ANALYTICAL QUALITY CONTROL AND ASSESSMENT FOR THE FARO LITHOGEOCHEMICAL EXPLORATION RESEARCH PROJECT

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INTRODUCTION

The Faro Lithogeochemical Exploration Research Project chose Bondar-Clegg and Co., Ltd., North Vancouver, British Columbia, as the commercial laboratory to undertake geochemical analysis of all samples collected as part of the research. This decision was made on the basis of competitive prices and historical performance, as demonstrated by a similar quality control / quality assessment of lithogeochemical results during the MDRU Lithogeochemical Exploration Research Project, 1994-1997 (Stanley 1997a).

An assessment of the analytical quality of the element determinations made by Bondar-Clegg was also undertaken as part of this research project. This was done using a set of four pulverized and well-blended reference materials that were submitted in quadruplicate with the normal lithogeochemical samples. These reference materials were chosen because of their geochemical affinity to rocks within the Faro mining district. The four reference materials used in this quality control and assessment study for the Faro Lithogeochemical Exploration Research Project include:

(i) ***BAS-1***, columnar Cheakamus basalt originally collected by Mark Coolbaugh from a 'road metal' quarry between Squamish and Whistler, B.C. in 1996,

(ii) ***CUL-1***, pyritic Cultus Lake shale originally collected by Cliff Stanley from a road cut along the east end of Cultus Lake, B.C. in 1994,

(iii) ***CHI-1***, Chilliwack limestone with minor chert nodules originally collected by Cliff Stanley from a quarry along the Chilliwack River Road, B.C. in 1994, and

(iv) ***QUA-1***, Quadra Formation sands originally collected by Cliff Stanley and Phil Wong from the bluffs below the University of British Columbia campus, B.C. in 1994.

Three or four 5-gallon buckets of each reference material were prepared by Chemex using a large capacity chrome steel dry ball mill, which crushed, pulverized and blended all of the reference material simultaneously. As a result, their degree of homogenization is expected to be superior to those reference materials blended by manual or semi-automated means.

Lithogeochemical data for these 'external' reference materials (16 analyses), along with lab-created 'internal' duplicate sample pulps of the normal research samples within the batch, and Bondar-Clegg 'internal' reference material pulps made to internally monitor analytical quality (up to 180 additional samples in total), were subjected to a modified Thompson and Howarth replicate analysis (Stanley 1997b) to determine the level of precision of these geochemical analyses.

The following report details only the results of geochemical determinations on 'internal' and 'external' reference materials and 'internal' duplicates used to determine the level of analytical precision within the lithogeochemical data. However, this report also compares the results for 25 elements analyzed by different analytical methods to identify the appropriate, highest quality and lowest cost analytical methodology.

REFERENCE MATERIALS AND GEOCHEMICAL DETERMINATIONS

The 'external' reference materials described above were analyzed for the same elements determined for the normal research samples sent to Bondar-Clegg. Lithogeochemical analyses included:

- Li metaborate fusion X-ray fluorescence analysis of major oxides (SiO_2, TiO_2, Al_2O_3, Cr_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5 and Cr,
- Gravimetry for Loss on Ignition (LOI),
- Pressed pellet X-ray fluorescence analysis of high field strength and camouflaged trace elements (Ba, Rb, Sr, Zr, Y, Nb),
- Colorimetric titration of FeO,
- Leco correlation spectrometry for total C and total S,
- Wet chemistry determinations of CO_2,
- Fire assay pre-concentration with inductively coupled plasma spectrometry for Au,
- Nitric, hydrochloric, hydrofluoric, perchloric acid digestion with inductively coupled plasma spectrometry for 34 trace elements (Ag, Cu, Pb, Zn, Mo, Ni, Co, Cd, Bi, As, Sb, Fe, Mn, Te, Ba, Cr, V, Sn, W, La, Al, Mg, Ca, Na, K, Sr, Y, Ga, Li, Nb, Sc, Ta, Ti and Zr),
- Aqua regia acid digestion with atomic absorption for 7 trace elements (Ag, Cu, Pb, Zn, Mo, Co, Cd),
- Aqua regia hydride generation digestions with atomic absorption for 5 trace elements (Bi, As, Sb, Te, Se),
- Aqua regia cold vapor digestion with atomic absorption for Hg,
- Aqua regia, MIBK organic extraction with atomic absorption for Tl, and
- Water leach and NaOH fusion with specific ion electrode analysis for Cl and F, respectively.

Only approximately 1/3 of all samples, and all of the external reference materials, were analyzed for FeO, Cl and F due to cost considerations. Detection limits for these techniques are presented in Table 1. All values below detection were recoded to a value equal to half of the detection limit.

ANALYTICAL PRECISION RESULTS

Replicate determinations for the above reference materials and elements submitted during the Faro Lithogeochemical Exploration Research Project were compiled in a spreadsheet and formatted for input into a computer program to perform a generalized Thompson-Howarth replicate error analysis (Stanley 1997b; Stanley 1986; Thompson and Howarth 1973, 1976a, 1976b, 1978; Thompson 1973). The program, called THPLOT, is written as a function in MATLAB, a matrix-based computer language interpreter that facilitates the numerical treatment of data expressed in matrix form. A detailed description of this THPLOT program, its features and a discussion of how it differs from, and why it is more comprehensive than, the original Thompson-Howarth methodology, along with the source code, is presented in Stanley (1997b).

Results from the analysis of replicate determinations using THPLOT include relative and absolute error terms, which define the slope and intercept of a model line describing a linear relationship between a measurement and its one standard deviation measurement error. These relationships will be used in future chemographic diagrams produced by the research project to assign analytical errors to every sample plotted. This ensures that interpretations of results are significant relative to measurement error, and thus have potential geological meaning. The error-measurement relationship may be also used to determine the 'effective detection limit' for the analytical method, which is defined as the concentration where two times the standard deviation of the measurement error equals the concentration measured (analytical precision = 100 %). This allows determination of the concentration at which the variation imposed by measurement error (the noise) exceeds the element concentration measured (the signal), and thus prevents mis- or over-interpretation of the lithogeochemical results.

All linear models describing the error-measurement relationships were derived using weighted or unweighted least squares regression to obtain the equation of the error-measurement line. Weights in the weighted regression involve two factors: (i) those that take into account the number of replicate analyses per reference material (the more replicates, the better the estimate of the standard deviation), and (ii) those that consider the estimated error in the standard deviation estimates made by replicate determinations for each reference material (the higher the standard deviation, the larger the error in the standard deviation estimate - a consequence of normal theory). These weighted and unweighted regression models were compared with the distribution of the data on the Thompson-Howarth plot and the one chosen was deemed most compatible with the data.

Results are tabulated in Table 1. Output from THPLOT illustrating the relationships between the measurements and their errors are presented in Appendix 1. These results indicate that the overall level of analytical error is very 'acceptable' for all elements and analytical techniques. Most relative and absolute error levels for elements of particular interest are very low, and most of the effective detection limits calculated from these error levels are equivalent to or better that the detection limits stated by the laboratory.

In most cases, the disparity of the data about the regression lines is extreme. This is a consequence of the poor standard deviation estimates obtained from duplicates. Given the actual magnitudes of these errors, the regression lines fit most of the widely scattered data at acceptable levels of significance (the 95th percentile).

Several elements have concentrations rarely exceeding the detection limit, and these have been omitted from this analysis because of the inconclusive error estimates resulting from these data (Te and Sn by multi-acid / ICP). Furthermore, loss on ignition (LOI) determinations include negative values (indicating gain on ignition and probably resulting from only minor volatile loss and significant oxidation of Fe and Mn). Thus, LOI determinations do not satisfy the assumptions required for a Thompson-Howarth replicate analysis. Consequently, results for LOI are also not presented, although visual examination of the results indicates acceptable analytical quality.

Results indicating high relative or absolute errors occur only for elements whose reference material concentrations are only slightly above the corresponding detection limit (*e.g.* - Ag, Bi, Sb, Nb, and Ta by multi-acid ICP; Te by aqua regia hydride AA; F by specific ion electrode). Consequently, although nominally unsatisfactory, these precisions are perfectly acceptable because of the low precisions that commonly occur in geochemical analyses immediately above the detection limit.

Although the analytical precisions for these data are at levels that are considered good, there is no specific *a priori* test to determine whether these level are adequate for subsequent lithogeochemical data analysis. As a result, application of these error-measurement relationships to estimate analytical precision levels in all samples will be undertaken to allow assessment as to whether the observed compositional variations in these samples exceed that attributable to measurement error. Formulae that allow propagation of these errors onto various chemographic diagrams, including molar element ratio diagrams, exist (Stanley 1990), and will be used where appropriate during data evaluation to confirm the significance of any geological or geochemical conclusions.

ANALYTICAL BLUNDER

One of the reference materials analyzed had element concentrations that were totally inconsistent with expected results. This sample FR98-267, a basalt, exhibited anomalous results for all $LiBO_3$ fusion / XRF major oxide analyses, but not for any other element determinations. Re-analysis by Bondar-Clegg of the 36 samples surrounding FR98-267 in the batch faithfully reproduced the errant element concentrations in this sample, as well as the concentrations of the elements in the unknown samples. Furthermore, although additional splits of pulp were fused and analyzed for the 36 samples surrounding FR98-267 in the analytical batch (and these analyses also reproduced the original results), sufficient material to prepare a second fused disk from sample FR98-267 was not available. Consequently, the anomalous characteristics associated with this errant sample remain unexplained. However, because both the re-analyzed original fused disks and the new replicate fused disks faithfully reproduced the original analyses of the other samples, this analytical 'blunder' is not interpreted to be representative of a batch-wide analytical problem.

