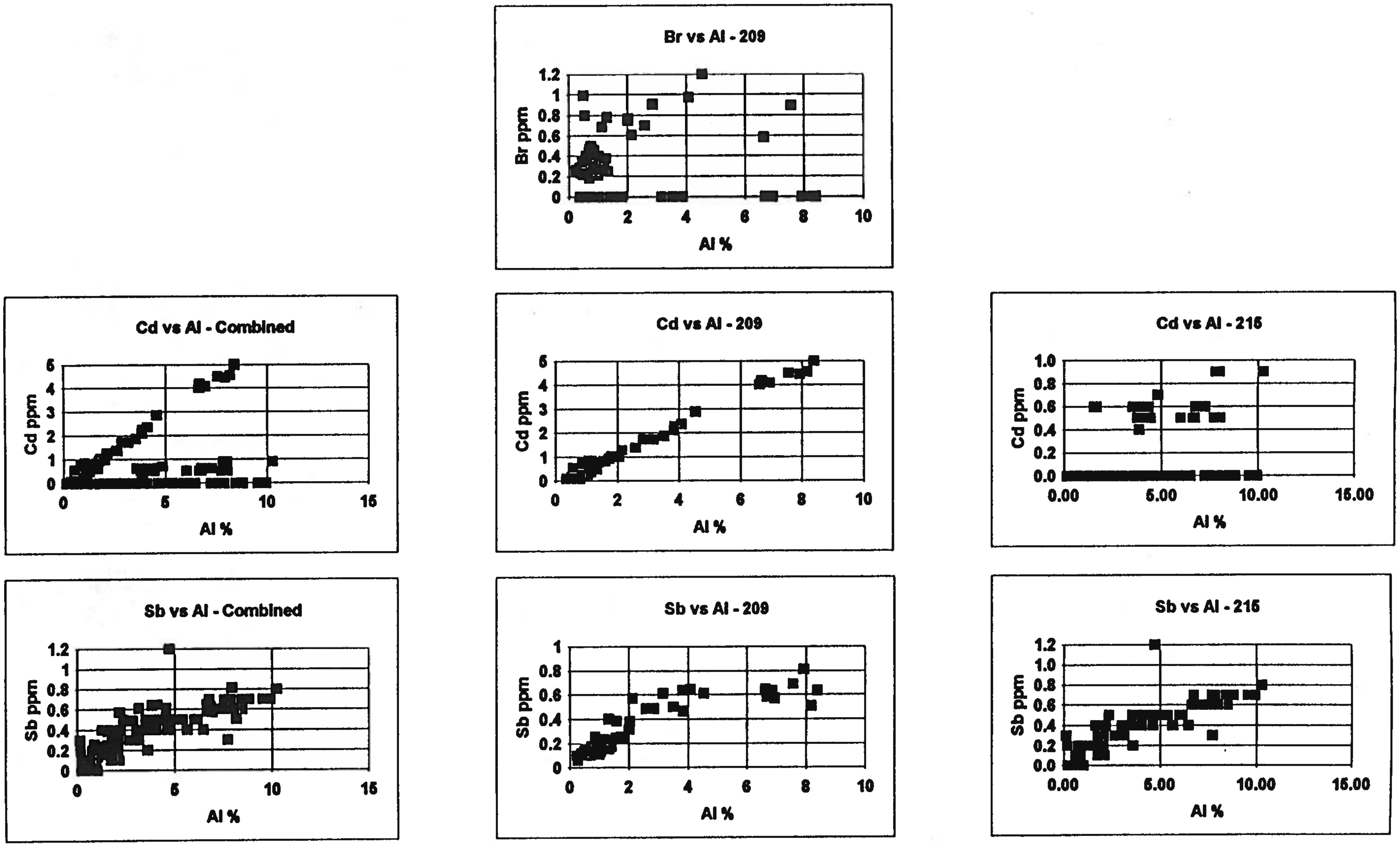


Figure H.1 (c) Trace Elements vs Aluminum Cross Plots

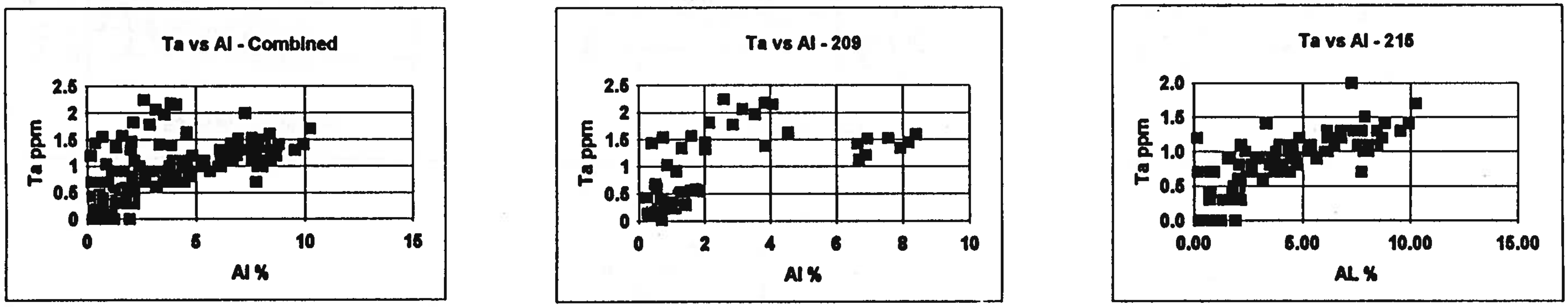


Figure H.1(d) Rare Earths vs Aluminum Cross Plots

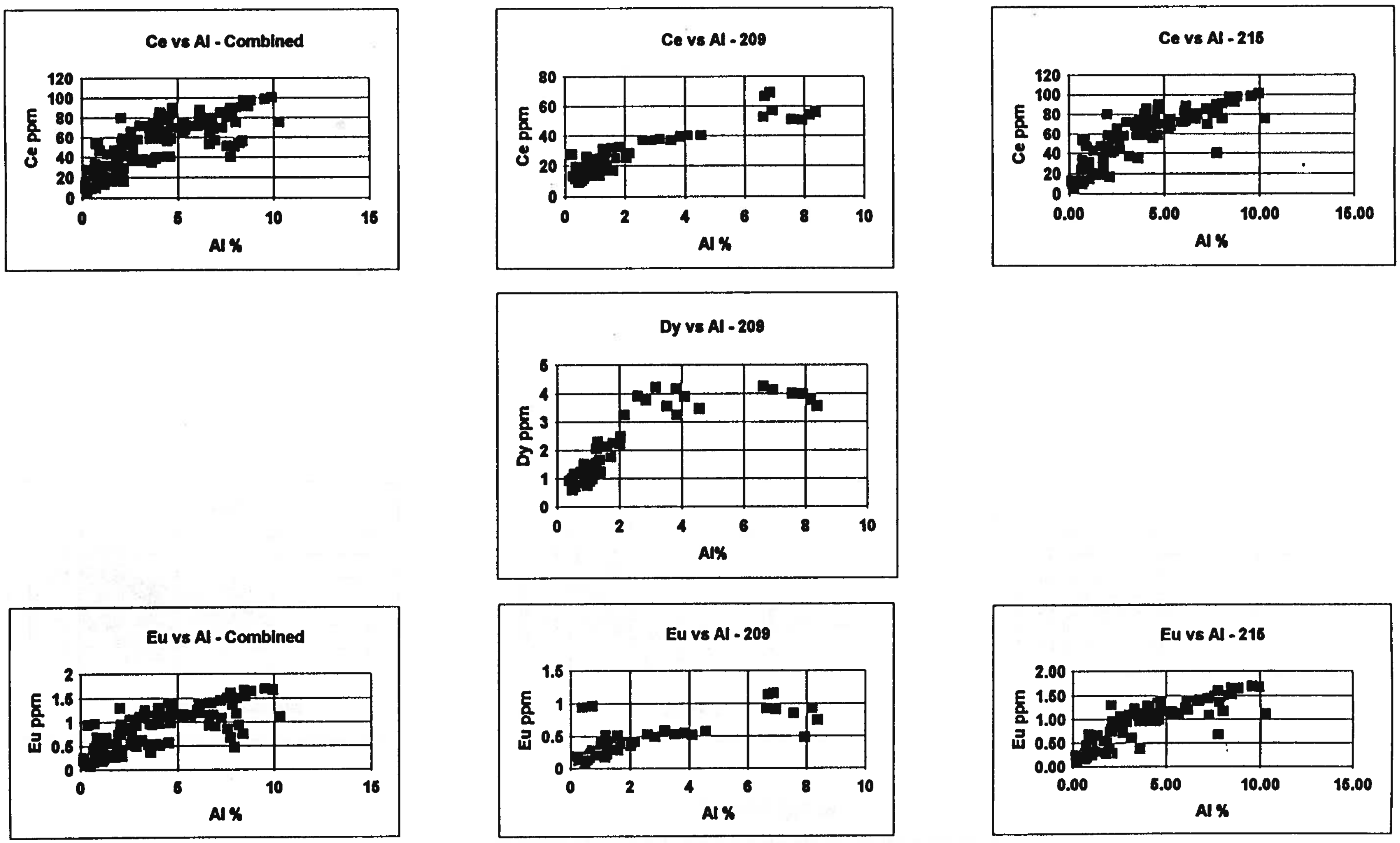


Figure H.1(d) Rare Earths vs Aluminum Cross Plots

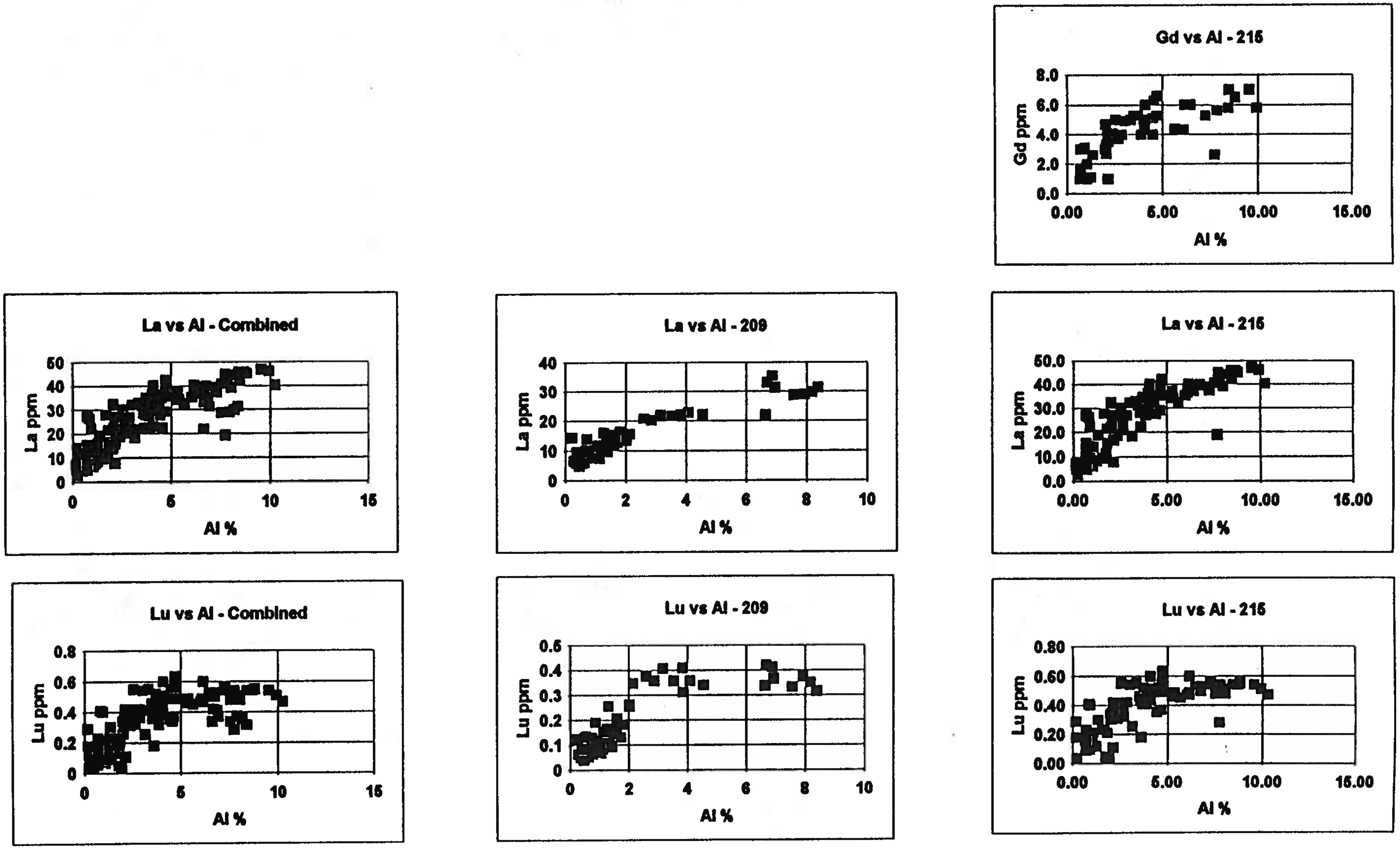


Figure H.1(d) Rare Earths vs Aluminum Cross Plots

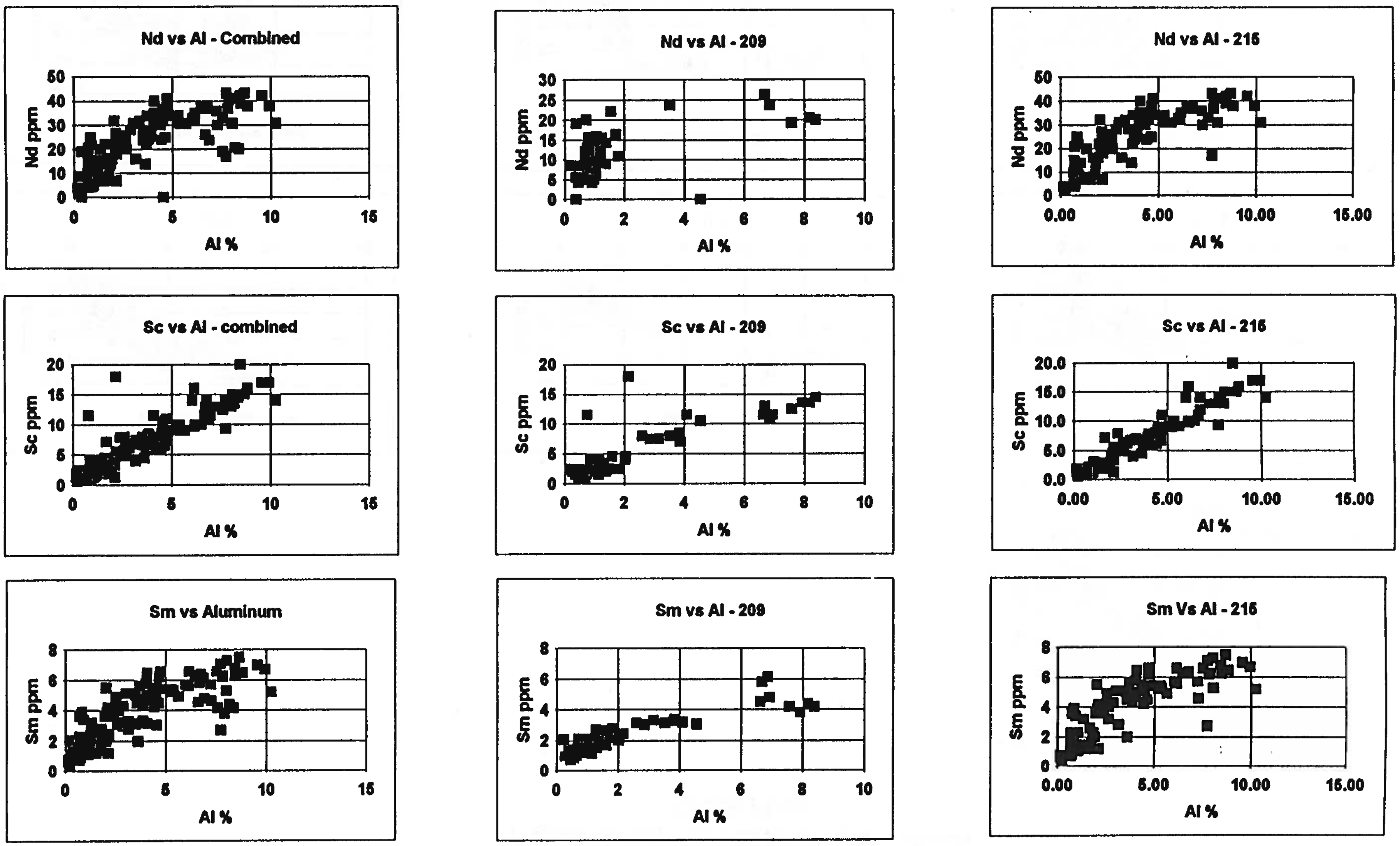


Figure H.1(d) Rare Earths vs Aluminum Cross Plots

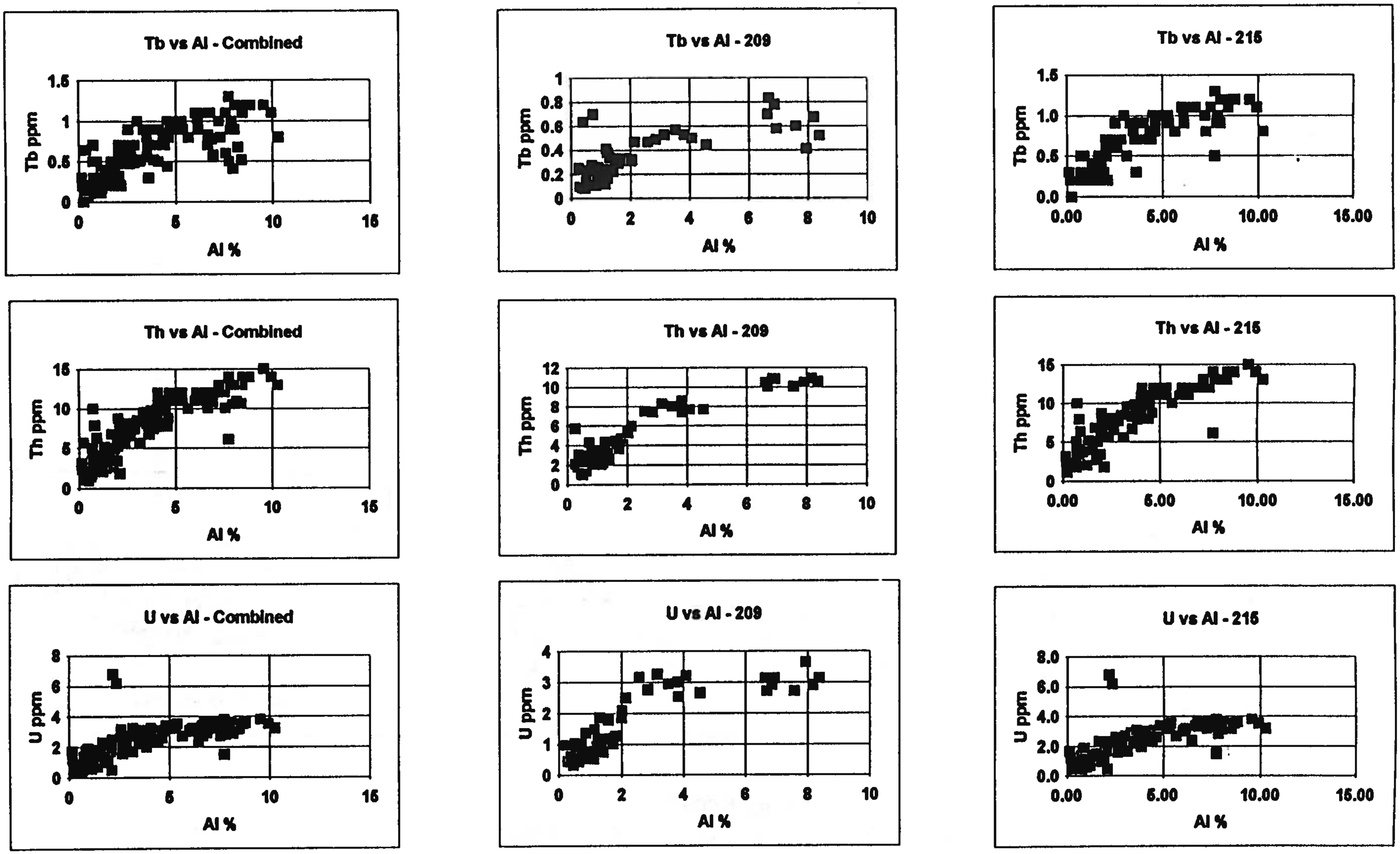
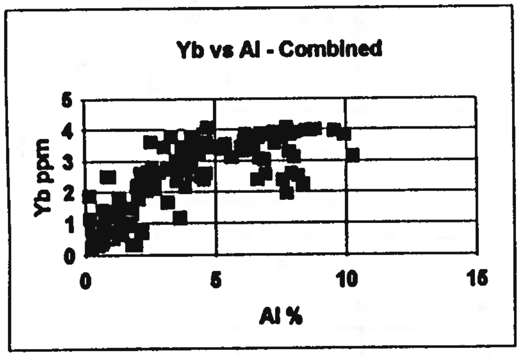
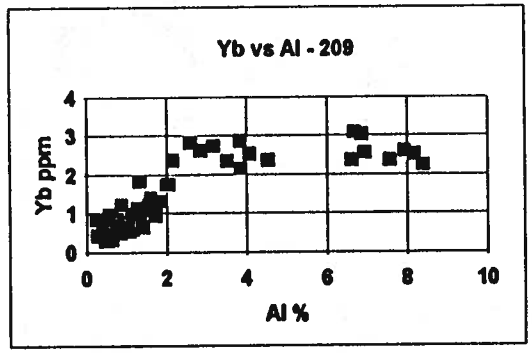


Figure H.1(d) Rare Earths vs Aluminum Cross Plots





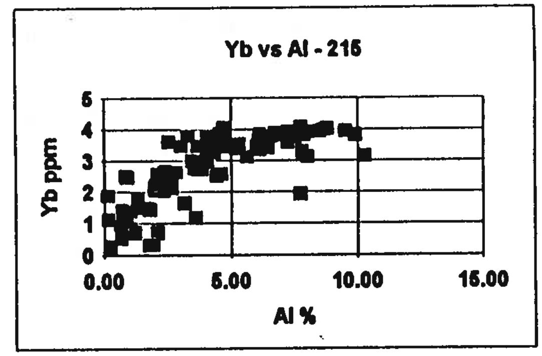


Figure H.1 (e) Metallic Elements vs Aluminum Cross Plots

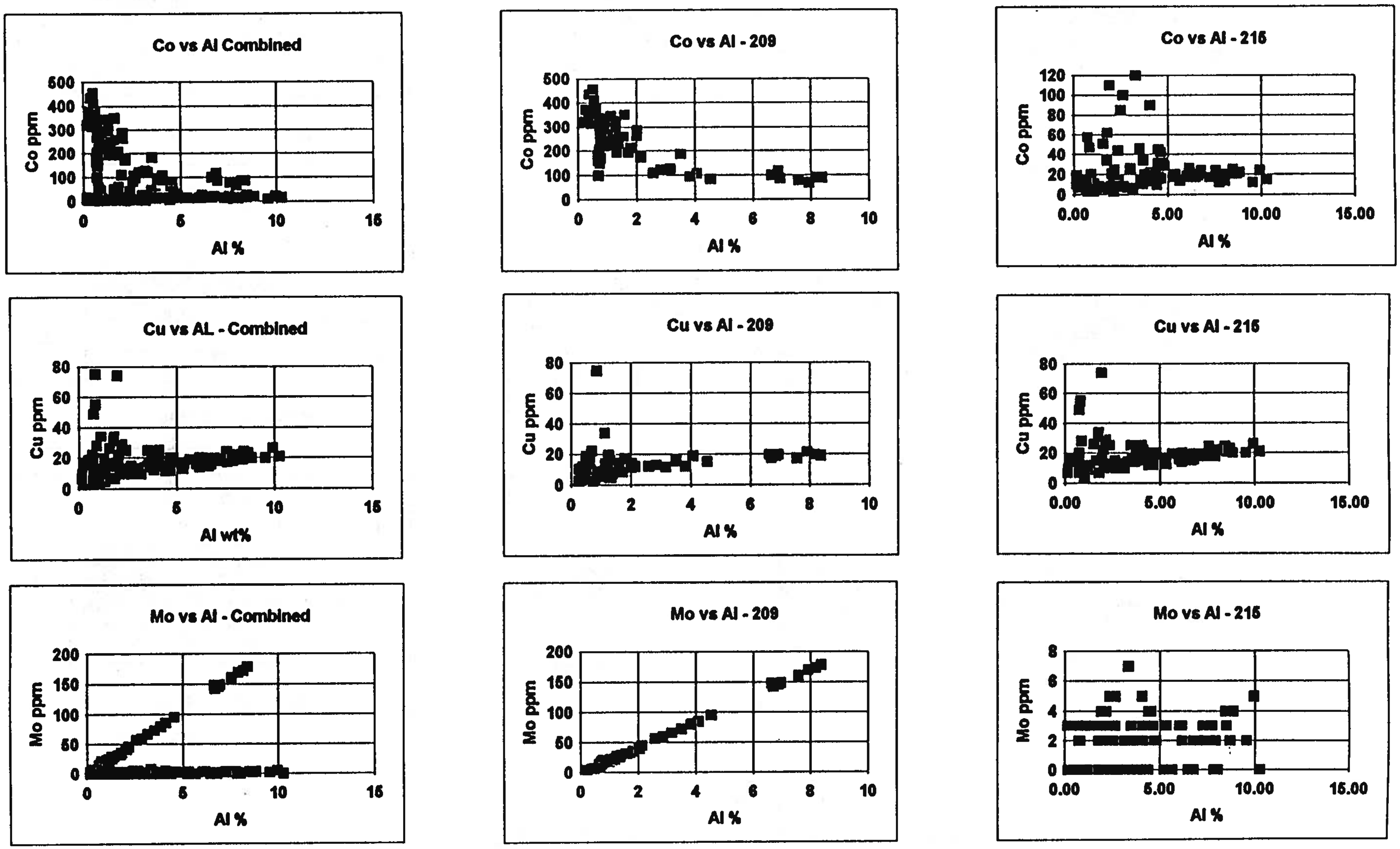


Figure H.1 (e) Metallic Elements vs Aluminum Cross Plots

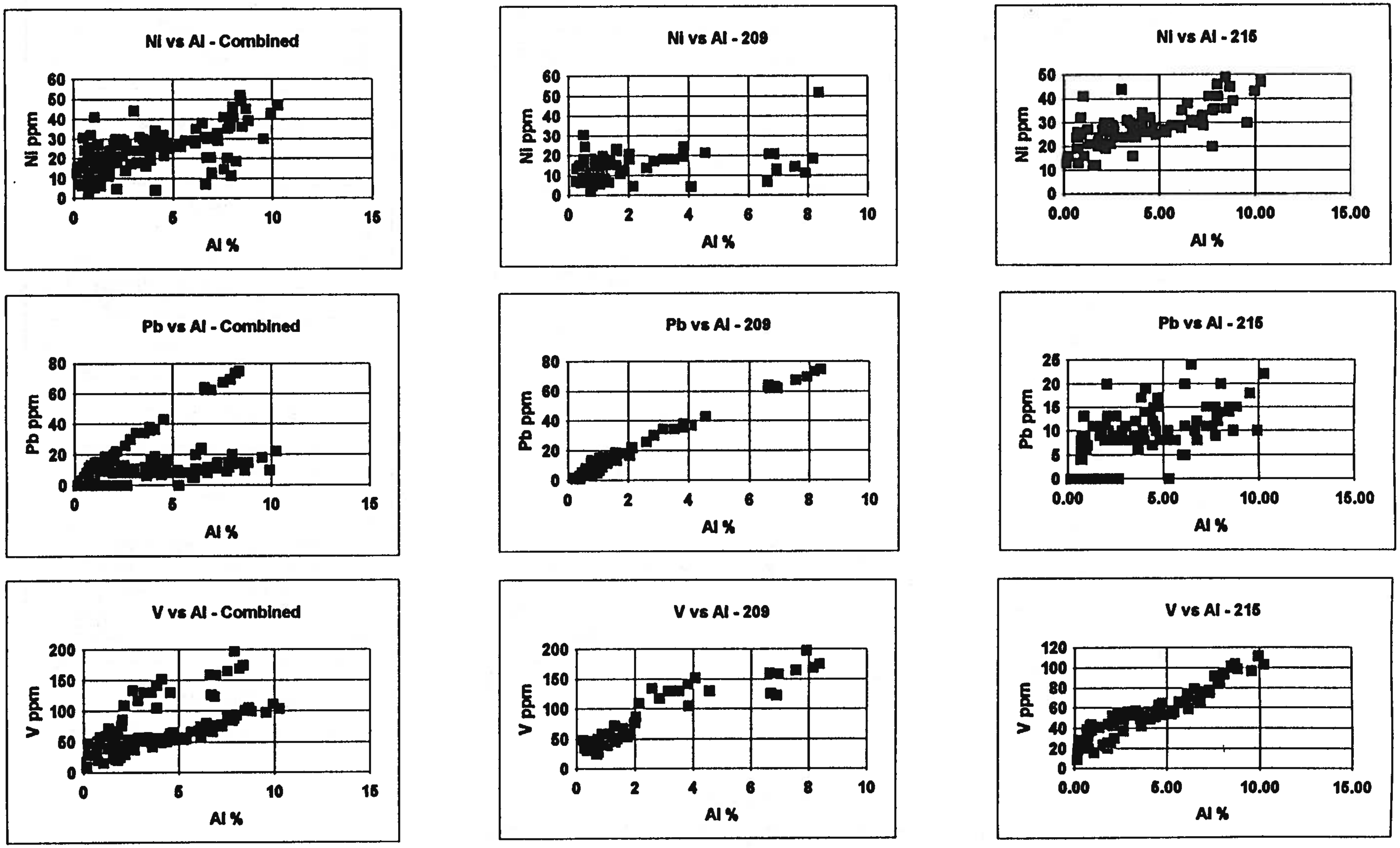


Figure H.1 (e) Metallic Elements vs Aluminum Cross Plots

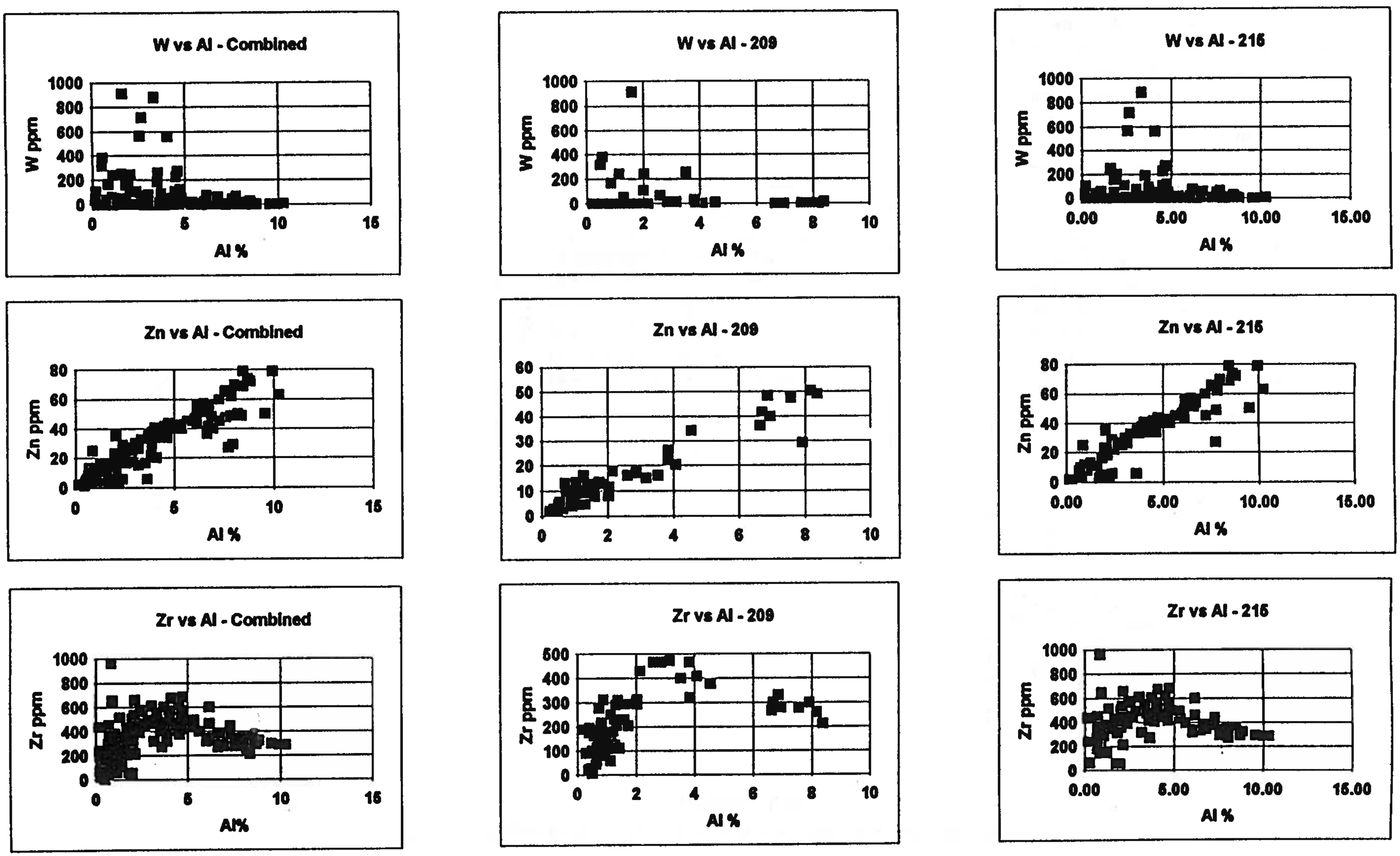


Figure H.1 (f) Precious Metals vs Aluminum Cross Plot

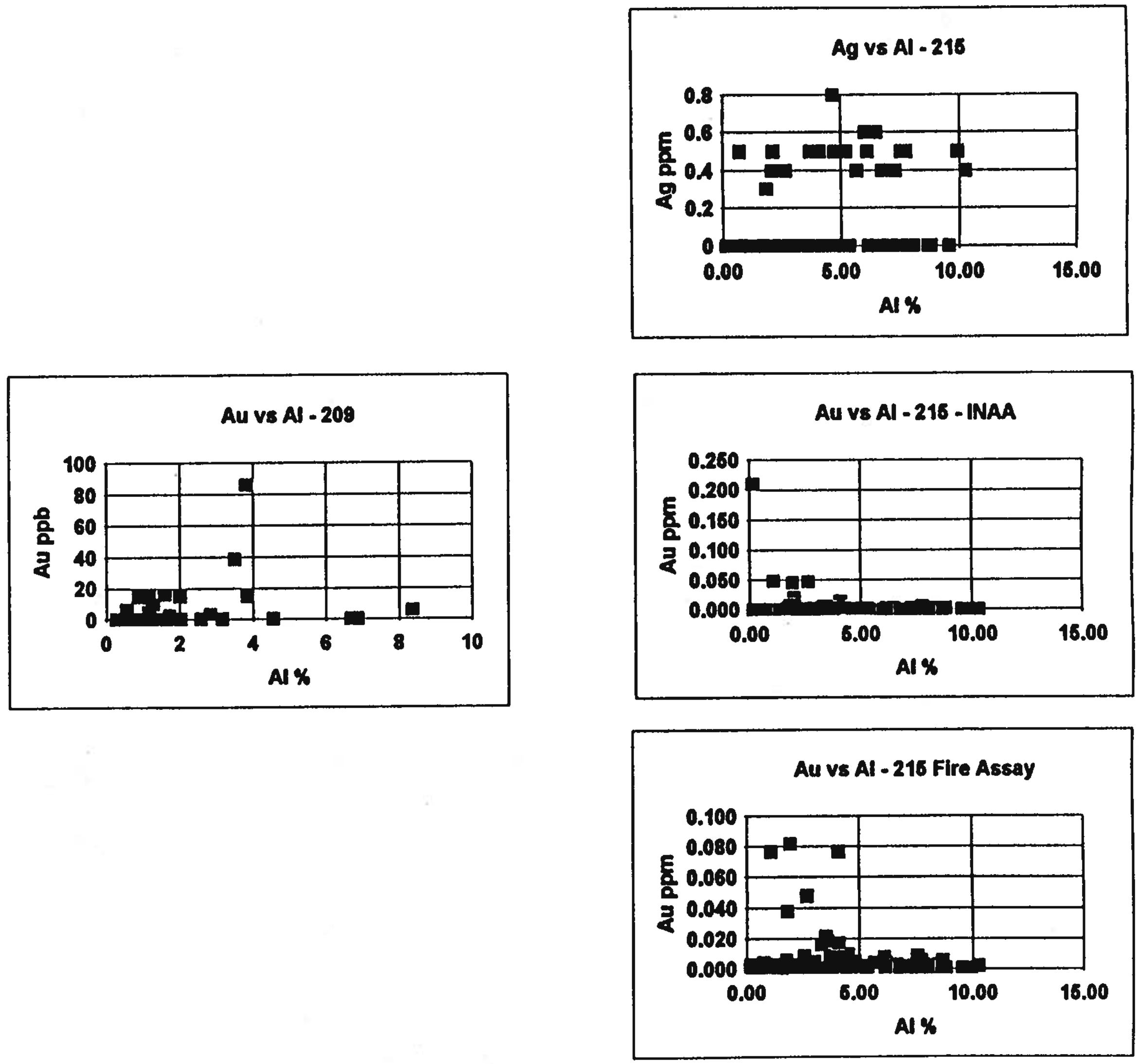
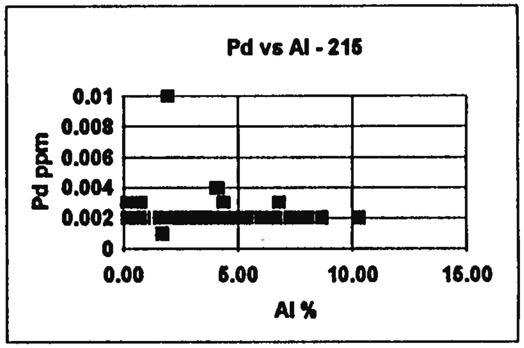