COMPARISON OF ALTERNATIVE GEOCHEMICAL ANALYSES

The lithogeochemical analysis packages chosen for use in this research project provided several element determinations analyzed by two methods (Ag, Cu, Pb, Zn, Mo, Co, Cd, Bi, As, Sb, Fe, Mn, Te, Ba, Cr, Al, Mg, Ca, Na, K, Sr, Y, Nb, Ti and Zr). These 'alternative' analyses were compared on scatterplots to determine whether significant differences result from the use of different analytical methods. Results are presented as scatterplots in Appendix 2. On all plots, the sloping lines indicate equivalent results, taking into account possibly different axis ranges and exaggerations, reporting units (*e.g.* - wt. % *versus* ppm) and element formulae (*e.g.* - Fe_2O_3 *versus* Fe) for each analytical method.

Results indicate that all chalcophile elements exhibit virtually identical concentrations for both analytical methods. Those that exhibit discrepancies either exhibit concentrations close to the detection limit and thus are subject to large proportional measurement errors (Bi, Sb and Te), exhibit extreme concentrations where non-linear calibration problems can be expected (Zn and Co), or are highly correlated but exhibit small proportional errors (< 10%) and thus do not significantly undermine confidence in the analytical quality because the relative order of concentration levels are similar (Mo and As).

Major elements exhibit good correspondence except for Al and Ca (which were clipped by an upper detection limit of 10 wt. % for the multi-acid ICP analysis), K and Ti (for which multi-acid digestion success is dependent on mineralogy - feldspars *versus* micas), and Mn (which exhibits non-linear calibration effects at concentrations > 3000 ppm). All other major elements exhibit identical or closely proportional results, although the multi-acid digestion ICP analyses are universally lower than the $LiBO_3$ fusion XRF analyses.

Non-chalcophile trace element analyses also exhibit good correspondence, except for Ba (which is clipped by a multi-acid ICP detection limit of 2000 ppm), and Y, Nb and Zr (which are only marginally digested by the multi-acid digestion). Cr and Sr exhibit slight proportional errors, but are highly correlated, and thus these results also do not undermine confidence in their analytical quality, as above.

A comparison of the level of analytical error in these 'alternative' element determinations reveals that the XRF and aqua regia AA analyses exhibit almost universally better precision than the multi-acid ICP results. This is probably because the highly saline nature of the multi-acid analyte solutions introduce matrix effects that are not adequately corrected for in the ICP data post-processing step. The multi-acid analyses also commonly exhibit restrictive upper limits of detection (*e.g.* - Al and Ca) that limit the utility of these analytical results. Consequently, recommended analytical methods for data interpretation in the future include $LiBO_3$ or pressed pellet XRF and aqua regia AA results, where available, over multi-acid ICP results.

CONCLUSIONS

Analytical results for reference materials submitted as part of the Faro Lithogeochemical Exploration Research Project have provided estimates of linear error-measurement relationships that can be used to estimate the magnitude of measurement error on any lithogeochemical determination. These results indicate that the overall analytical quality is expected to be very acceptable for the purposes of molar element ratio analysis and geochemical interpretation.

Comparisons of alternative analytical methods for element determinations indicate that good correspondence exists for most elements. Nevertheless, the X-ray fluorescence and atomic absorption analyses are preferred over the multi-acid ICP analyses because of their superior level of analytical precision. Finally, the aqua regia analyses of chalcophile trace elements are virtually a total analyses, based on comparison with multi-acid inductively coupled plasma analysis, and thus can be used in lieu of more costly total analysis procedures.

ADDITIONAL QUALITY CONTROL / ASSESSMENT SAMPLES AND ANALYSIS

In addition to the above reference material quality control / assessment evaluation of sample pulp replicates, several additional datasets exist that may be used to quantify the errors introduced in various aspects of sample collection and analysis. For example, five samples were collected in duplicate in the field to determine the magnitude of sampling errors that exist in these data. These replicate samples were collected adjacent to each other in the drillcores from material that appeared to be texturally and mineralogically homogeneous. Similarly, four adjacent samples were collected across visible hydrothermal alteration boundaries (or fronts) to assess the magnitude of small-scale compositional variations that exist in the study area due to hydrothermal alteration.

Additionally, during the course of lithogeochemical analysis, Bondar-Clegg re-analyzed 36 fused disks for major oxides by X-ray fluorescence, and re-sampled 36 splits of jaw-crushed samples, which were subsequently pulverized, fused and analyzed for major oxides by X-ray fluorescence. These additional datasets allow assessment of sampling, preparation and instrumental analysis errors; however, because of the modest size of these four datasets, conclusions from these assessments are generally qualitative, and thus a discussion of the results of these evaluations will be included in appendices to the final report.

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TABLES

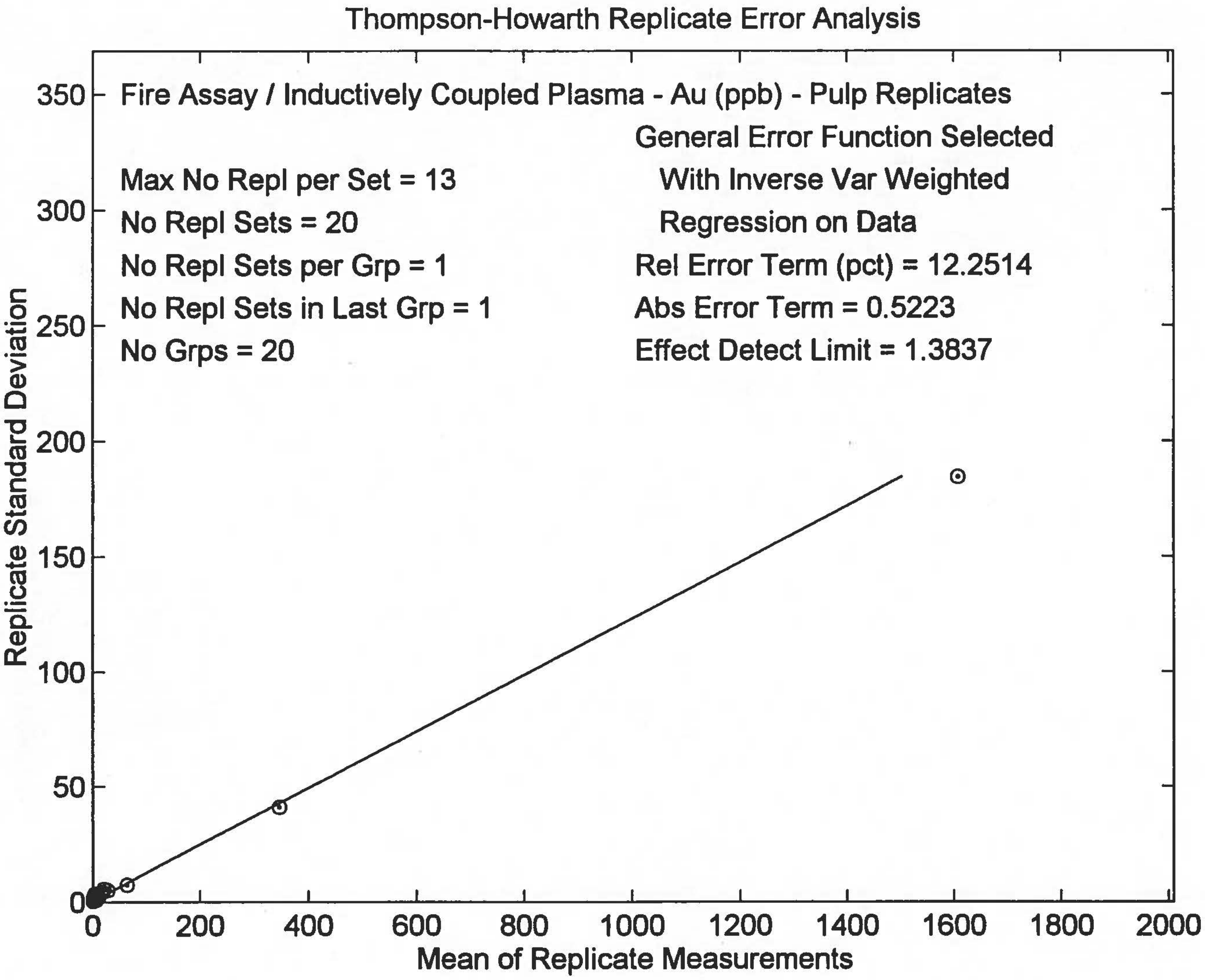
Table 1 - Thompson-Howarth replicate error analysis results for reference materials submitted to Bondar-Clegg Laboratories during the Faro Lithogeochemical Exploration Research Project.