Figure H.1 (f) Precious Metals vs Aluminum
Cross Plot



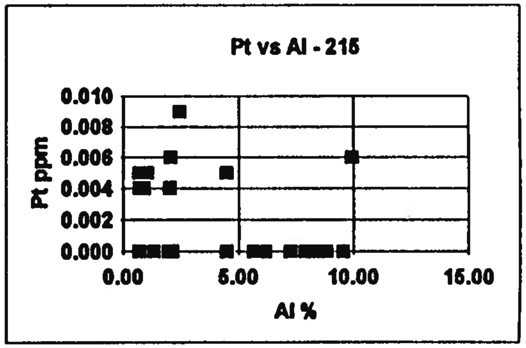


Figure H.2 Miscellaneous Cross Plots

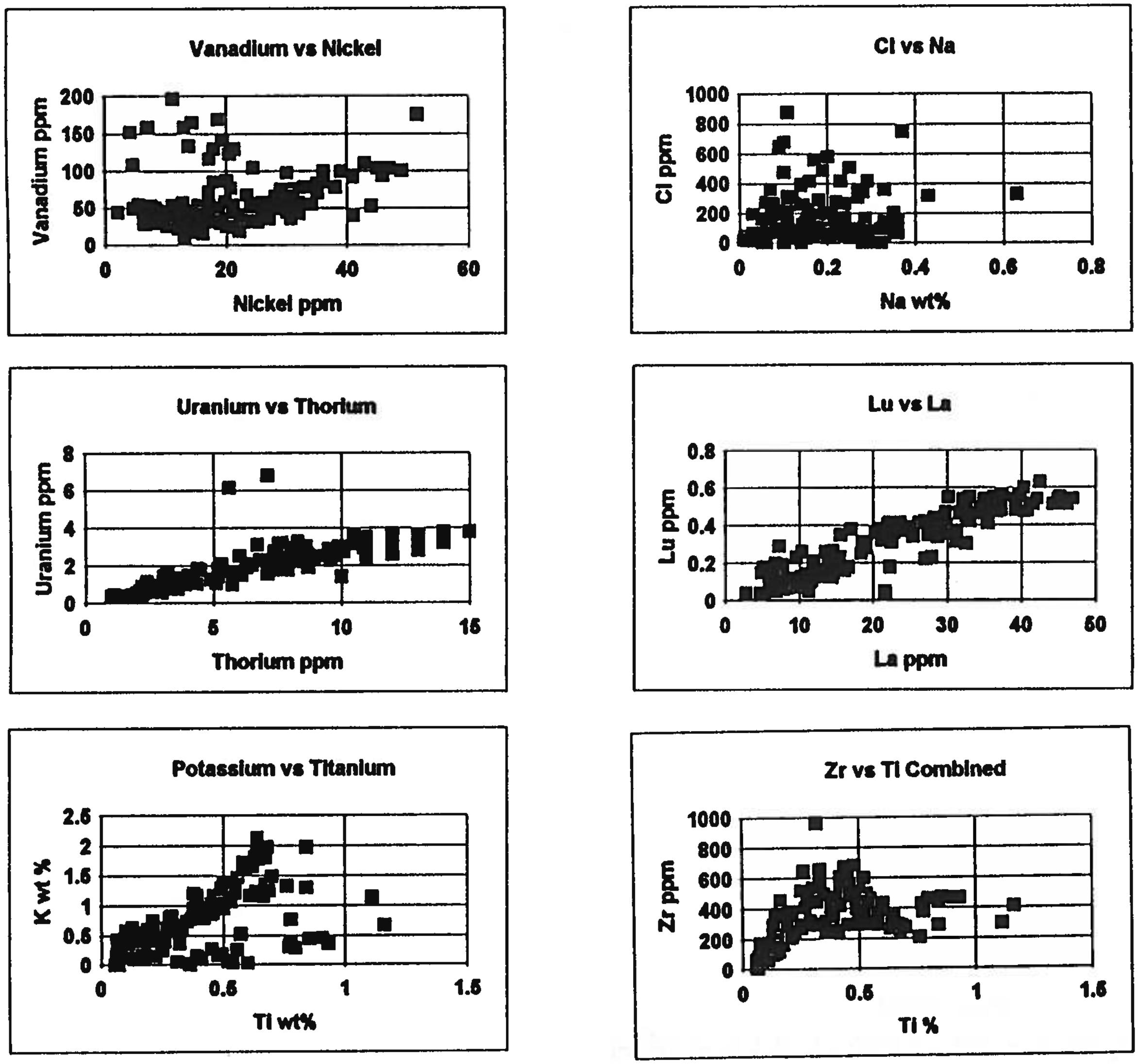


Figure H.3 Gamma and MTB Cross Plots

Data limited to corresponding MTB Tests

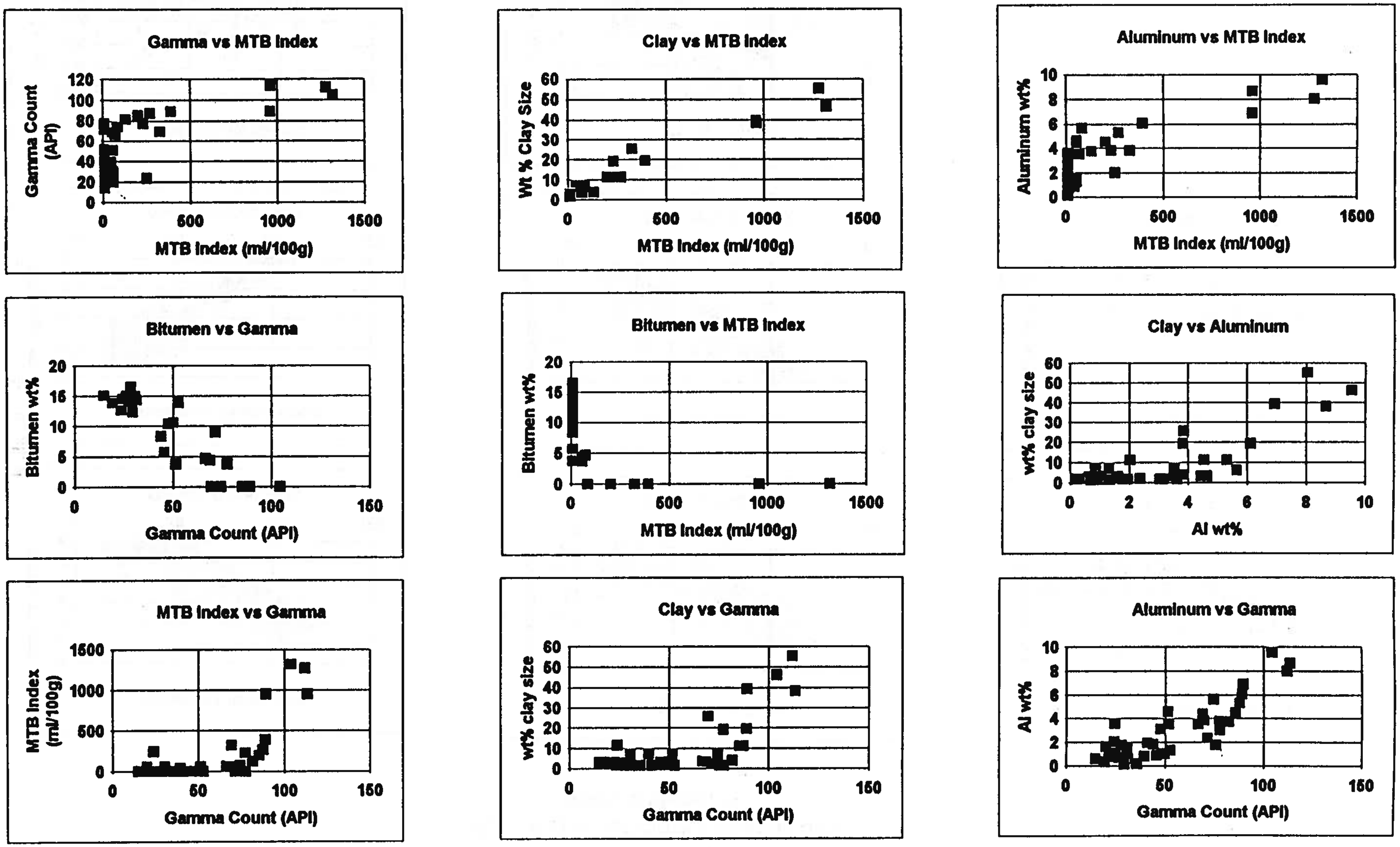


Figure H.4 Gamma Cross Plots
Various Elements

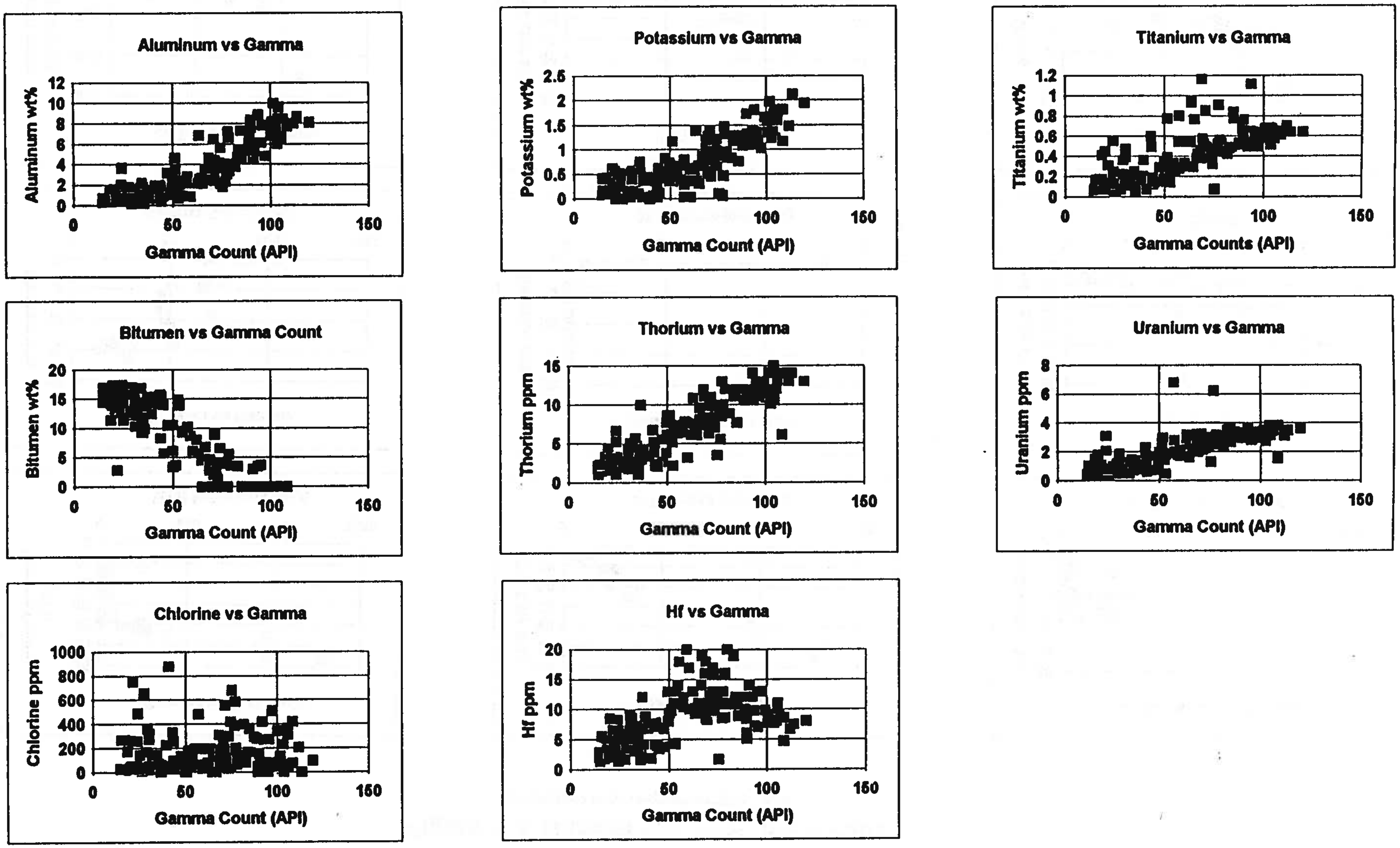


Figure H.5 Bitumen Cross Plots

Elements reported to be Totally Organically Bound

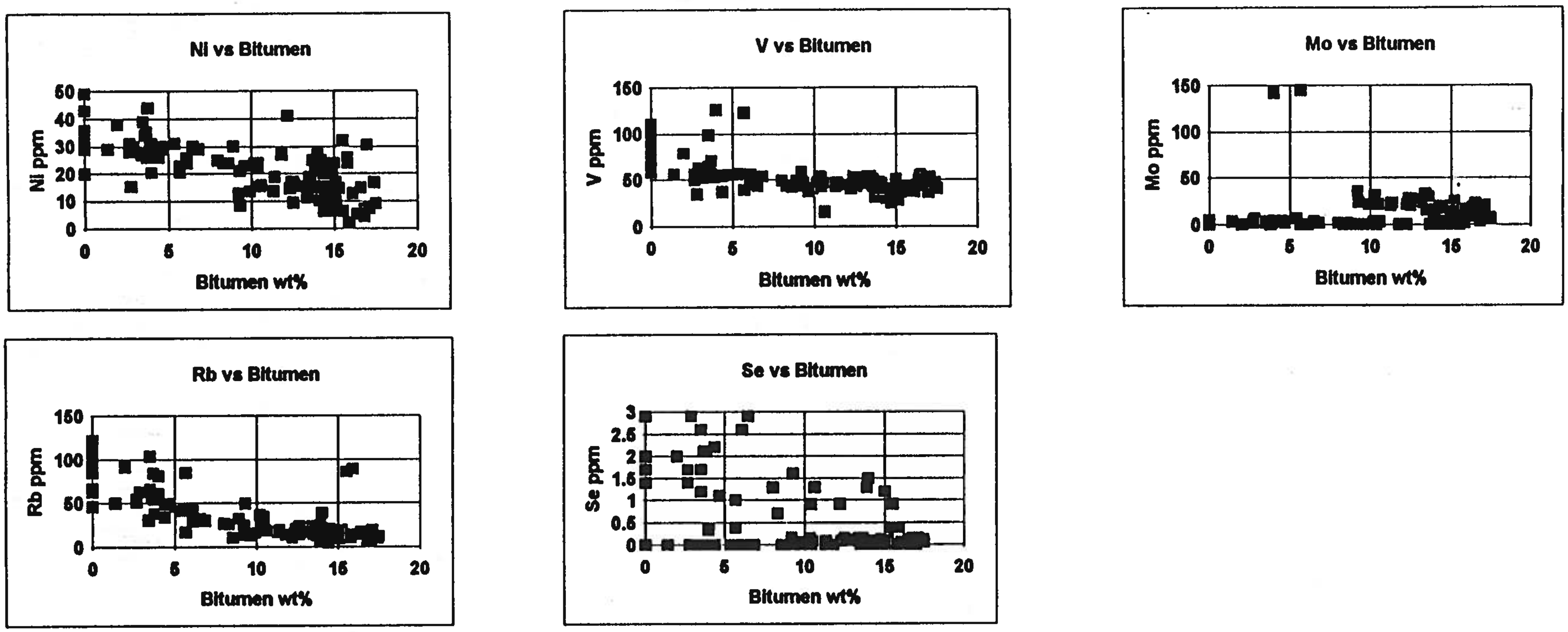


Figure H.5 Bitumen Cross Plots

Elements reported to be Predominantly Organically Bound

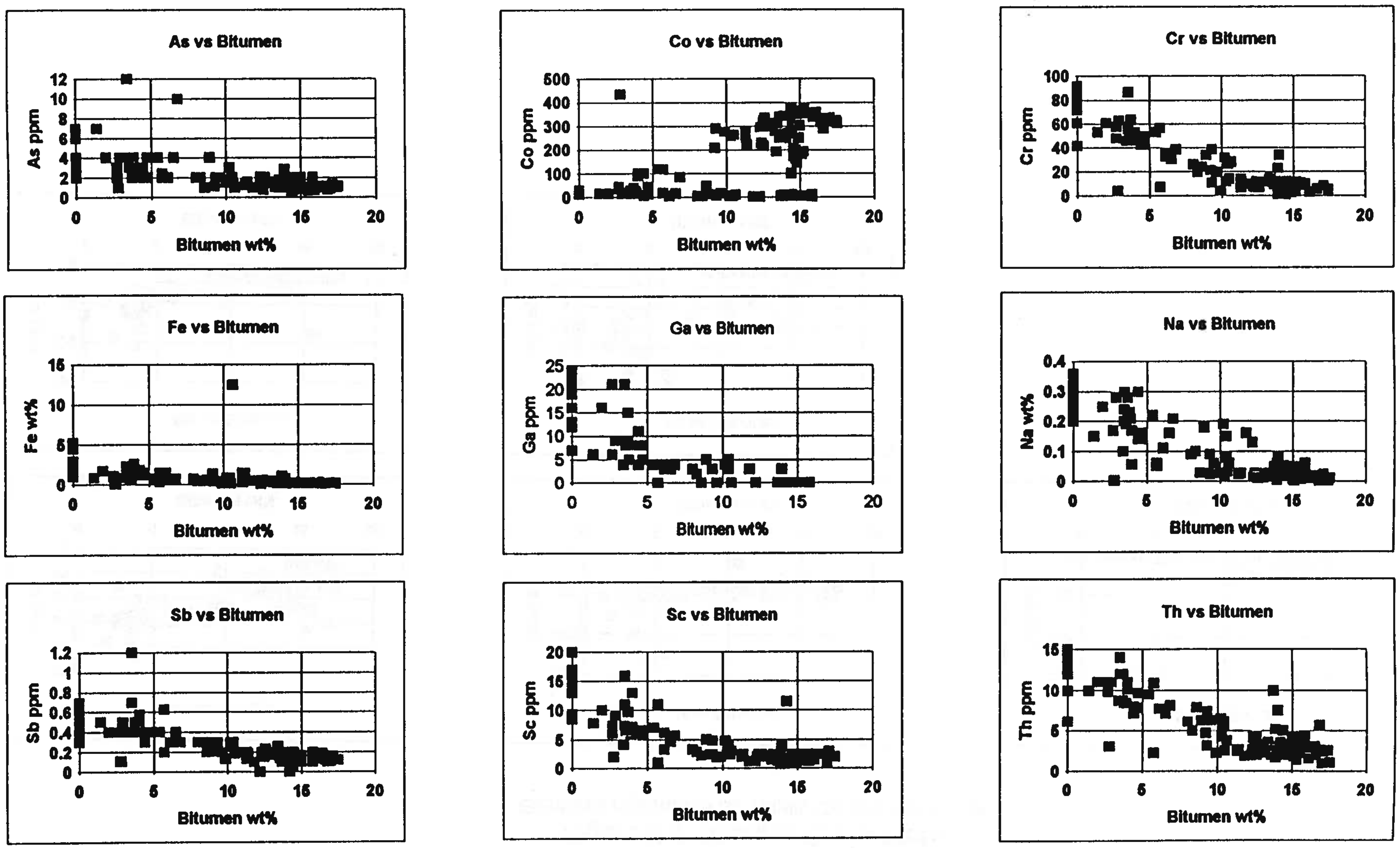


Figure H.5 Bitumen Cross Plots

Elements reported to be Totally Inorganically Bound

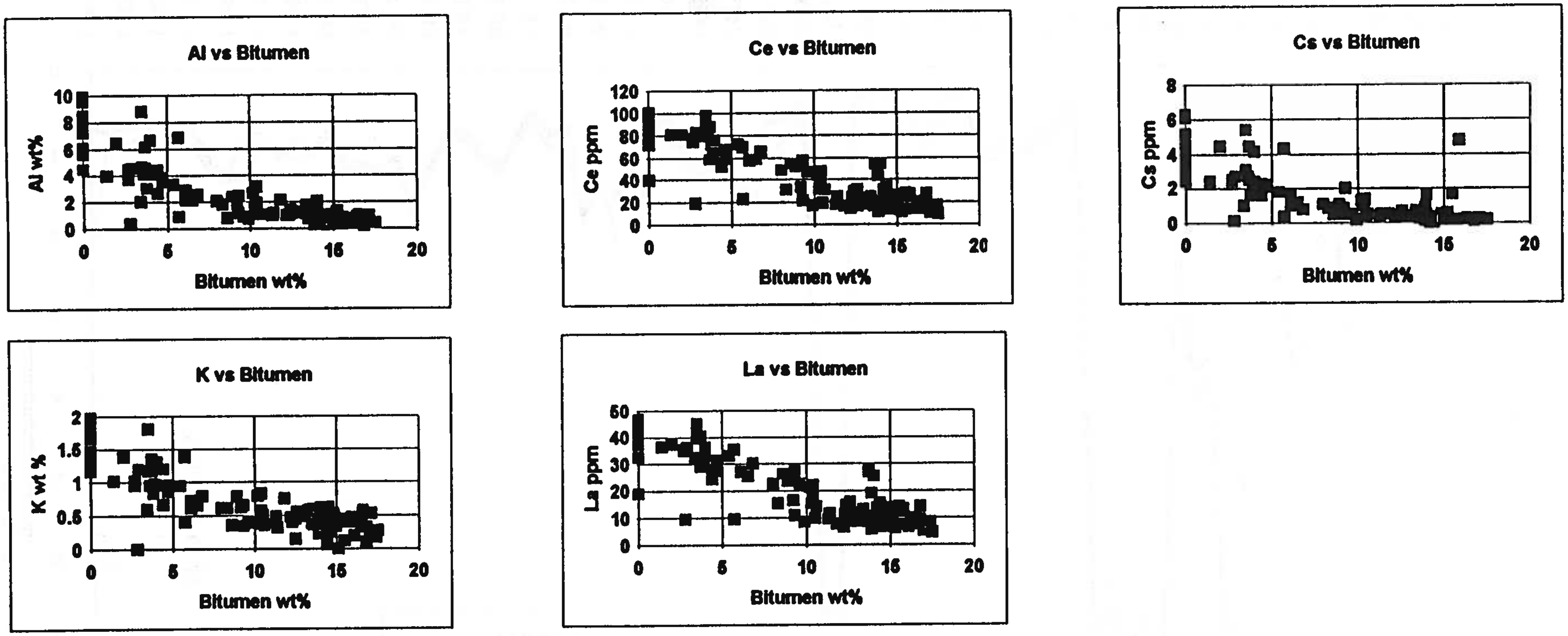


Figure H.6(a) Duplicate Analysis vs. Depth - INAA vs. ICP for Aluminum

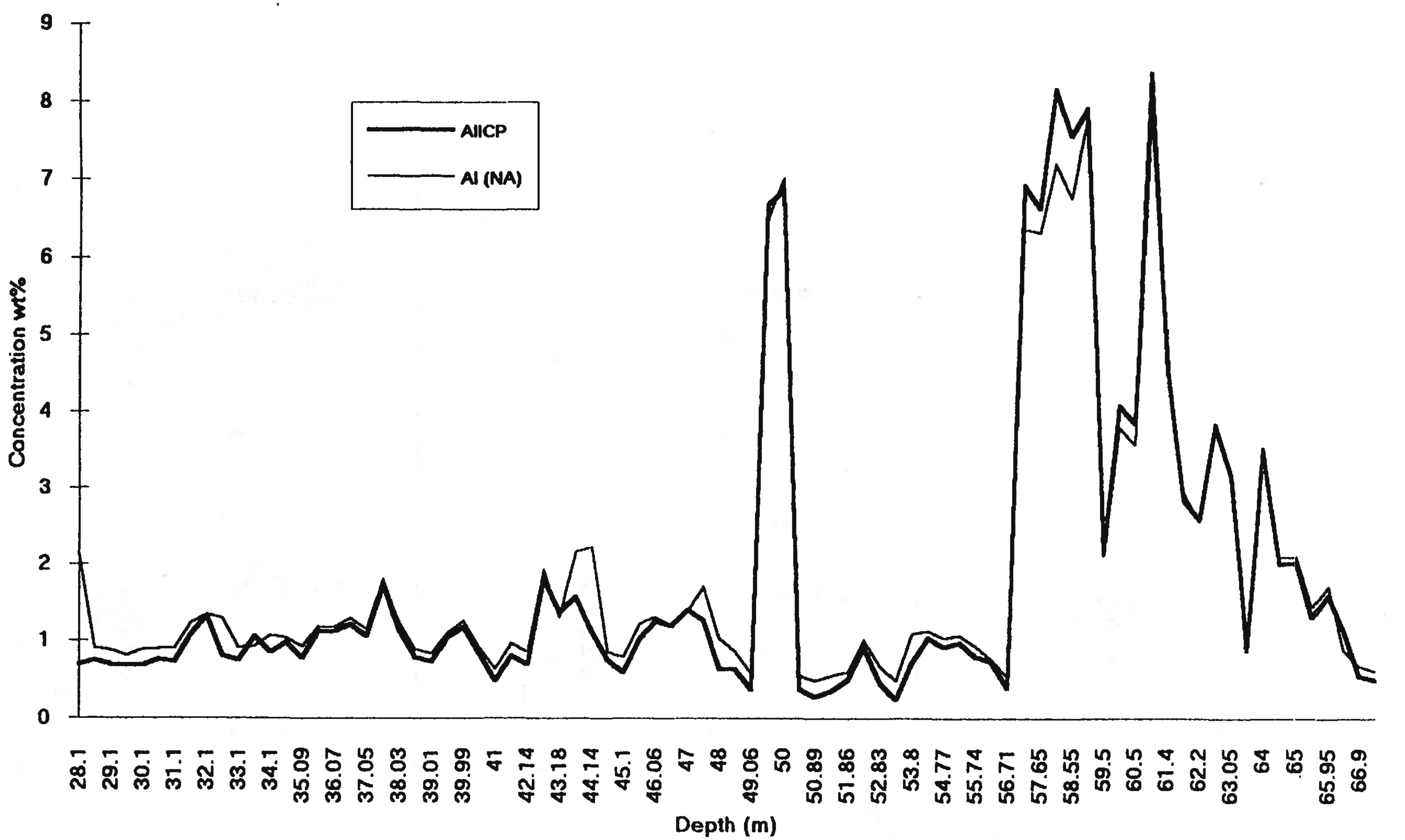


Figure H.6(b) Duplicate Analysis vs. Depth - INAA vs. ICP for Barium

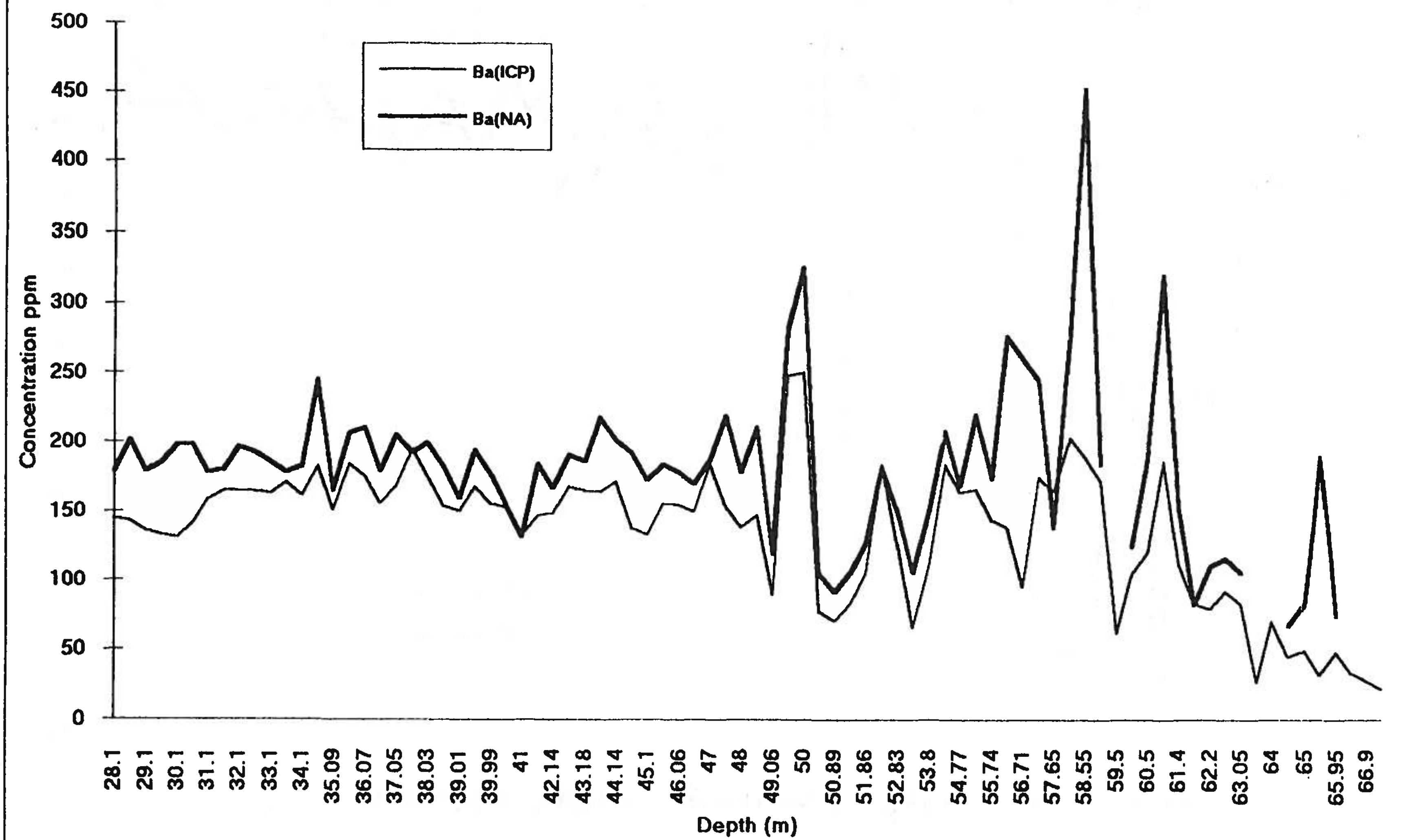
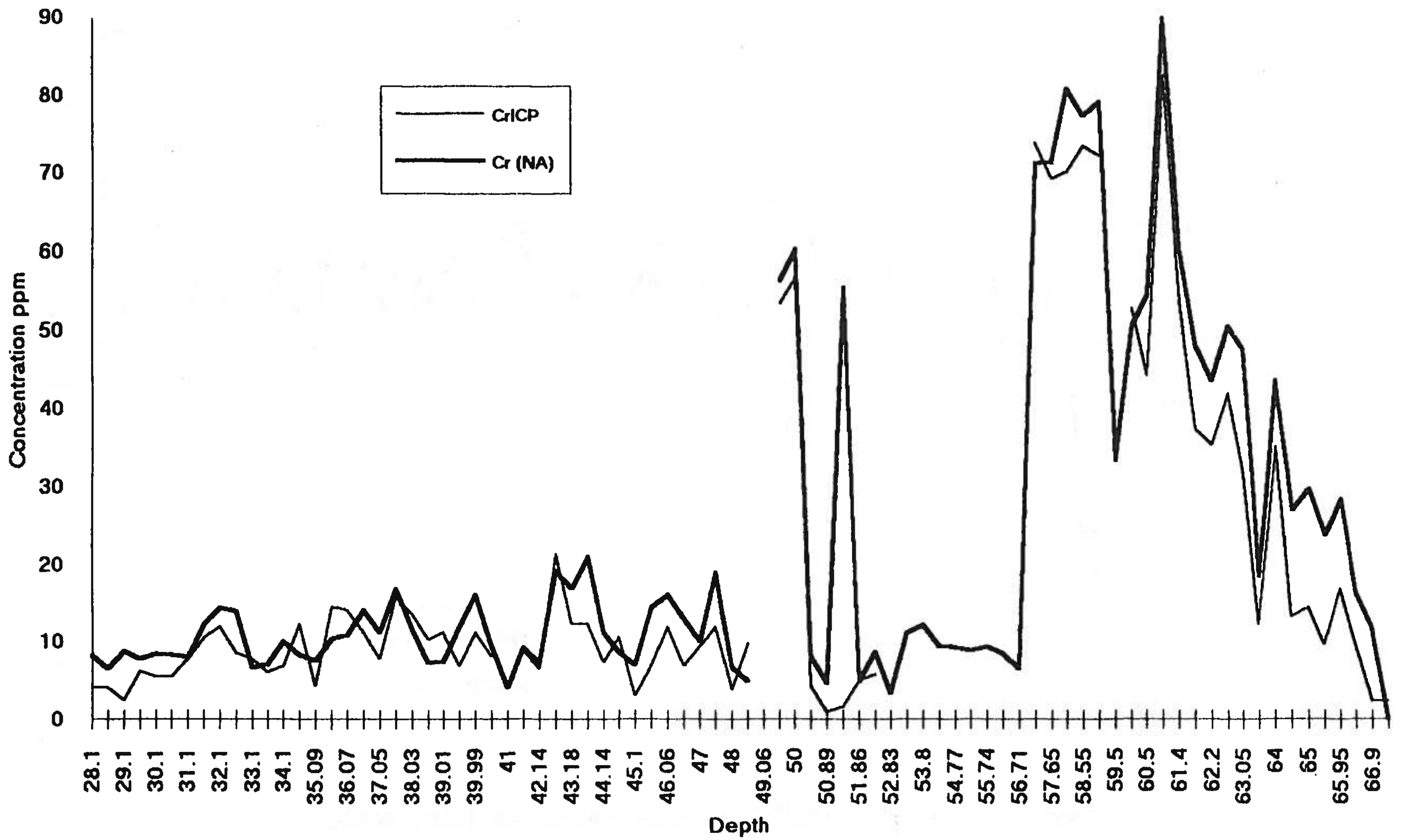