Element	*Analytical Method*	*Quoted Detection Limit*	*Effective Detection Limit*	*Relative Error Term (1 st dev)*	*Absolute Error Term (1 st dev)*
Au (ppb)	Fire Assay / ICP	1 ppb	1.38 ppb	12.25 %	0.52 ppb
Ag (ppm)	Multi-acid / ICP	0.5 ppm	0.08 ppm	19.19 %	0.03 ppm
Cu (ppm)	Multi-acid / ICP	1 ppm	1.32 ppm	1.55 %	0.64 ppm
Pb (ppm)	Multi-acid / ICP	2 ppm	5.14 ppm	1.44 %	2.49 ppm
Zn (ppm)	Multi-acid / ICP	2 ppm	3.93 ppm	1.98 %	1.89 ppm
Mo (ppm)	Multi-acid / ICP	1 ppm	1.33 ppm	2.01 %	0.64 ppm
Ni (ppm)	Multi-acid / ICP	1 ppm	0.62 ppm	1.47 %	0.30 ppm
Co (ppm)	Multi-acid / ICP	1 ppm	0.90 ppm	5.08 %	0.40 ppm
Cd (ppm)	Multi-acid / ICP	1 ppm	0.58 ppm	6.53 %	0.25 ppm
Bi (ppm)	Multi-acid / ICP	5 ppm	0.00 ppm	23.24 %	0.00 ppm
As (ppm)	Multi-acid / ICP	5 ppm	4.46 ppm	4.00 %	2.05 ppm
Sb (ppm)	Multi-acid / ICP	5 ppm	0.00 ppm	62.22 %	0.00 ppm
Fe (pct)	Multi-acid / ICP	0.01 pct	0.00 pct	2.16 %	0.00 pct
Mn (ppm)	Multi-acid / ICP	5 ppm	0.00 ppm	2.04 %	0.00 ppm
Te (ppm)	Multi-acid / ICP	25 ppm	-----	-----	-----
Ba (ppm)	Multi-acid / ICP	25 ppm	0.00 ppm	3.07 %	0.00 ppm
Cr (ppm)	Multi-acid / ICP	5 ppm	6.53 ppm	2.95 %	3.07 ppm
V (ppm)	Multi-acid / ICP	2 ppm	0.09 ppm	1.51 %	0.05 ppm
Sn (ppm)	Multi-acid / ICP	20 ppm	-----	-----	-----
W (ppm)	Multi-acid / ICP	2 ppm	0.15 ppm	2.83 %	0.07 ppm
La (ppm)	Multi-acid / ICP	5 ppm	1.66 ppm	0.62 %	0.82 ppm
Al (pct)	Multi-acid / ICP	0.01 pct	0.01 pct	1.93 %	0.00 pct
Mg (pct)	Multi-acid / ICP	0.01 pct	0.00 pct	1.74 %	0.00 pct
Ca (pct)	Multi-acid / ICP	0.01 pct	0.06 pct	0.05 %	0.03 pct
Na (pct)	Multi-acid / ICP	0.01 pct	0.01 pct	1.77 %	0.01 pct
K (pct)	Multi-acid / ICP	0.01 pct	0.00 pct	6.27 %	0.00 pct
Sr (ppm)	Multi-acid / ICP	1 ppm	0.31 ppm	3.78 %	0.14 ppm
Y (ppm)	Multi-acid / ICP	5 ppm	0.46 ppm	2.18 %	0.22 ppm
Ga (ppm)	Multi-acid / ICP	10 ppm	0.62 ppm	5.81 %	0.28 ppm
Li (ppm)	Multi-acid / ICP	2 ppm	0.91 ppm	2.70 %	0.43 ppm
Nb (ppm)	Multi-acid / ICP	5 ppm	0.64 ppm	13.77 %	0.23 ppm
Sc (ppm)	Multi-acid / ICP	5 ppm	0.54 ppm	4.28 %	0.25 ppm
Ta (ppm)	Multi-acid / ICP	5 ppm	0.00 ppm	13.27 %	0.00 ppm
Ti (pct)	Multi-acid / ICP	0.01 pct	0.01 pct	3.51 %	0.00 pct
Zr (ppm)	Multi-acid / ICP	5 ppm	0.91 ppm	3.30 %	0.43 ppm

Table 1 (continued)

Element	***Analytical Method***	***Quoted Detection Limit***	***Effective Detection Limit***	***Relative Error Term (1 st dev)***	***Absolute Error Term (1 st dev)***
Ag (ppm)	Aqua Regia / AA	0.1 ppm	0.03 ppm	3.56 %	0.01 ppm
Cu (ppm)	Aqua Regia / AA	1 ppm	0.11 ppm	2.32 %	0.05 ppm
Pb (ppm)	Aqua Regia / AA	2 ppm	1.93 ppm	0.25 %	0.96 ppm
Zn (ppm)	Aqua Regia / AA	1 ppm	3.85 ppm	0.16 %	1.92 ppm
Mo (ppm)	Aqua Regia / AA	1 ppm	0.58 ppm	0.66 %	0.29 ppm
Co (ppm)	Aqua Regia / AA	1 ppm	0.53 ppm	1.63 %	0.26 ppm
Cd (ppm)	Aqua Regia / AA	0.2 ppm	0.08 ppm	0.18 %	0.04 ppm
Bi (ppm)	Aqua Regia Hydride / AA	0.2 ppm	0.06 ppm	9.86 %	0.02 ppm
As (ppm)	Aqua Regia Hydride / AA	1 ppm	1.43 ppm	1.63 %	0.69 ppm
Sb (ppm)	Aqua Regia Hydride / AA	0.2 ppm	0.09 ppm	3.24 %	0.04 ppm
Te (ppm)	Aqua Regia Hydride / AA	0.1 ppm	0.03 ppm	27.95 %	0.01 ppm
Se (ppm)	Aqua Regia Hydride / AA	0.1 ppm	0.50 ppm	0.00 %	0.25 ppm
Hg (ppm)	Aqua Regia Cold Vapor / AA	0.01 ppm	0.00 ppm	2.95 %	0.00 ppm
Tl (ppm)	Aqua Regia Org. Extract. / AA	0.2 ppm	0.02 ppm	3.04 %	0.01 ppm
FeO (pct)	Colorimetric Titration	0.05 pct	0.06 pct	1.48 %	0.03 pct
Cl (ppm)	Specific Ion	100 ppm	18.17 ppm	0.65 %	8.96 ppm
F (ppm)	Specific Ion	20 ppm	49.23 ppm	3.65 %	22.81 ppm
SiO_2 (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.41 pct	0.00 %	0.21 pct
TiO_2 (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.05 pct	0.02 %	0.02 pct
Al_2O_3 (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.19 pct	0.09 %	0.19 pct
Fe_2O_3 (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.05 pct	0.42 %	0.03 pct
MnO (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.00 pct	0.48 %	0.00 pct
MgO (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.04 pct	0.22 %	0.02 pct
CaO (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.00 pct	0.47 %	0.00 pct
Na_2O (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.01 pct	0.82 %	0.01 pct
K_2O (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.02 pct	1.42 %	0.01 pct
P_2O_5 (pct)	$LiBO_3$ Fused Disk XRF	0.01 pct	0.00 pct	0.53 %	0.00 pct
LOI (pct)	Gravimetry	0.01 pct	-----	-----	-----
Rb (ppm)	Pressed Pellet XRF	2 ppm	1.56 ppm	0.52 %	0.77 ppm
Sr (ppm)	Pressed Pellet XRF	1 ppm	0.06 ppm	1.18 %	0.03 ppm
Ba (ppm)	Pressed Pellet XRF	10 ppm	6.96 ppm	2.51 %	3.31 ppm
Zr (ppm)	Pressed Pellet XRF	1 ppm	1.14 ppm	1.38 %	0.56 ppm
Nb (ppm)	Pressed Pellet XRF	2 ppm	0.96 ppm	1.33 %	0.47 ppm
Y (ppm)	Pressed Pellet XRF	1 ppm	2.11 ppm	0.00 %	1.06 ppm
CO_2(pct)	Wet Chemistry	0.1 pct	0.04 pct	1.07 %	0.02 pct
C (pct)	Leco Correlation Spectrometry	0.02 pct	0.00 pct	0.60 %	0.00 pct
S (pct)	Leco Correlation Spectrometry	0.02 pct	0.01 pct	0.50 %	0.00 pct
Cr (ppm)	$LiBO_3$ Fused Disk XRF	20 ppm	19.96 ppm	0.58 %	9.87 ppm