Figure H.6(c) Duplicate Analysis vs. Depth - INAA vs. ICP for Chromium



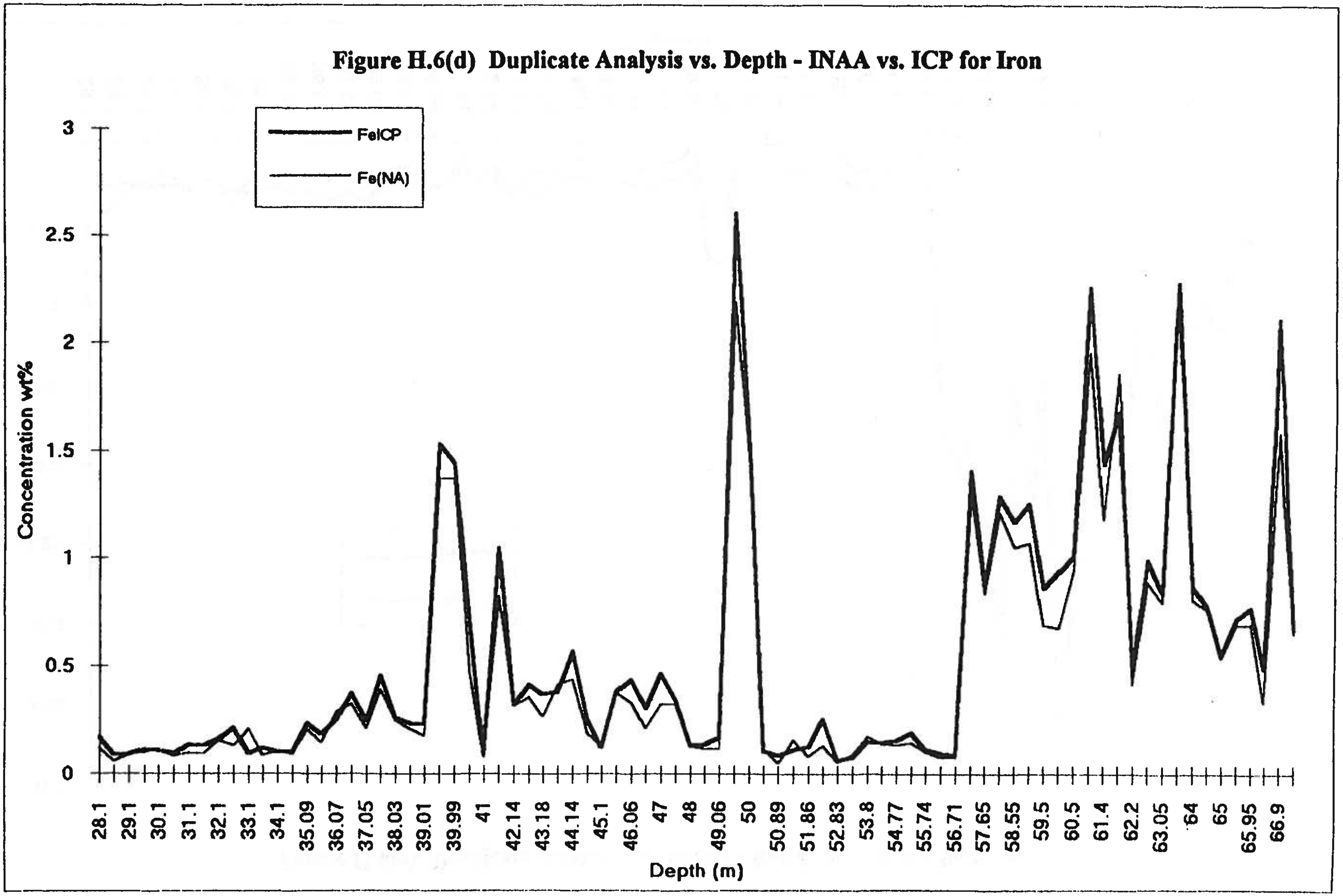


Figure H.6(d) Duplicate Analysis vs. Depth - INAA vs. ICP for Iron
FeICP
Fe(NA)
Concentration wt%
3
2.5
2
1.5
1
0.5
0
28.1
29.1
30.1
31.1
32.1
33.1
34.1
35.09
36.07
37.05
38.03
39.01
39.99
41
42.14
43.18
44.14
45.1
46.06
47
48
49.06
50
50.89
51.86
52.83
53.8
54.77
55.74
56.71
57.65
58.55
59.5
60.5
61.4
62.2
63.05
64
65
65.95
66.9
Depth (m)

- H. 33 -

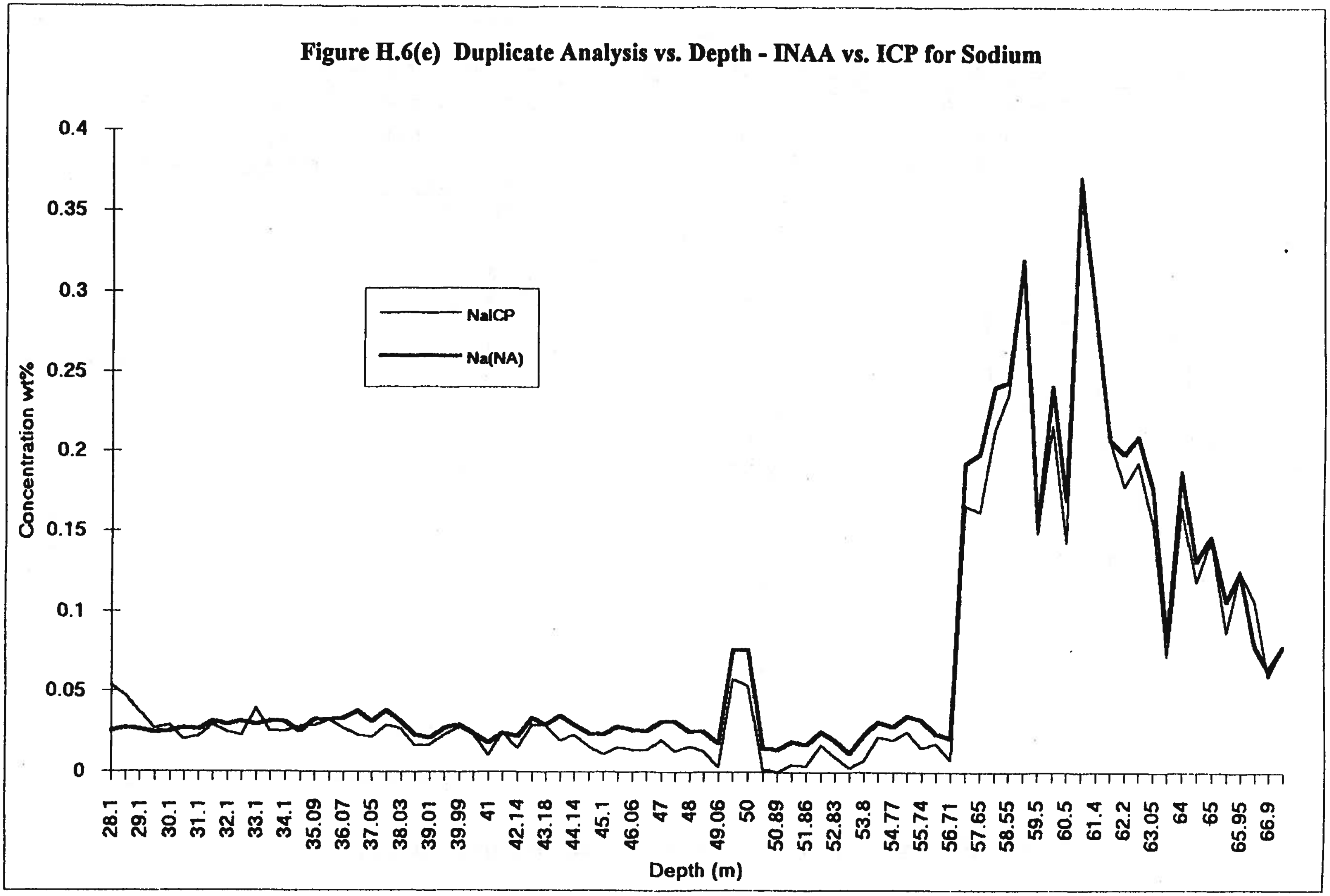


Figure H.6(e) Duplicate Analysis vs. Depth - INAA vs. ICP for Sodium
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Concentration wt%
NaICP
Na(NA)
28.1
29.1
30.1
31.1
32.1
33.1
34.1
35.09
36.07
37.05
38.03
39.01
39.99
41
42.14
43.18
44.14
45.1
46.06
47
48
49.06
50
50.89
51.86
52.83
53.8
54.77
55.74
56.71
57.65
58.55
59.5
60.5
61.4
62.2
63.05
64
65
65.95
66.9
Depth (m)

Figure H.6(f) Duplicate Analysis vs. Depth - INAA vs. ICP for Manganese

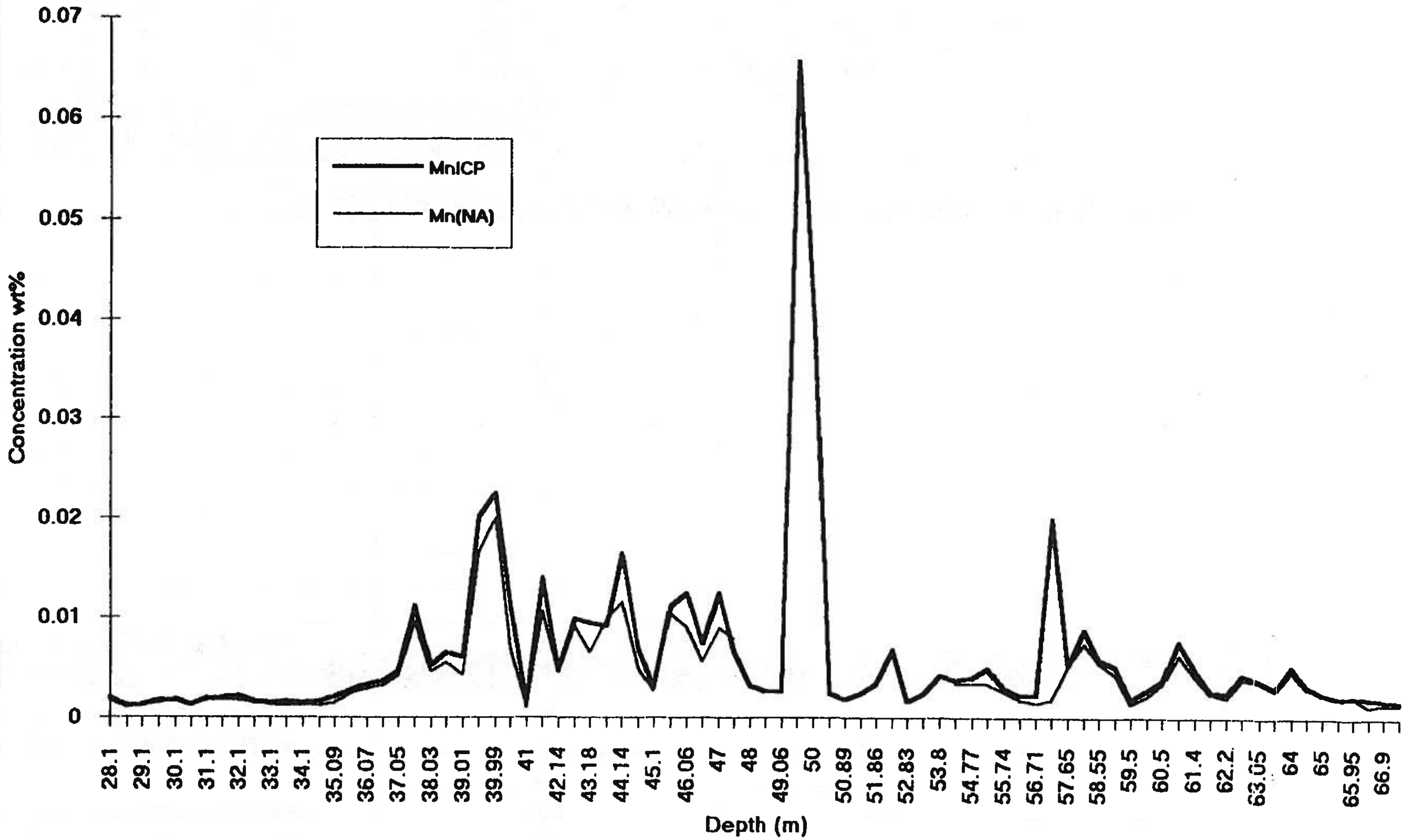


Figure H.8(a) Gulf - Sandalta Core Hole 209-85
Concentration of Primary Elements (%)

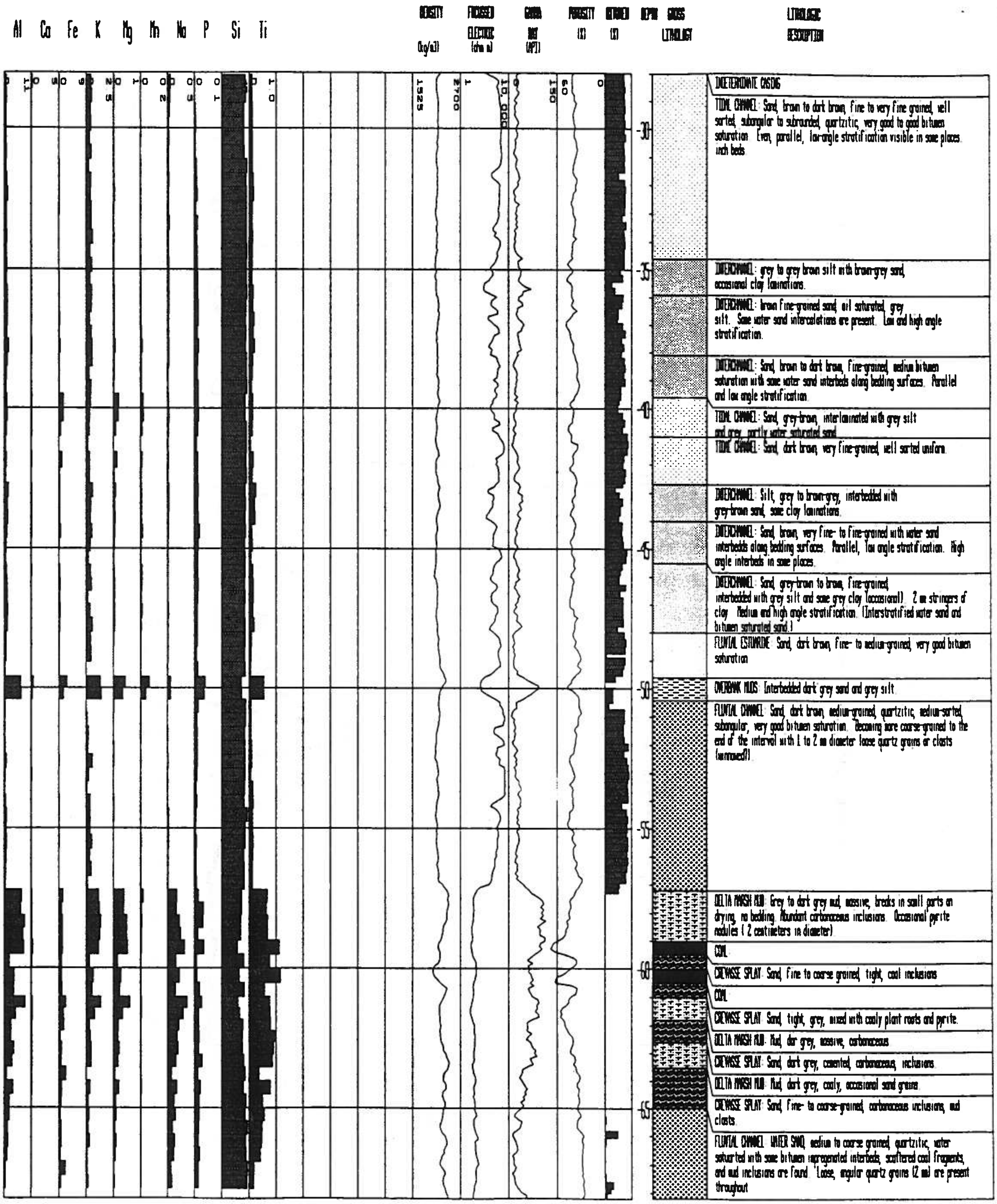


Figure H.8(a) Gulf - Sandalta Core Hole 209-85
Concentration of Minor Elements (ppm)