APPENDIX 1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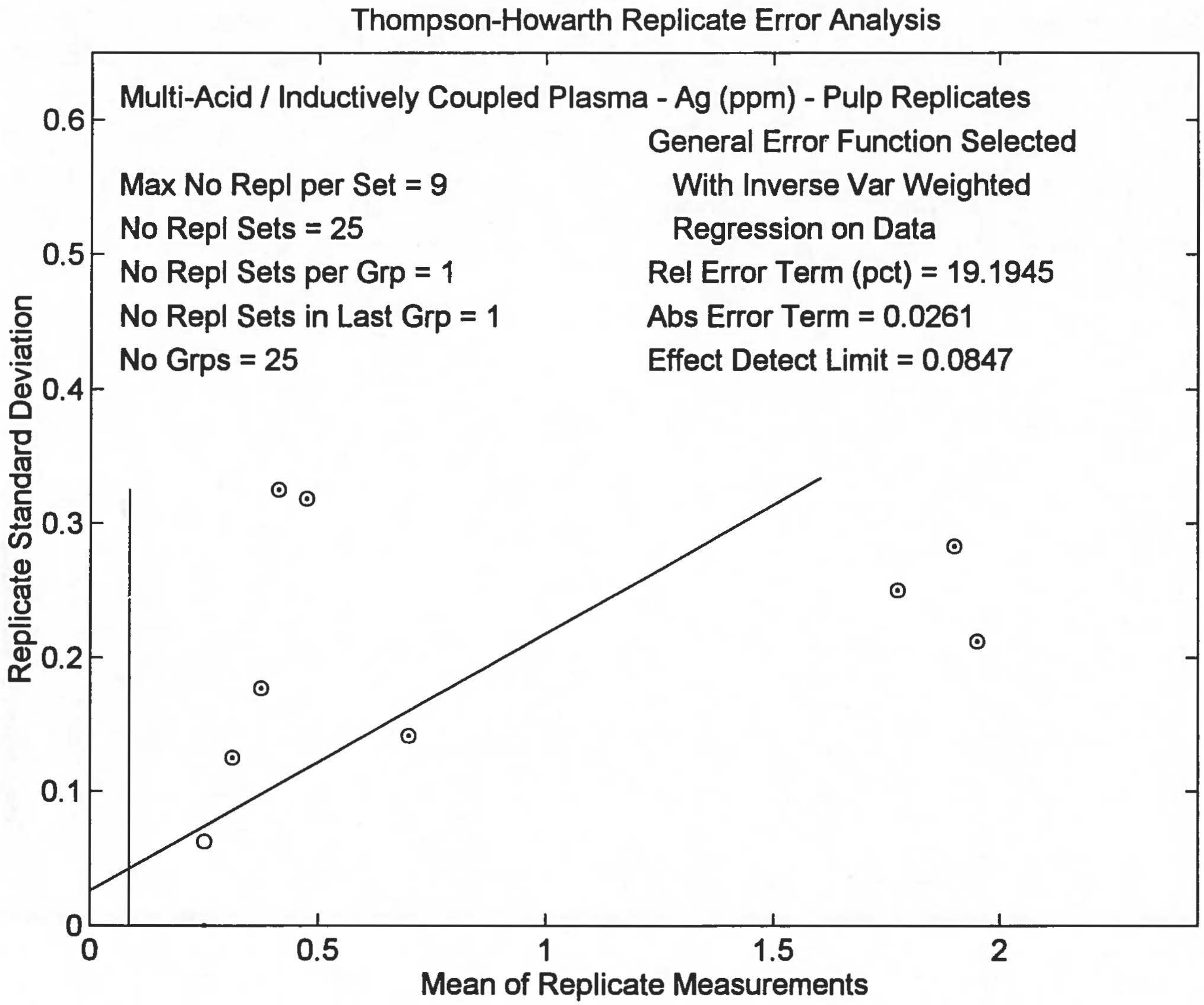
Mean of Replicate Measurements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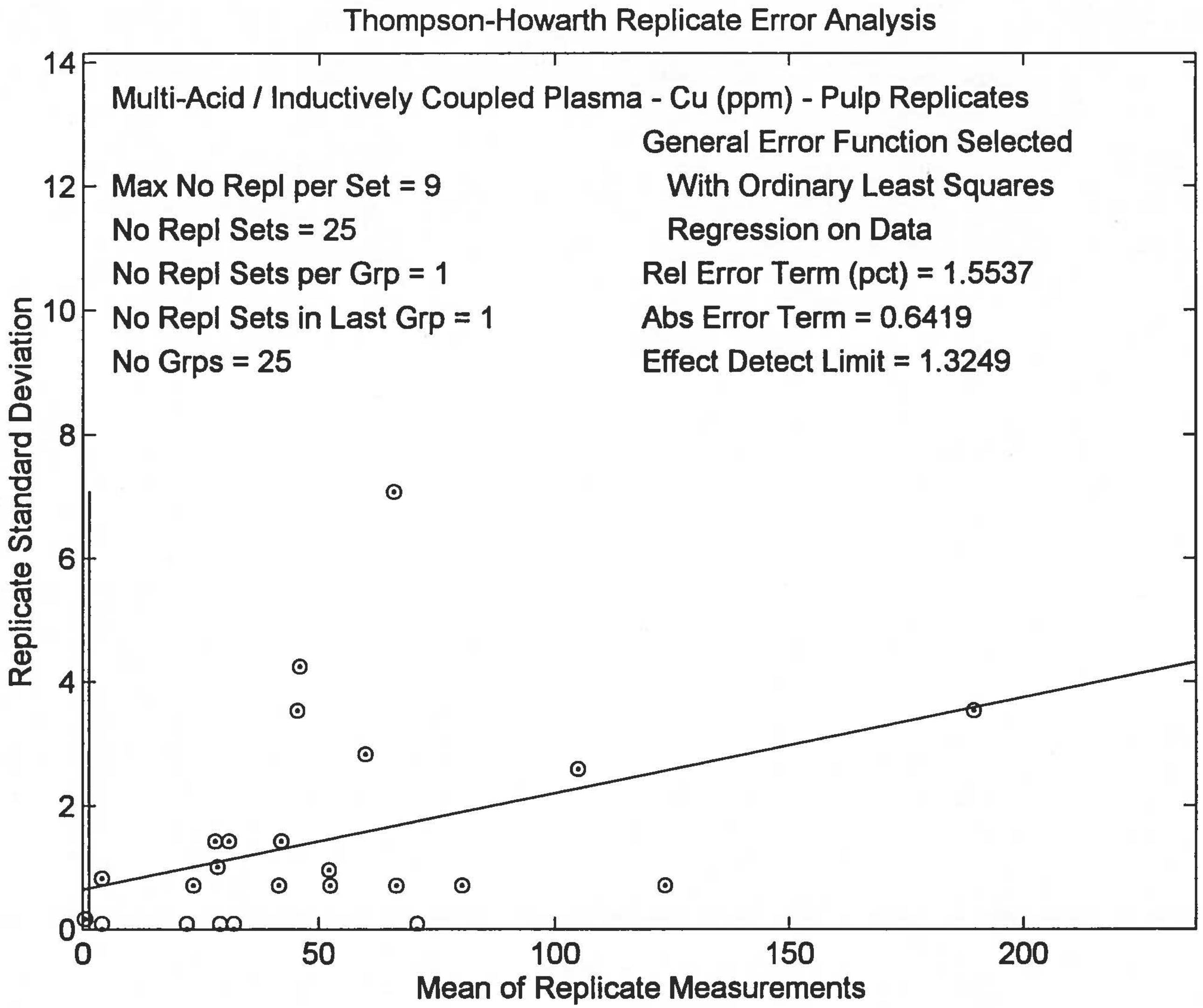