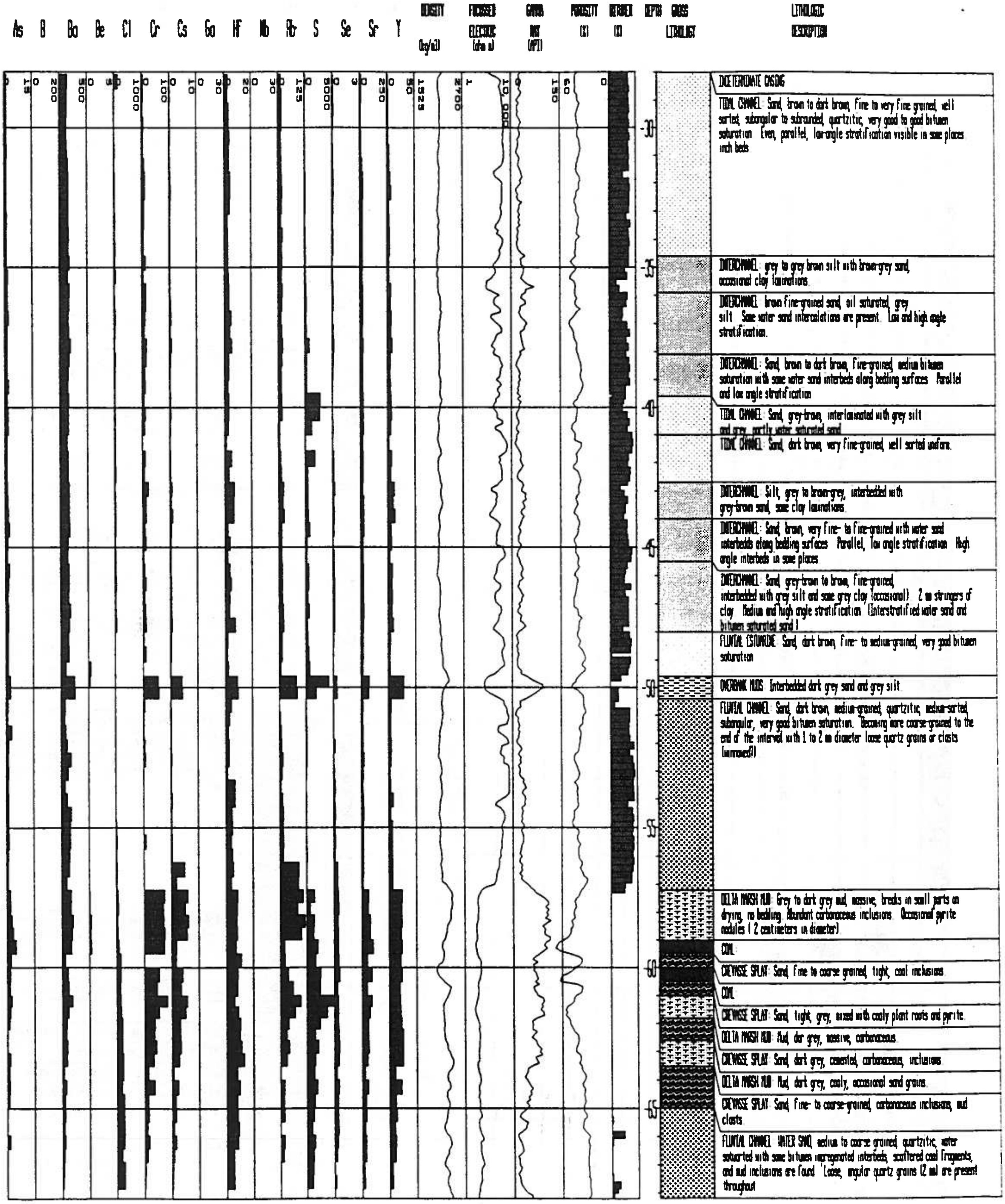


Figure H.8(a) Gulf - Sandalta Core Hole 209-85
Concentration of Metallic Elements (ppm)

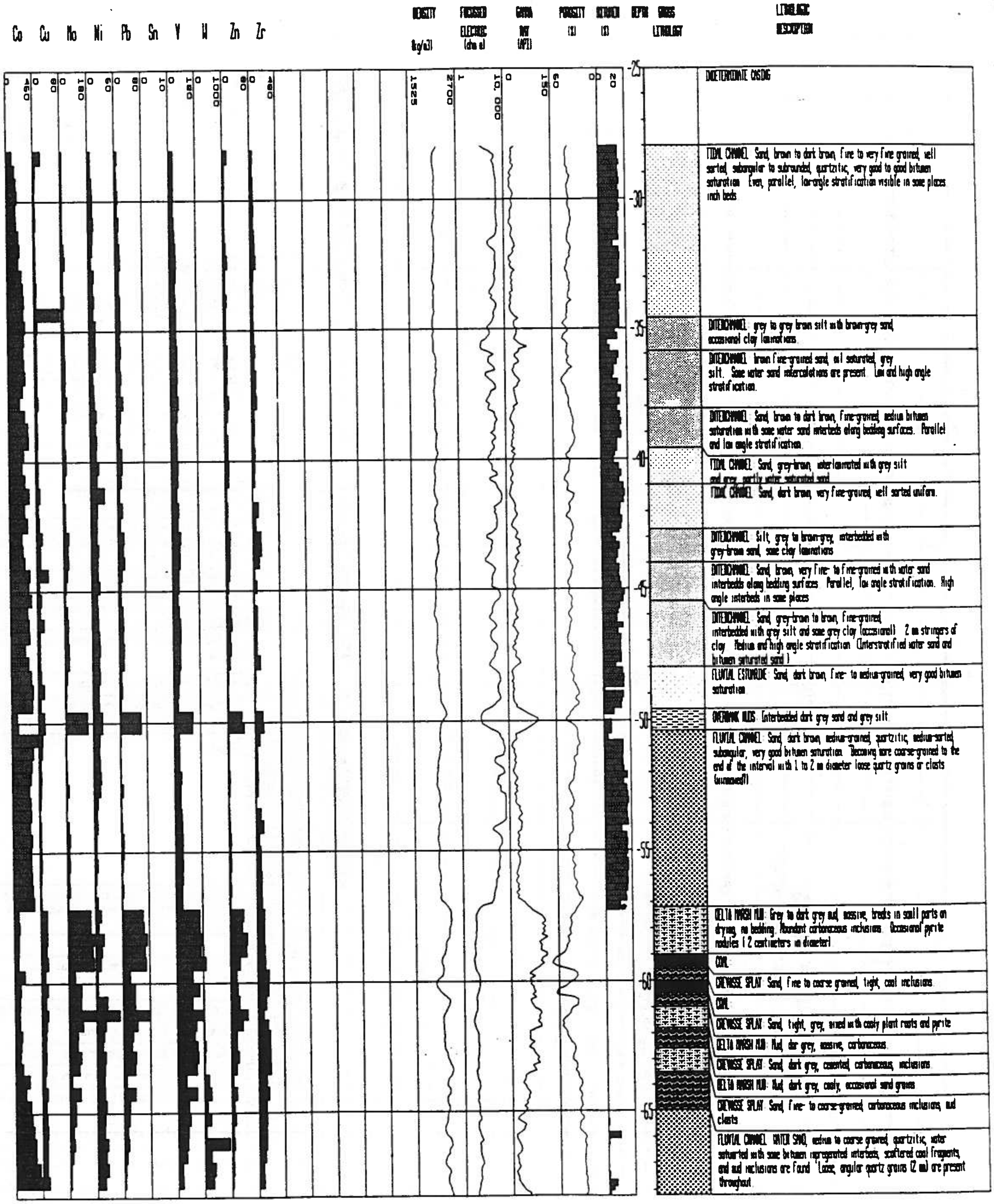


Figure H.8(a) Gulf - Sandalta Core Hole 209-85
Concentration of Rare Earth Elements (ppm)

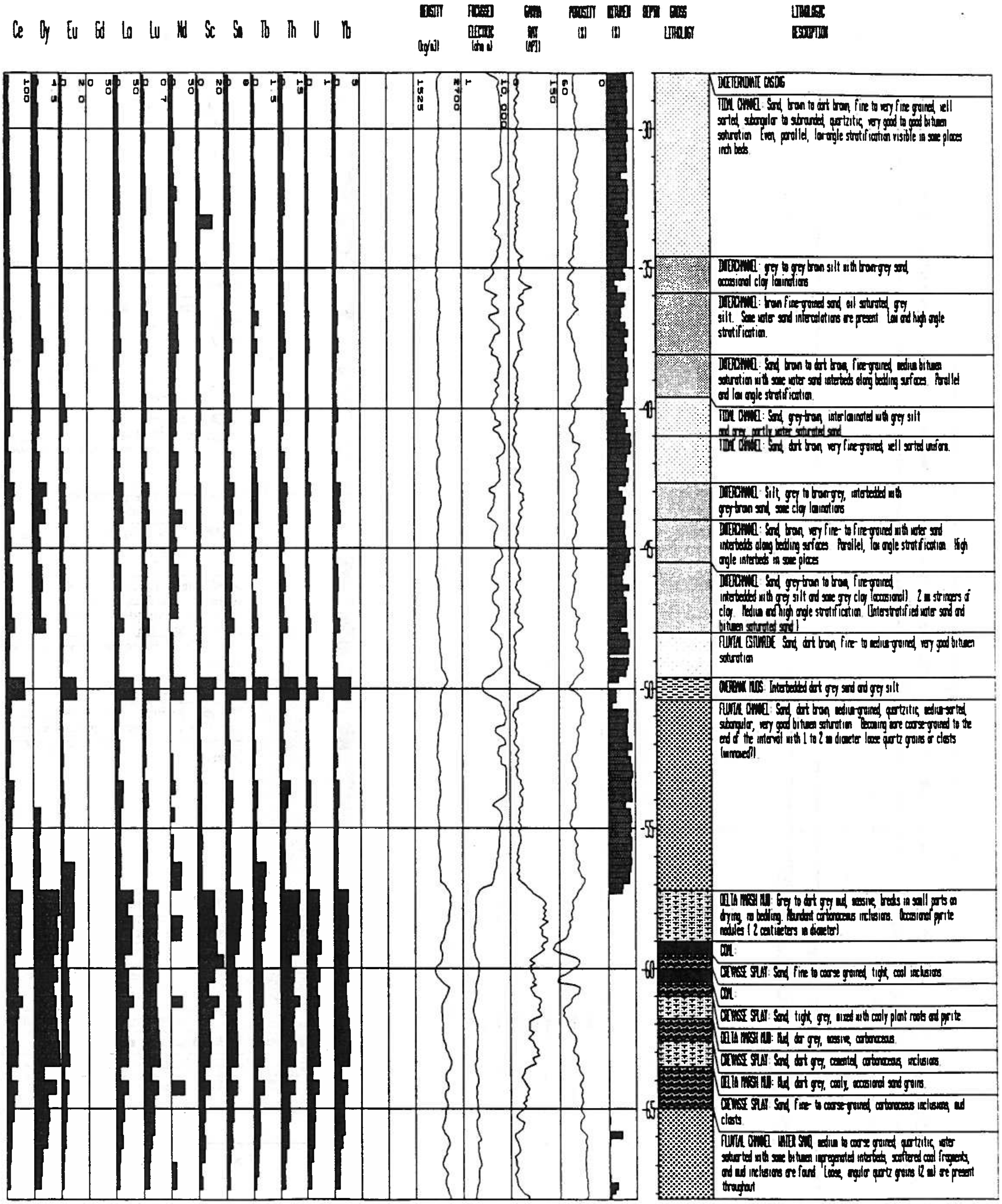


Figure H.8(a) Gulf - Sandalta Core Hole 209-85
Concentration of Trace Elements (ppm)

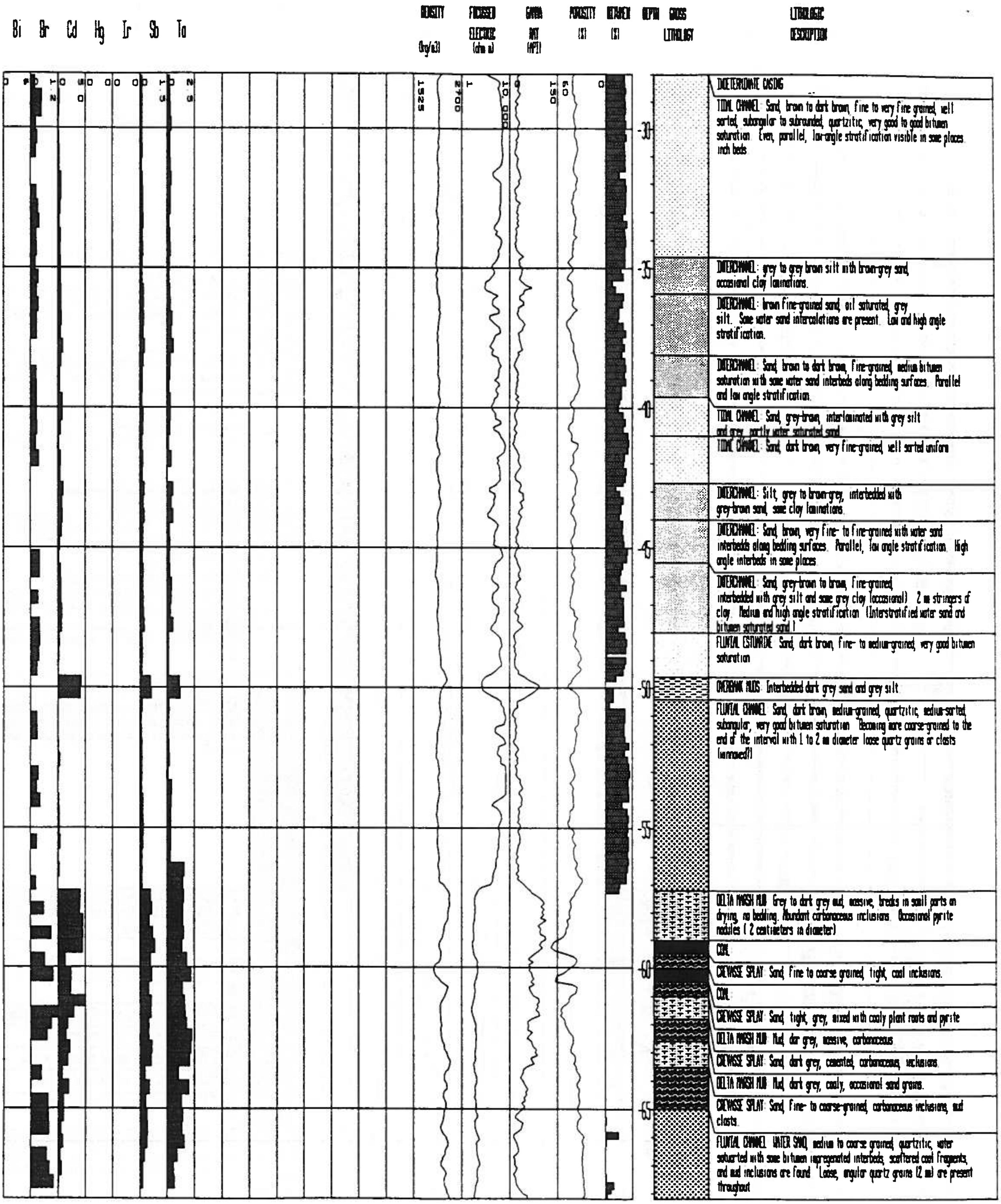


Figure H.8(a) Gulf - Sandalta Core Hole 209-85 Concentration of Precious Metals (ppm)