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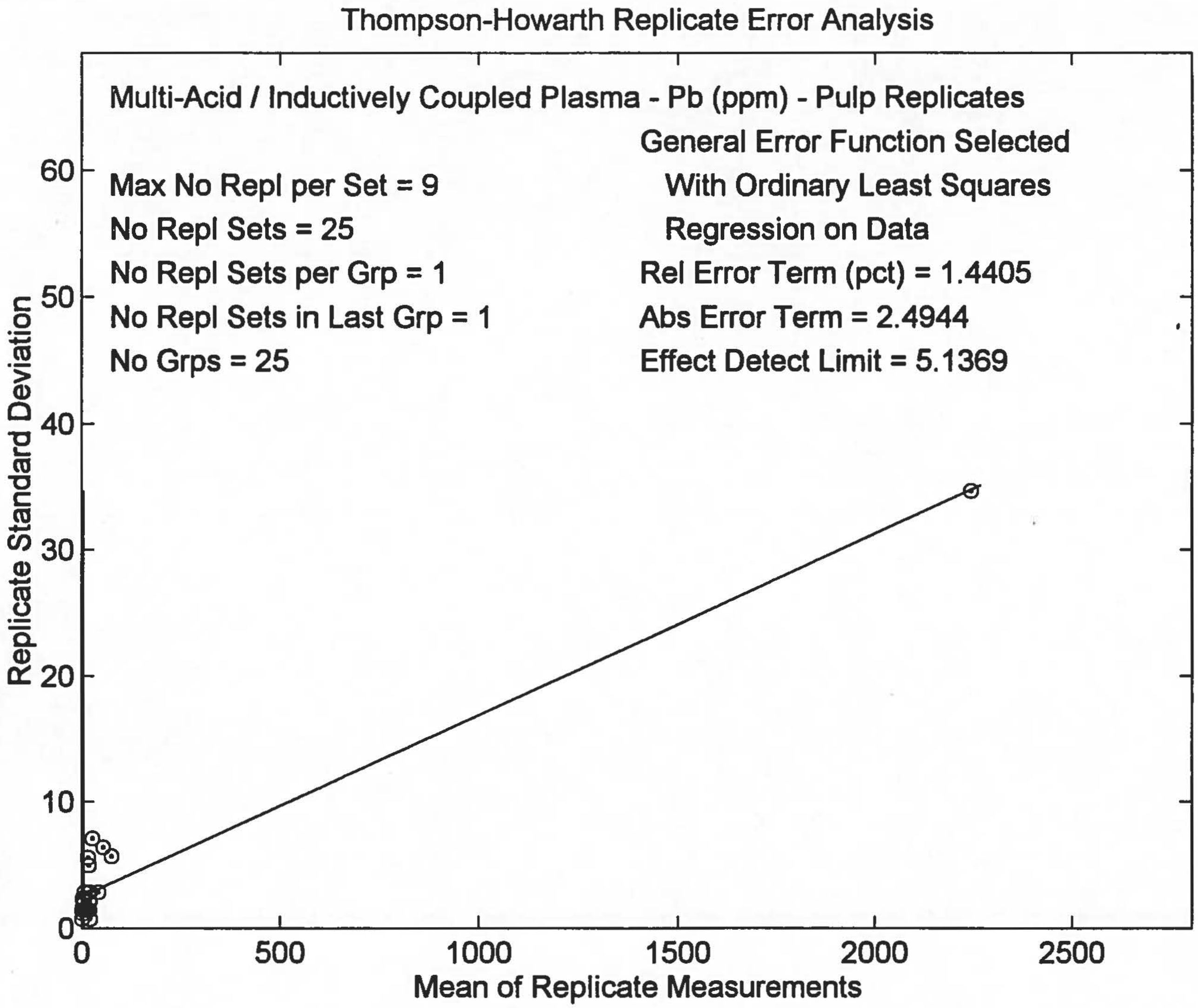
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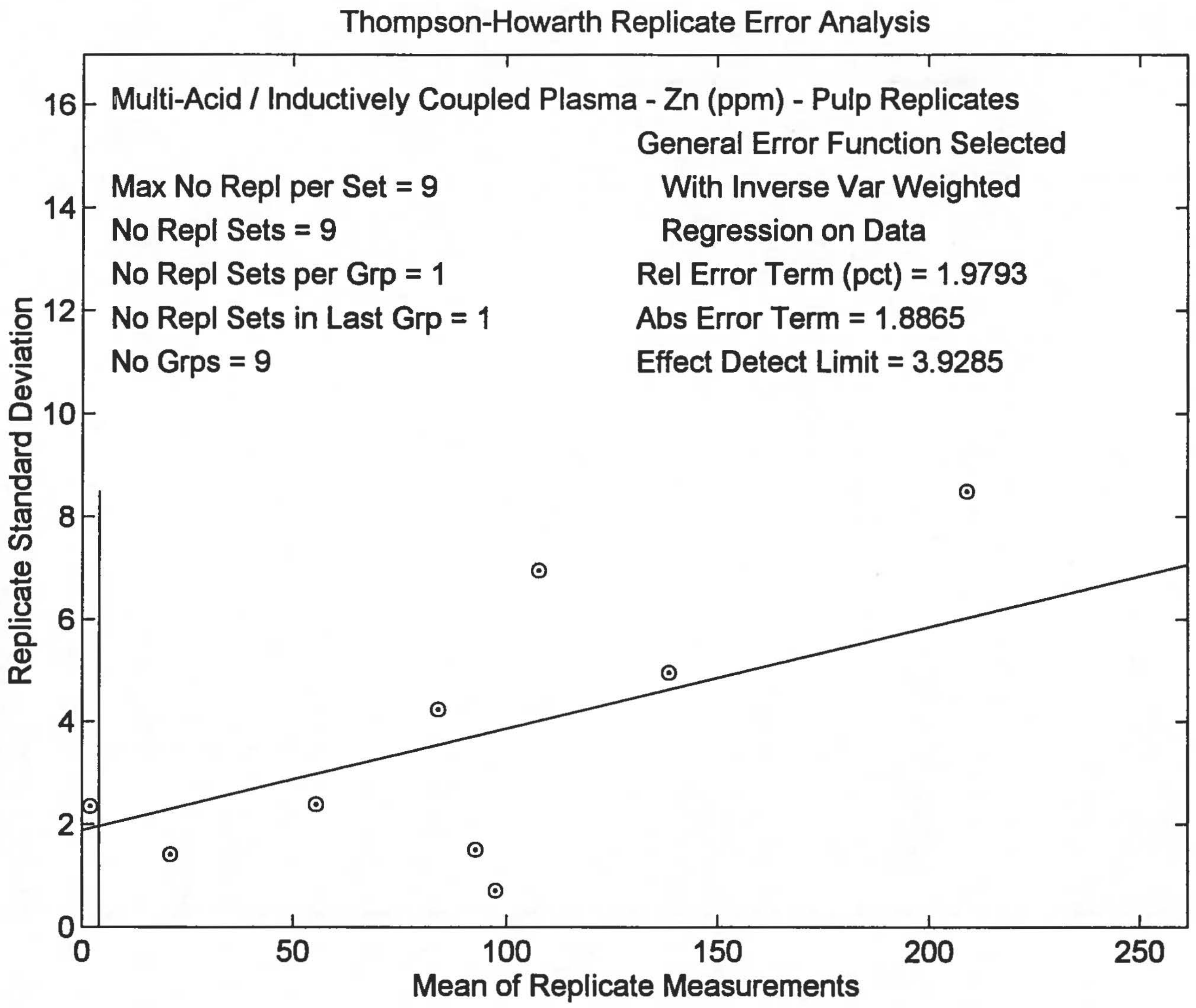
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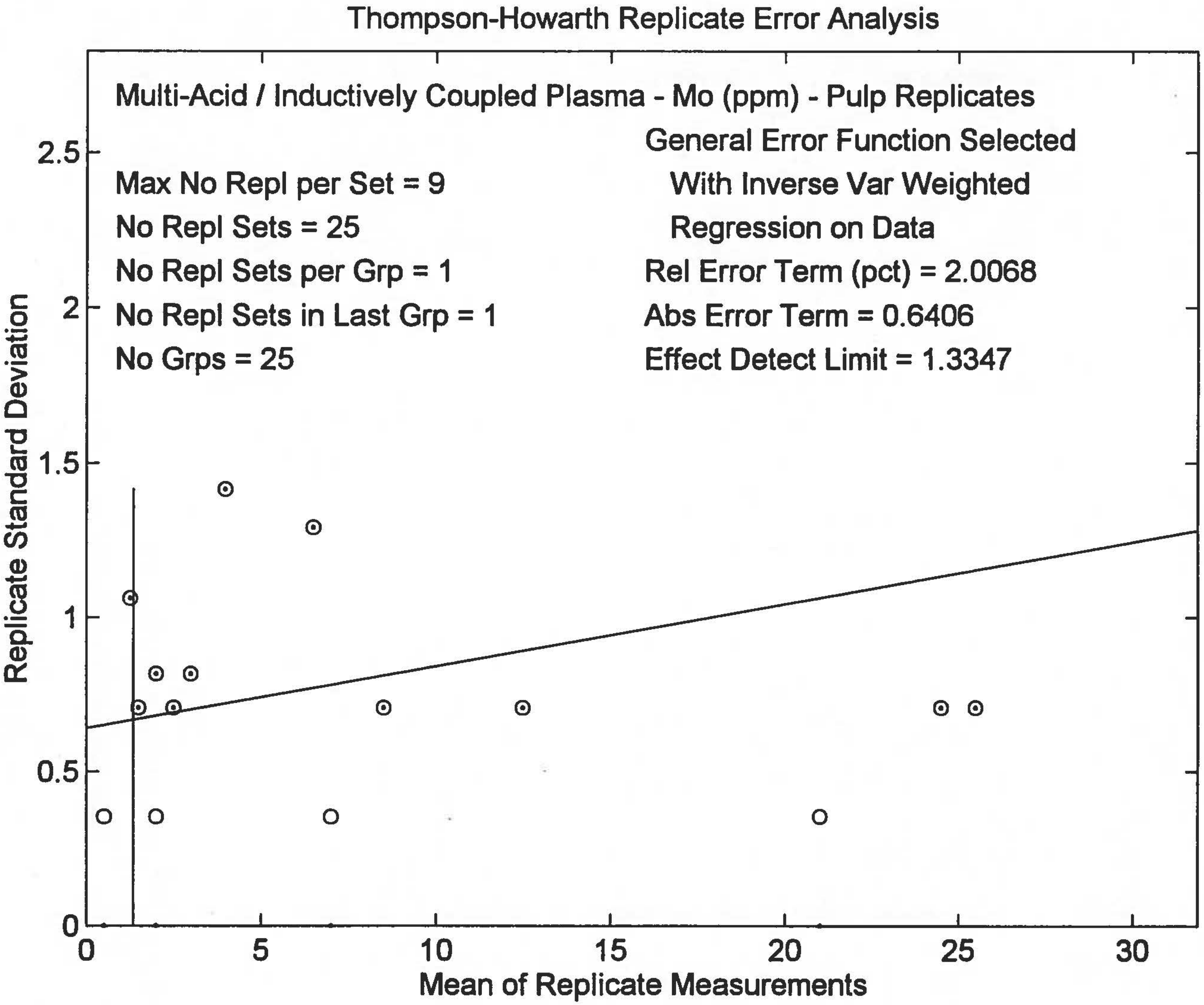
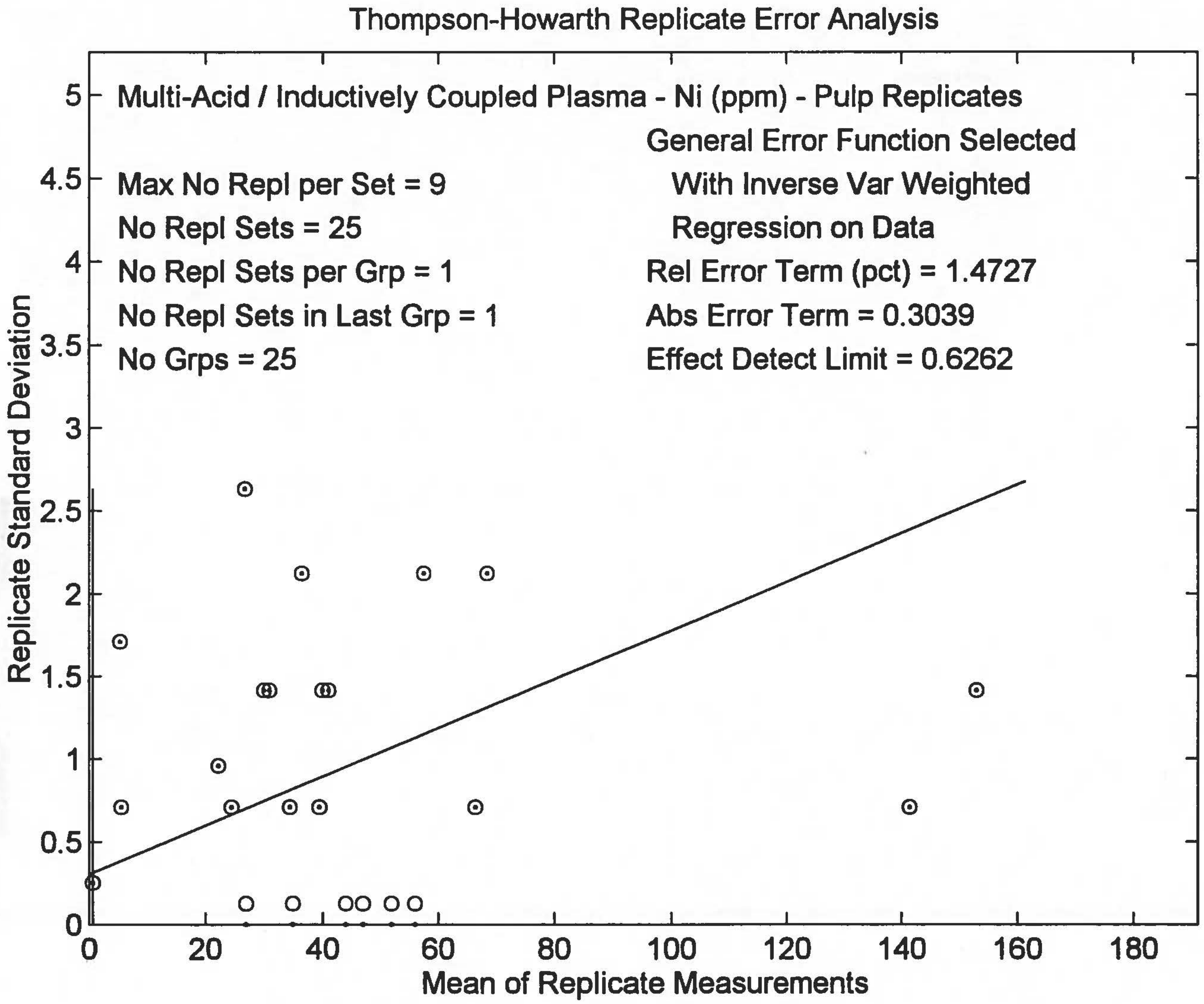
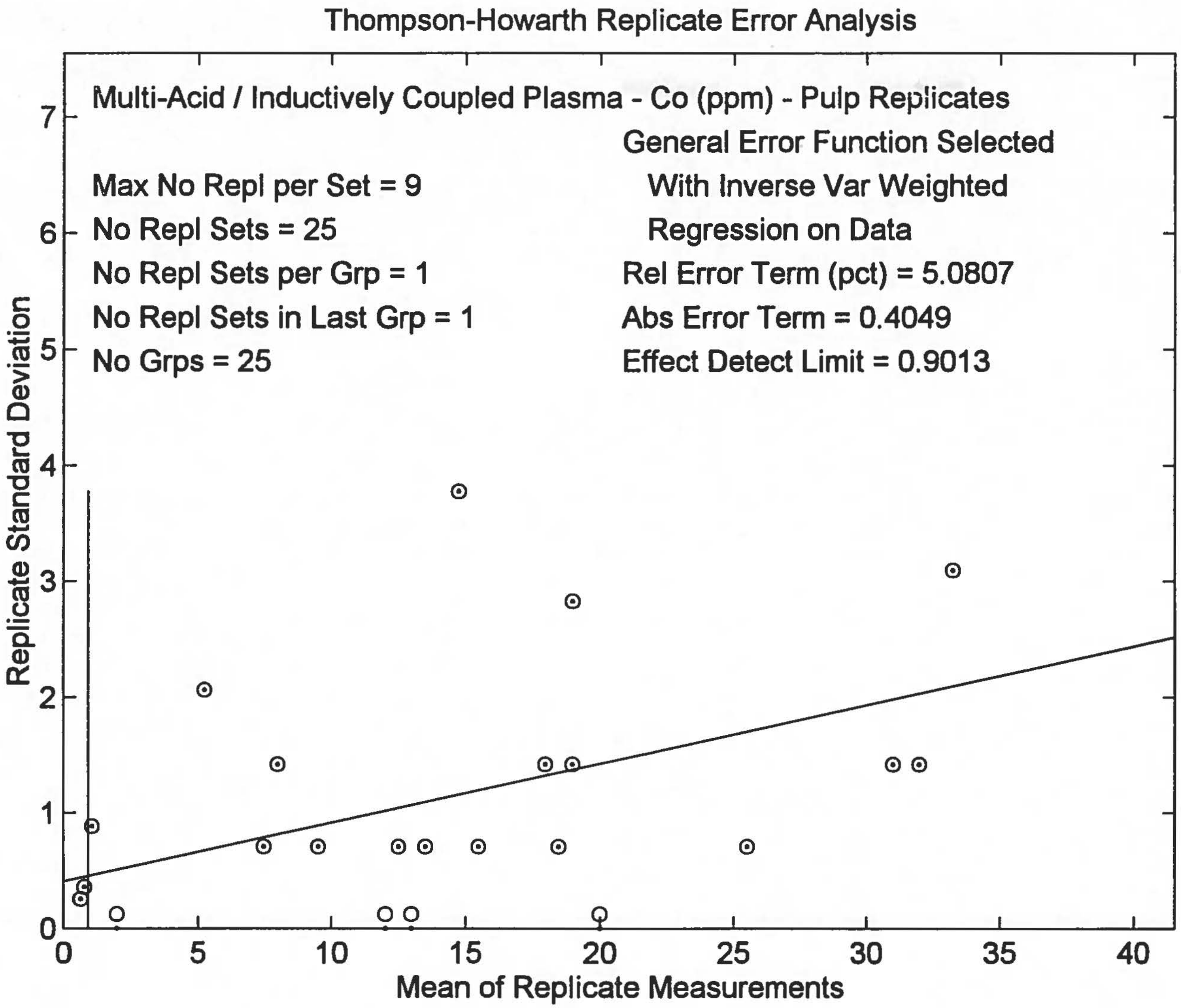
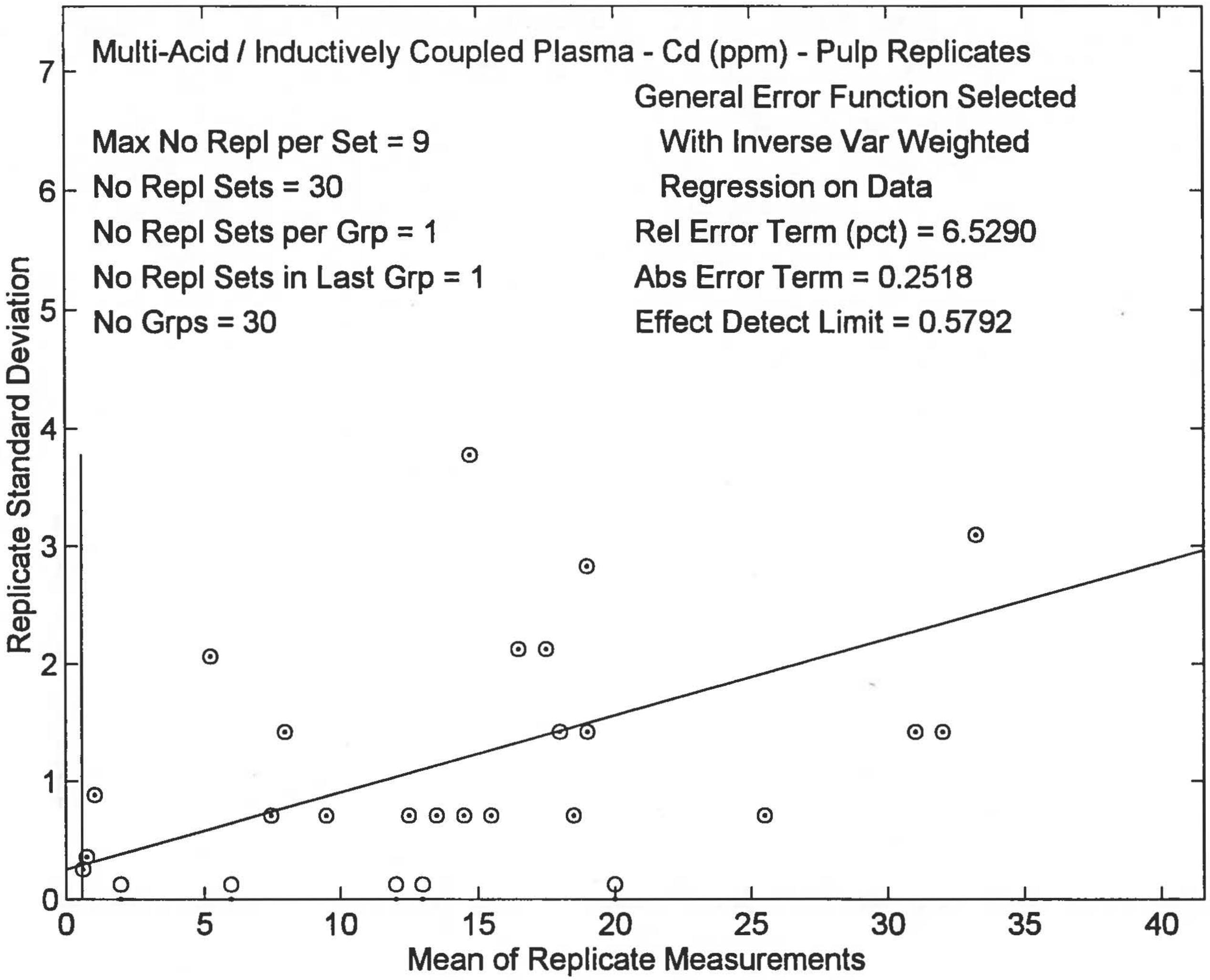
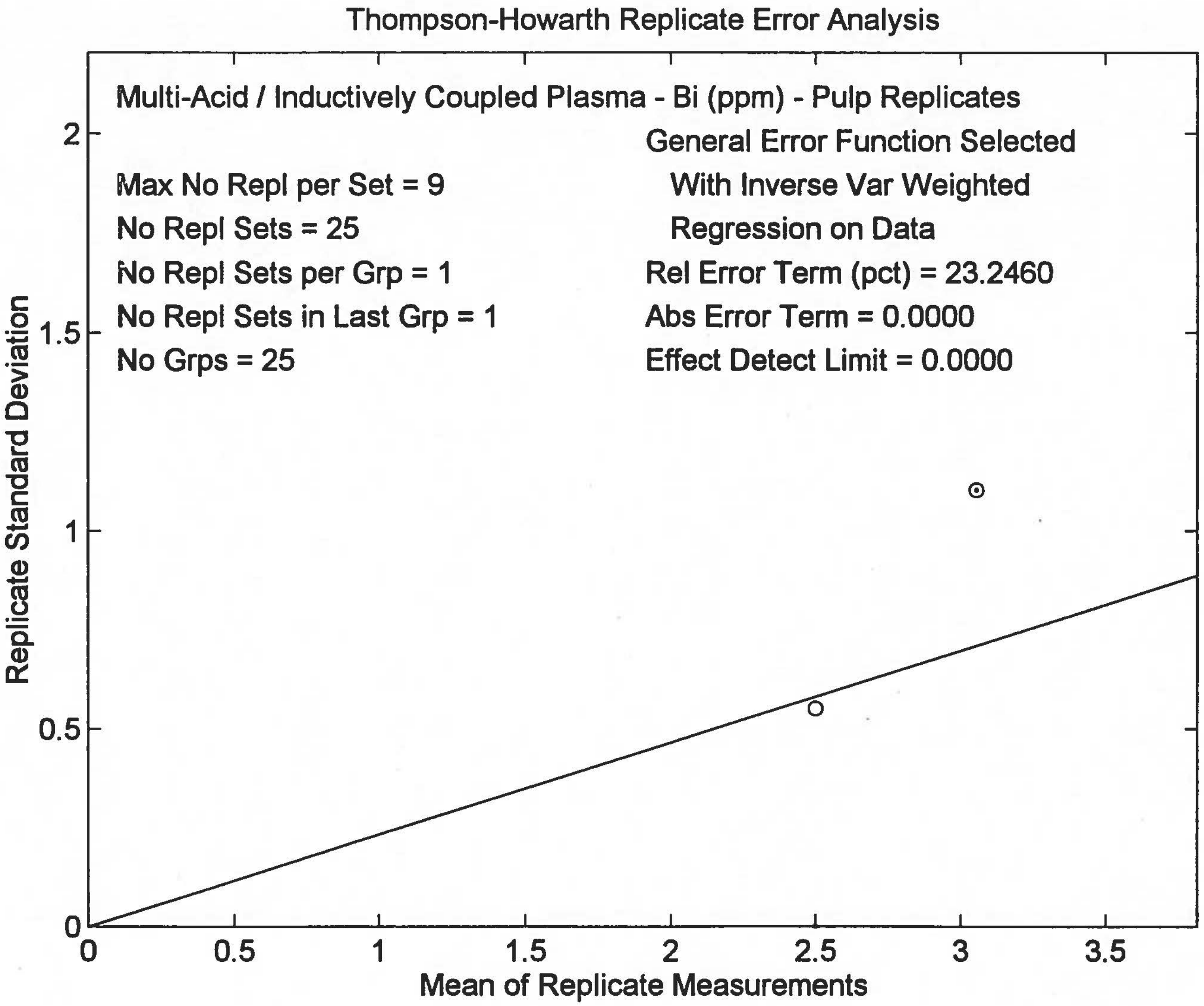