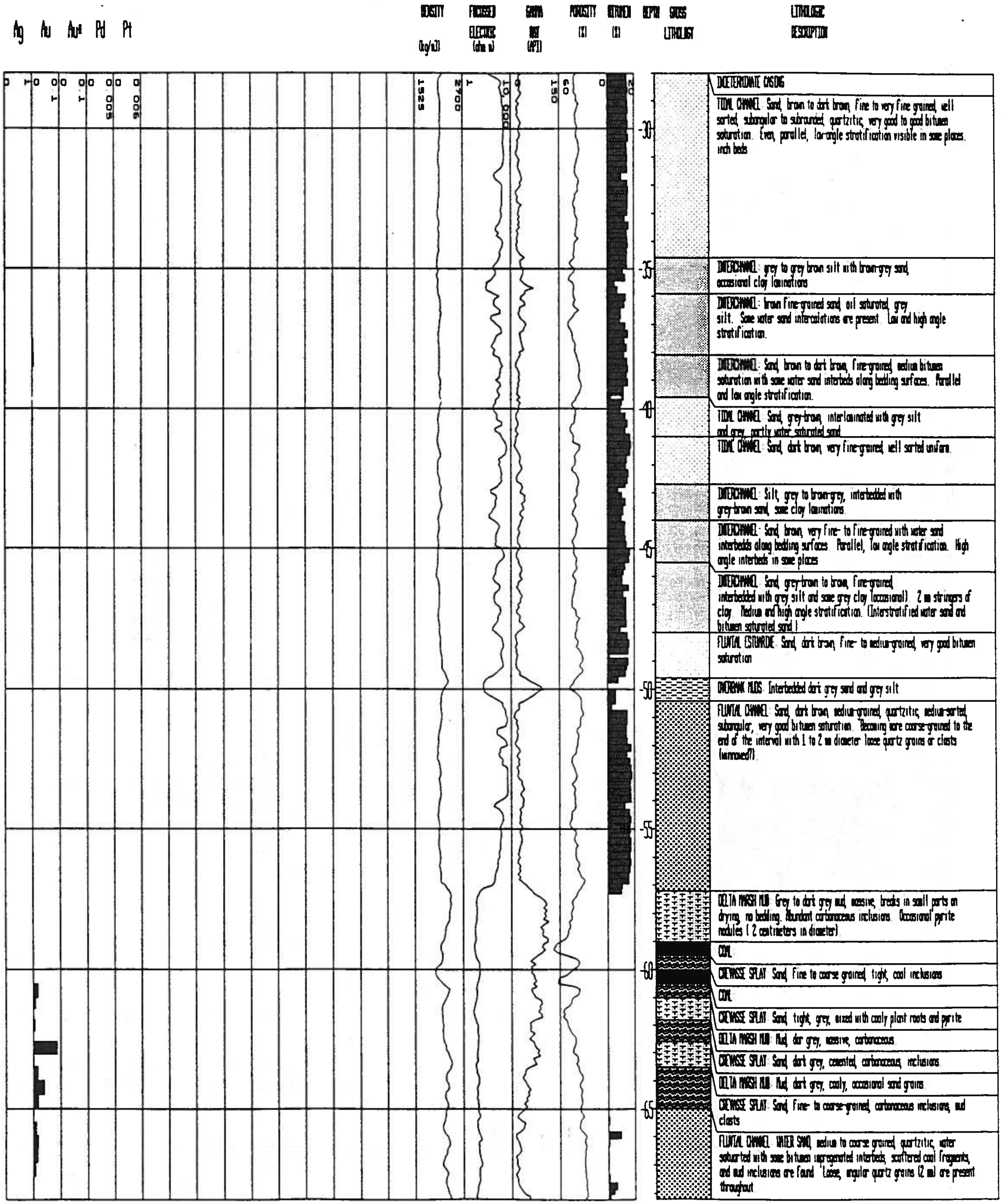


Figure H.8(b) Gulf - Sandalta Core Hole 215-85
Concentration of Primary Elements (%)

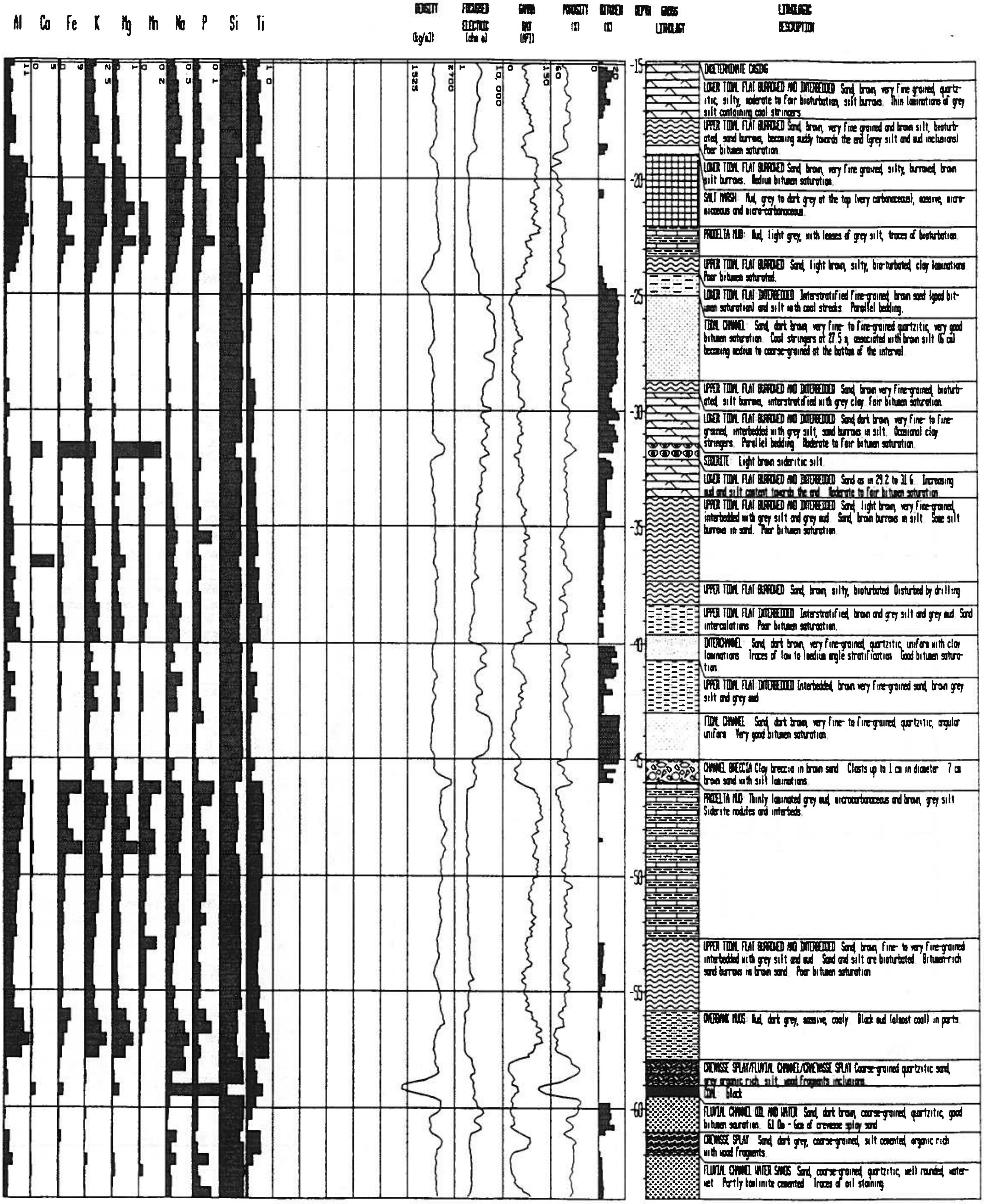


Figure H.8(b) Gulf - Sandalta Core Hole 215-85 Concentration of Minor Elements (ppm)

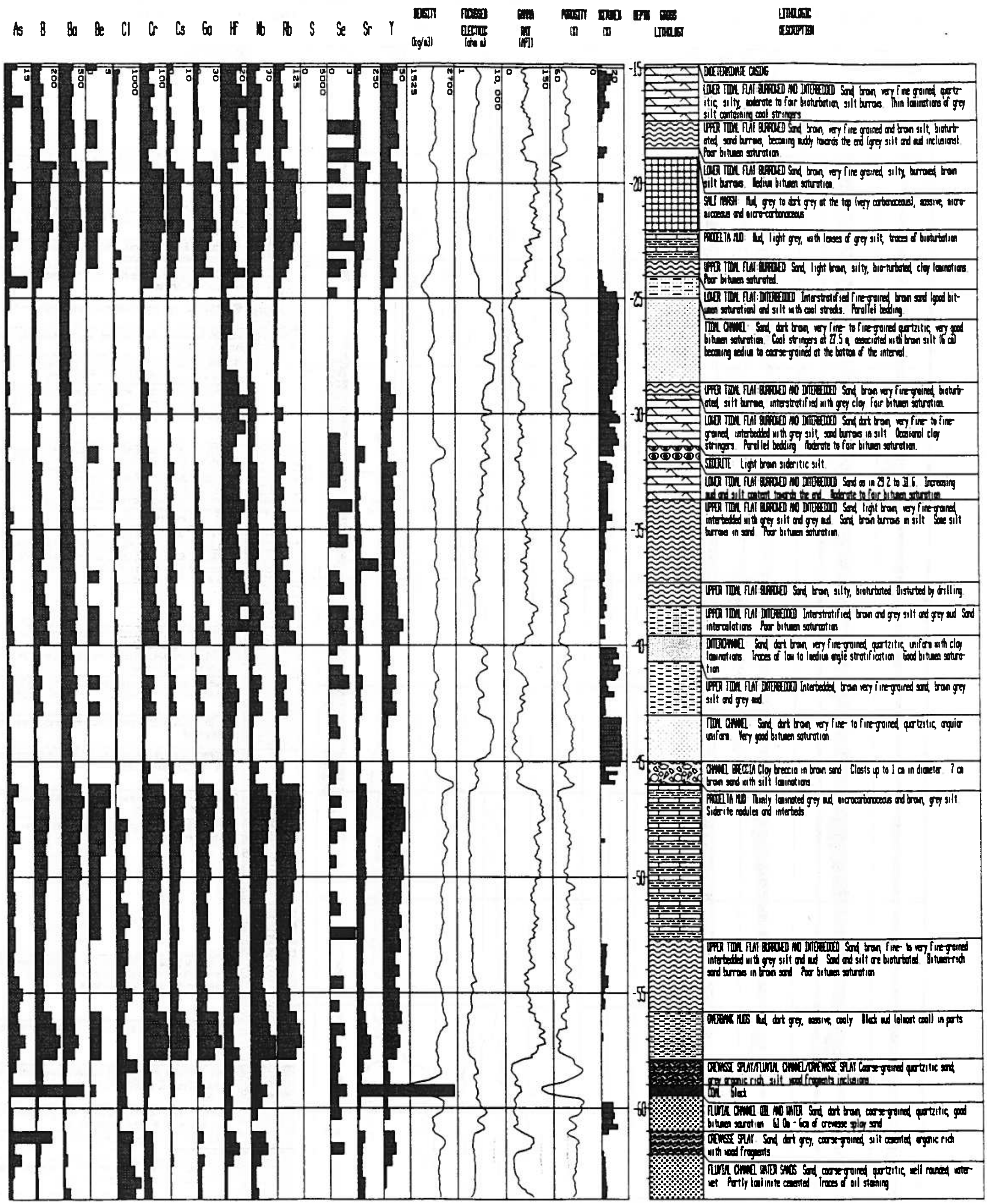


Figure H.8(b)Gulf - Sandalta Core Hole 215-85 Concentration of Metallic Elements (ppm)

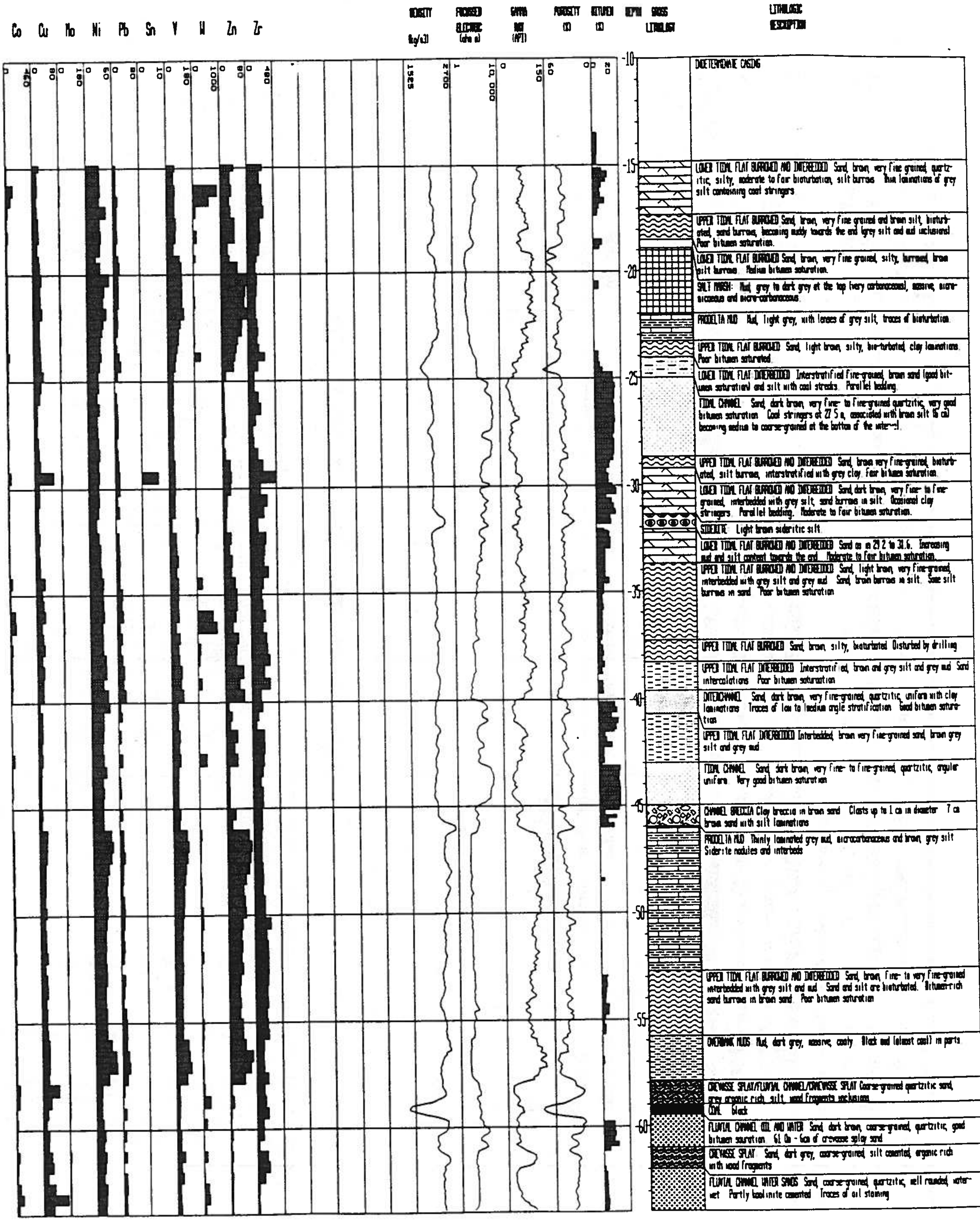


Figure H.8(b) Gulf - Sandalta Core Hole 215-85 Concentration of Rare Earth Elements (ppm)

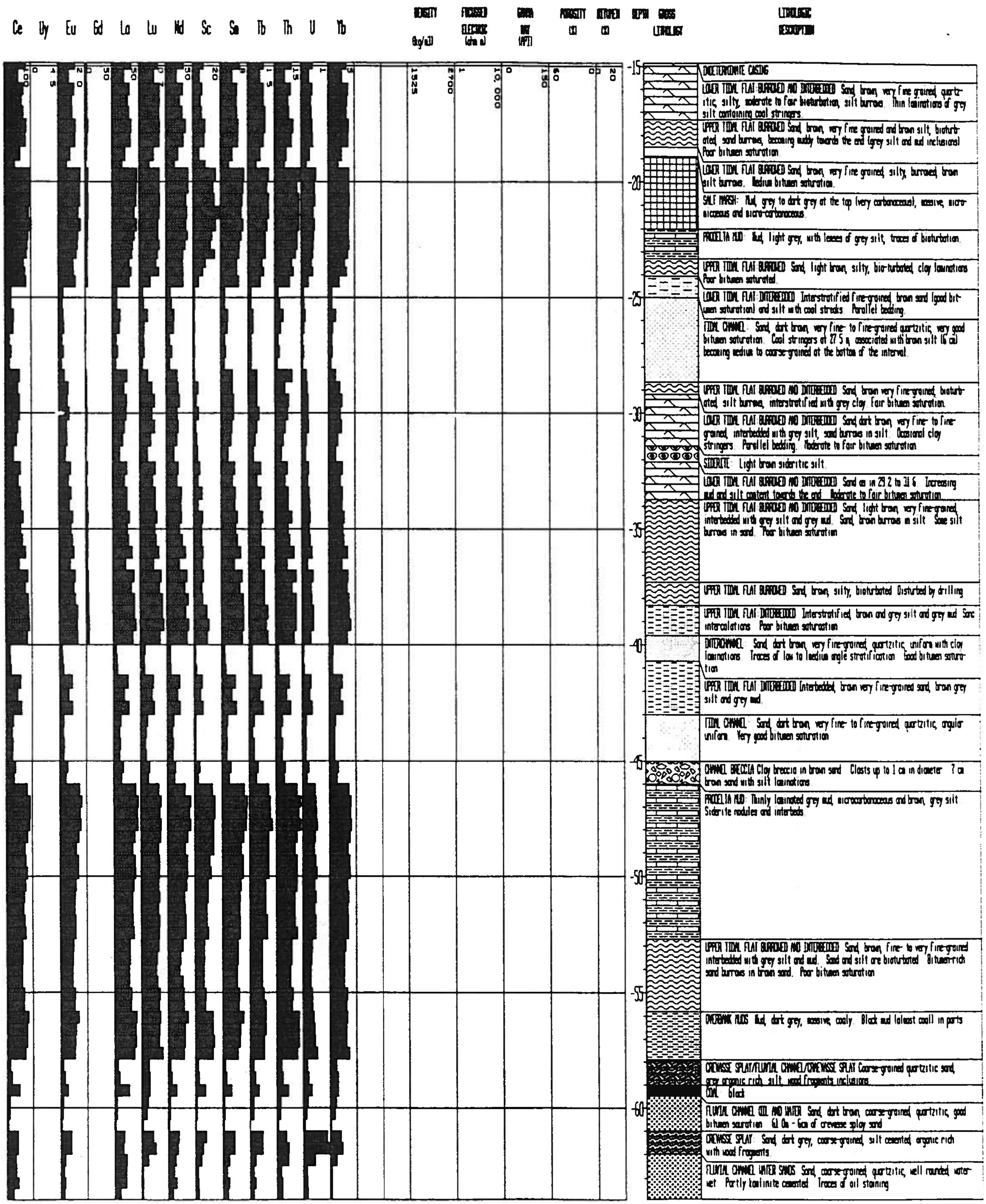


Figure H.8(b) Gulf - Sandalta Core Hole 215-85 Concentration of Trace Elements (ppm)