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Mo (ppm) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Rel Error Term (pct) = 2.0068
Abs Error Term = 0.6406
Effect Detect Limit = 1.3347
Replicate Standard Deviation
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25
30
Mean of Replicate Measurements

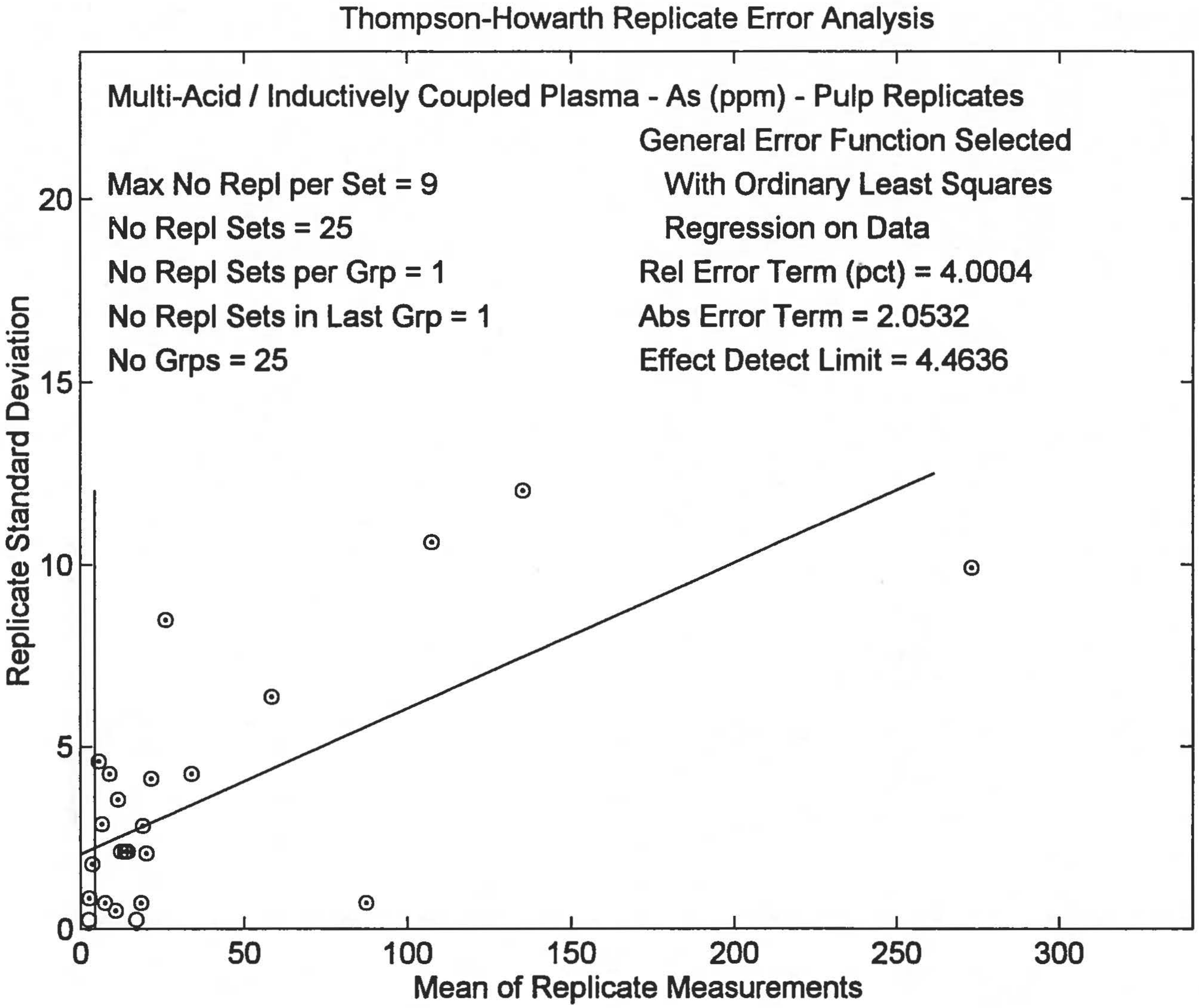

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Ni (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 1.4727
Abs Error Term = 0.3039
Effect Detect Limit = 0.6262
Replicate Standard Deviation
Mean of Replicate Measurements
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
180