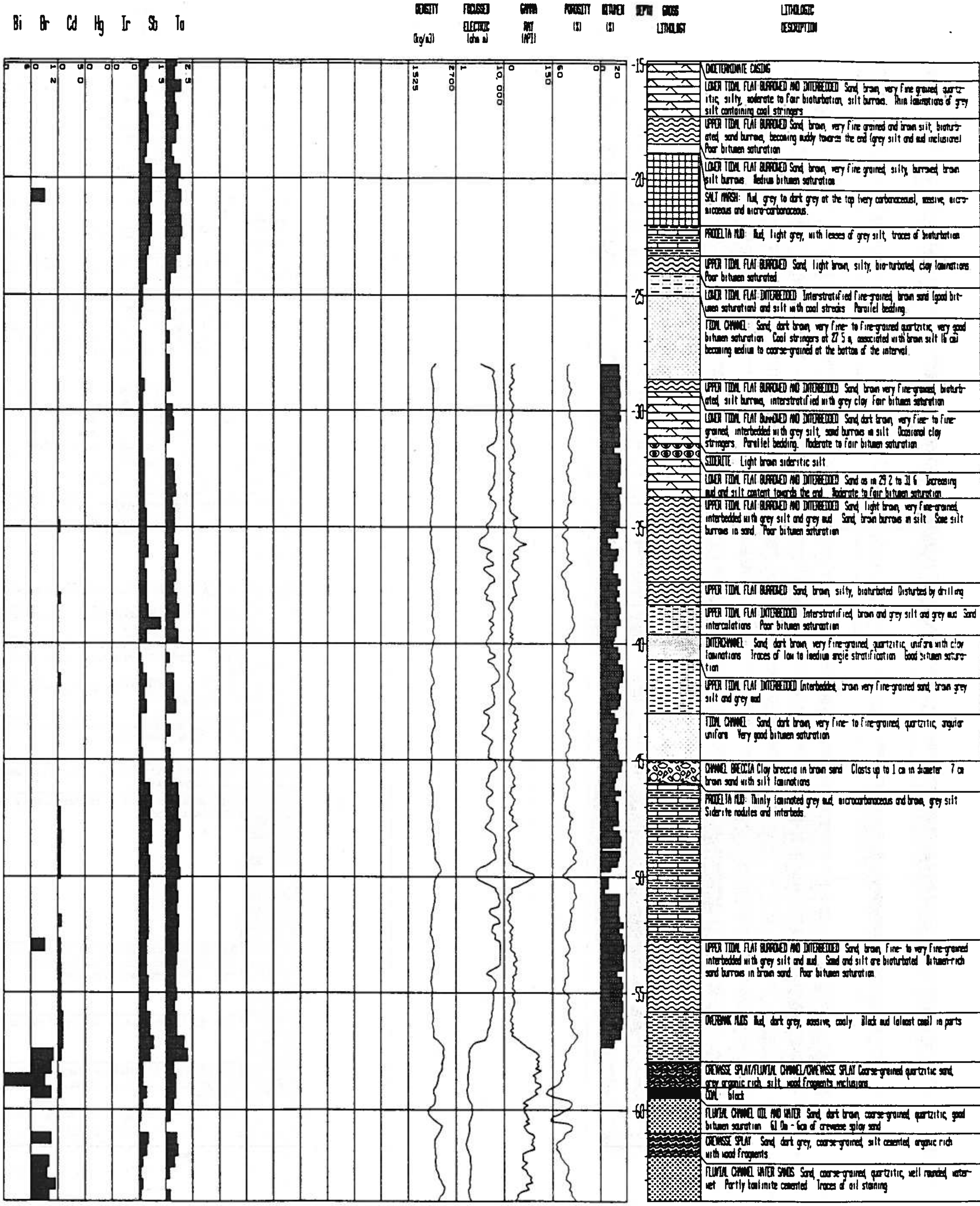


Figure H.8(b) Gulf - Sandalta Core Hole 215-85
Concentration of Precious Metals (ppm)

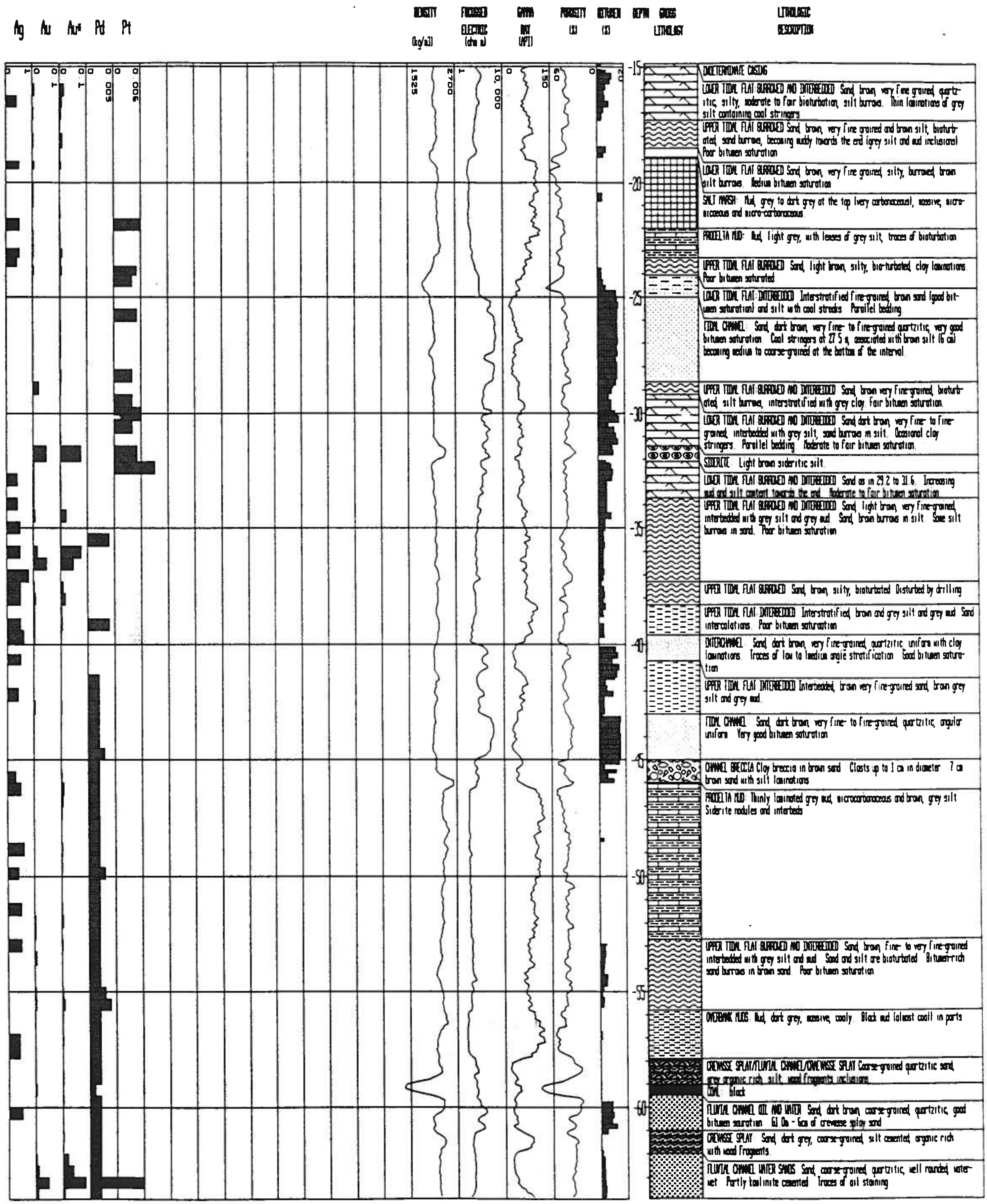


Table I.1 Summary of Cross Plots

Element	Relationship to Aluminum	Agreement in bore hole trends	Comment
Primary Elements			
Ca	Positive linear trend plus scatter	Yes	
Fe	Positive linear trend + some scatter	Yes	
K	Positive linear trend	Yes	
Mg	Positive linear trend	Yes	
Mn	Dual linear trend + scatter	Yes	Only part of trend reflected in hole 209
Na	Positive linear trend	Partial	
P	Poor linear + scatter	Yes	
Si	Negative linear trend	Yes	
Ti	Positive linear trend + scatter	Yes	
Minor Elements			
As	Positive linear trend + scatter	Yes	
B	Positive linear trend	Yes	Only tested in hole 215
Ba	Two distinct linear trends	Yes	
Be	Scatter	-	Only tested in one hole - at detection limit
Cl	Reverse linear trend Considerable scatter	Yes	
Cr	Positive linear trend	Yes	
Cs	Positive linear trend	Yes	
Ga	Positive linear trend	Yes	Only one hole tested
Hf	Scatter	Yes	
Nb	Positive linear trend	Yes	Only one hole tested
Rb	Positive linear trend	Yes	
S	Scatter		Only one hole tested
Se	Scatter	Poor correlation	
Sr	Positive linear trend	Yes	
Y	Positive linear trend	Yes	

Table I.1 Summary of Cross Plots (continued)

Element	Relationship to Aluminum	Agreement in bore hole trends	Comment
Trace Elements			
Br	Scatter		Only one hole tested
Cd	Linear in 209, scattered in 215	No	Data from hole 209 suspect - (Al affecting ICP analysis)
Sb	Positive linear trend	Yes	
Ta	Poor positive linear trend + scatter	Poor	
Rare Earths			
Ce	Scattered positive linear trend	Yes	
Dy	Positive linear trend + scatter	Yes	Only one hole tested
Eu	Positive linear trend with scatter	Yes	
Gd	Scattered positive linear trend		Only one hole tested
La	Scattered positive linear trend	Yes	
Lu	Scattered positive linear trend	Yes	
Nd	Scattered positive linear trend	Yes	
Sc	Positive linear trend	Yes	
Sm	Scattered positive linear trend	Yes	
Tb	Scattered positive linear trend	Yes	
Th	Positive linear trend	Yes	
U	Positive linear trend with some scatter	Yes	
Yb	Scattered positive linear trend	Yes	

Table I.1 Summary of Cross Plots (continued)

Element	Relationship to Aluminum	Agreement in bore hole trends	Comment
Metallic Elements			
Co	Scattered reverse trend	Yes	
Cu	Positive linear trend + some scatter	Yes	
Mo	Dual linear relationship	No - very different	Data from hole 209 suspect - (Al affecting ICP)
Ni	Scattered positive linear + scatter	Yes	
Pb	Dual linear + scatter	No - very different	Data from hole 209 suspect (Al affecting ICP)
V	Positive dual linear trend	Linear but diverging trend	Possible 2X scaling error in analysis of hole 209. Check warranted.
W	Scatter - reverse concentration	Yes	
Zn	positive linear trend	Yes	
Zr	Bimodal. Positive linear trend below 3% Al Negative linear trend above 3% Al	Yes	Strong bimodal modal distribution - similar to Ba
Precious Metals			
Ag	Scatter		Only tested in one hole. At detection limit.
Au	Scatter	Yes	Highest concentrations appear to be related to low Al. Fire assay confirms trend indicated by INAA
Pd	Scatter		Only tested in one hole.
Pt	Scatter		Only tested in one hole.

Table I.1 Summary of Cross Plots Continued.

Miscellaneous Cross Plots - Fig H.2	Relationship	Comment
Va vs. Ni	Positive linear trend - considerable scatter	Part of the deposit could have a related origin
Cl vs. Na	Scatter - no agreement	Conclude concentrations due to different phenomena
U vs. Th	Good positive linear relationship	Conclude present as impurities with consistent concentrations
Lu vs. La	Good positive relationship	Same as above
K vs. Ti	Positive linear trend + scatter	Part of concentration due to the same mechanism
Zr vs. Ti	Dual linear trend - positive to Ti concentration of 0.4% - negative above Ti conc. of 0.4%	Conclude part of concentration due to same phenomenon, part not.

Table I.1 Summary of Cross Plots Continued.

Gamma and MBT Cross Plots - Fig H.3	**Data base limited to samples with grain size analysis**	All these relationships are related so can be predicted from one another.
Gamma count vs. MBT Index	Positive linear trend above MBT of 200	Can predict MBT index from Gamma count
Clay wt % vs. MBT Index	Positive linear trend	Can predict clay content from MBT Index
Al vs. MBT Index	Positive linear trend	Can predict Al from MBT Index
Bitumen vs. MBT Index	Reverse trend - essentially no bitumen when MBT Index is over 200.	No bitumen when MBT index is over 200.
Clay wt % vs. Al	Positive linear trend	Al and clay content are related
Bitumen vs. Gamma	Reverse linear trend. No bitumen when gamma count exceeds 100.	Gamma count indicates clay and when significant clay is present bitumen is not. Note that bitumen does not have to be present if there is no clay.
MBT Index vs. Gamma count	Positive linear relationship above Gamma count of 70	Can predict MBT index from Gamma count.
Clay wt % vs. Gamma count	Positive linear relationship above Gamma count of 70 Plot trend is the same as the MBT index.	Can predict clay content from Gamma count.
Al vs. Gamma count	Positive linear relationship	Can predict AL from Gamma count.
Gamma Cross Plots - Fig H.4	**Full data base**	
Al vs. Gamma count	Positive linear trend	Can predict Al % (and clay %) from Gamma count.
K vs. Gamma count	Positive linear trend	Can predict K (and clay %) from gamma count. Gamma count could be due to radioactive K isotopes in clay minerals.
Ti vs. Gamma count	Positive linear trend with scatter	Some Ti closely related to gamma count. Some Ti apparently has another origin.
Bitumen vs. Gamma count	Reverse linear trend	Bitumen not present when gamma count exceeds 100. Trend indicates potential bitumen content of bitumen saturated formation.
Thorium vs. Gamma count	Positive linear trend	Can predict Th (and clay %) from gamma count. Gamma count could be due to radioactivity from Th which is present in clays in a consistent amount.
Uranium vs. Gamma count	Positive linear trend	Can predict U (and clay %) from gamma count. Gamma count could be due to radioactivity from U which is present in clays in a consistent amount.
Cl and Hf vs. Gamma count	Scatter	Origin of these elements is due to factors different than those related to the clay content.

Table I.2 Summary of Cross Plots Continued

Elements	Relationship	Comment
Elements Expected to be Totally Organically Bound - Fig H.5		
Ni vs. Bitumen	Reverse linear trend. Considerable scatter.	Ni content decreases with bitumen content. No indication of linkage between Ni and bitumen
V vs. Bitumen	Constant V content (about 50 ppm) regardless of bitumen content.	No indication of linkage between V and bitumen
Mo vs. bitumen	No apparent trend	No indication of linkage between Mo and bitumen
Rb vs. bitumen	Reverse linear trend. Considerable scatter.	No indication of linkage between Rb and bitumen
Se vs. bitumen	Scatter with a reverse trend.	No indication of linkage between Se and bitumen.
Elements expected to be predominantly organically bound. Fig H.5		
As vs. bitumen	Reverse linear trend. Considerable scatter.	No indication of linkage between As and bitumen
Co vs. bitumen	Scattered positive trend	Possible indication of linkage - Co and bitumen
Cr vs. bitumen	Reverse linear trend	No indication of linkage between Cr and bitumen
Fe vs. bitumen	No apparent trend	No indication of linkage between Fe and bitumen
Ga vs. bitumen	Scattered reverse linear trend	No indication of linkage between Ga and bitumen
Na vs. bitumen	Scattered reverse linear trend	No indication of linkage between Na and bitumen
Sb vs. bitumen	Reverse linear trend	No indication of linkage between Sb and bitumen
Sc vs. bitumen	Scattered reverse linear trend	No indication of linkage between Sc and bitumen
Th vs. bitumen	Scattered reverse linear trend	No indication of linkage between Th and bitumen
Elements expected to be totally inorganically bound - Fig H.5		
Al vs. bitumen	Reverse linear relationship	Same relationship as elements expected to be linked. No indication of linkage between Al and bitumen
Ce vs. bitumen	Reverse linear relationship	Same as above
Cs vs. bitumen	Reverse linear relationship + scatter	Same as above
K vs. bitumen	Scattered reverse linear relationship	Same as above
La vs. bitumen	Reverse linear relationship	Same as above