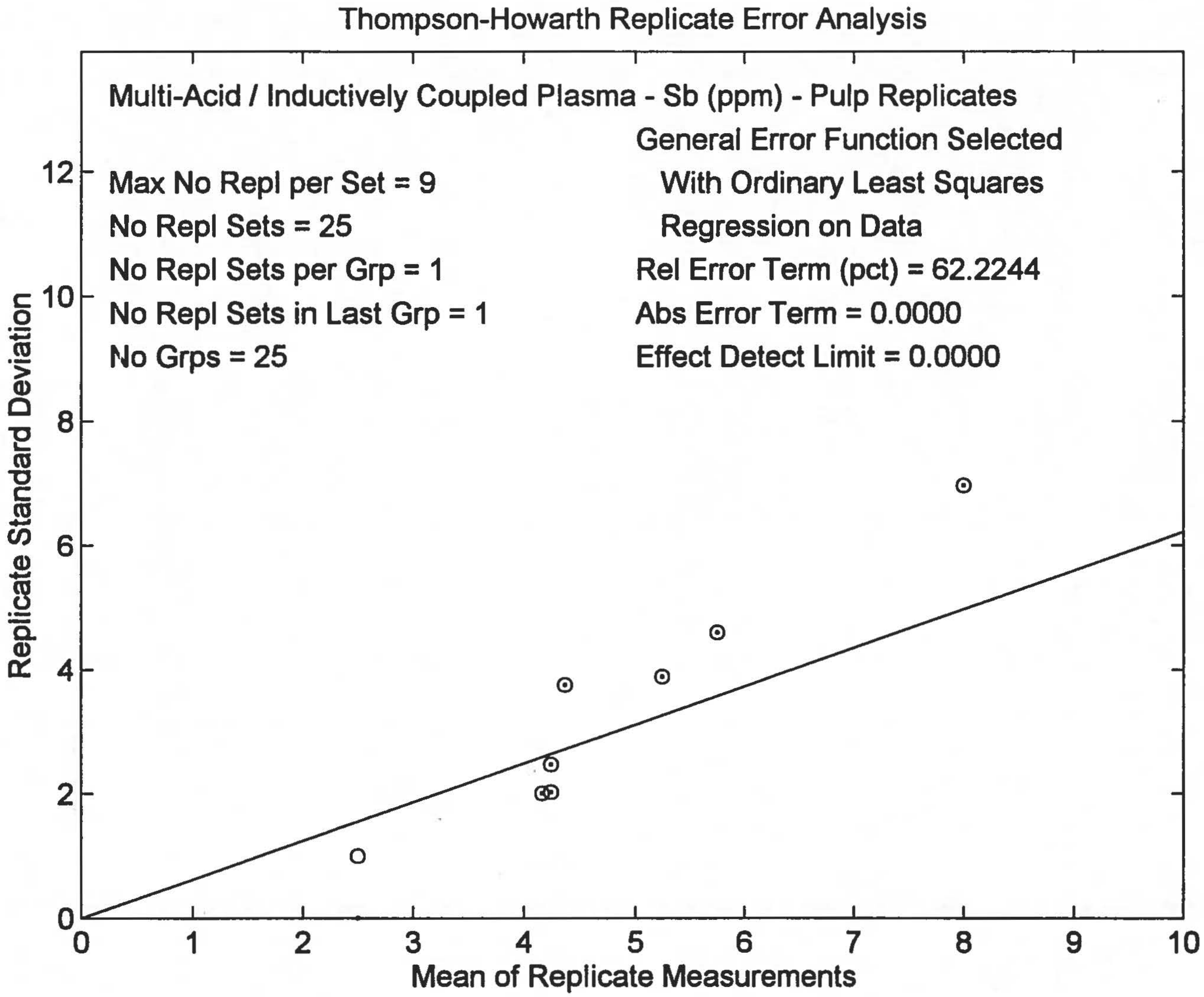

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Co (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 5.0807
Abs Error Term = 0.4049
Effect Detect Limit = 0.9013
Replicate Standard Deviation
0
1
2
3
4
5
6
7
Mean of Replicate Measurements
0
5
10
15
20
25
30
35
40

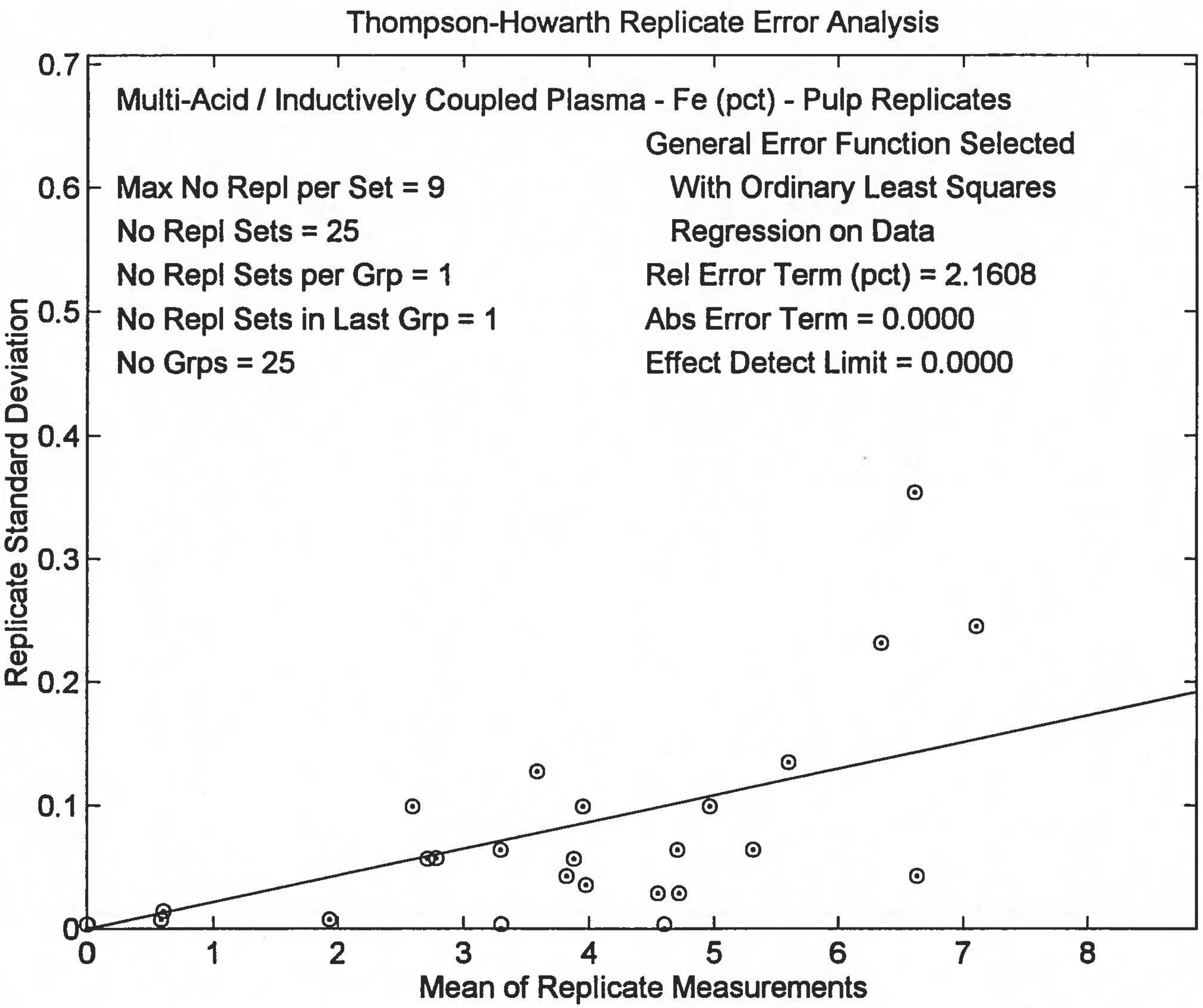


Thompson-Howarth Replicate Error Analysis

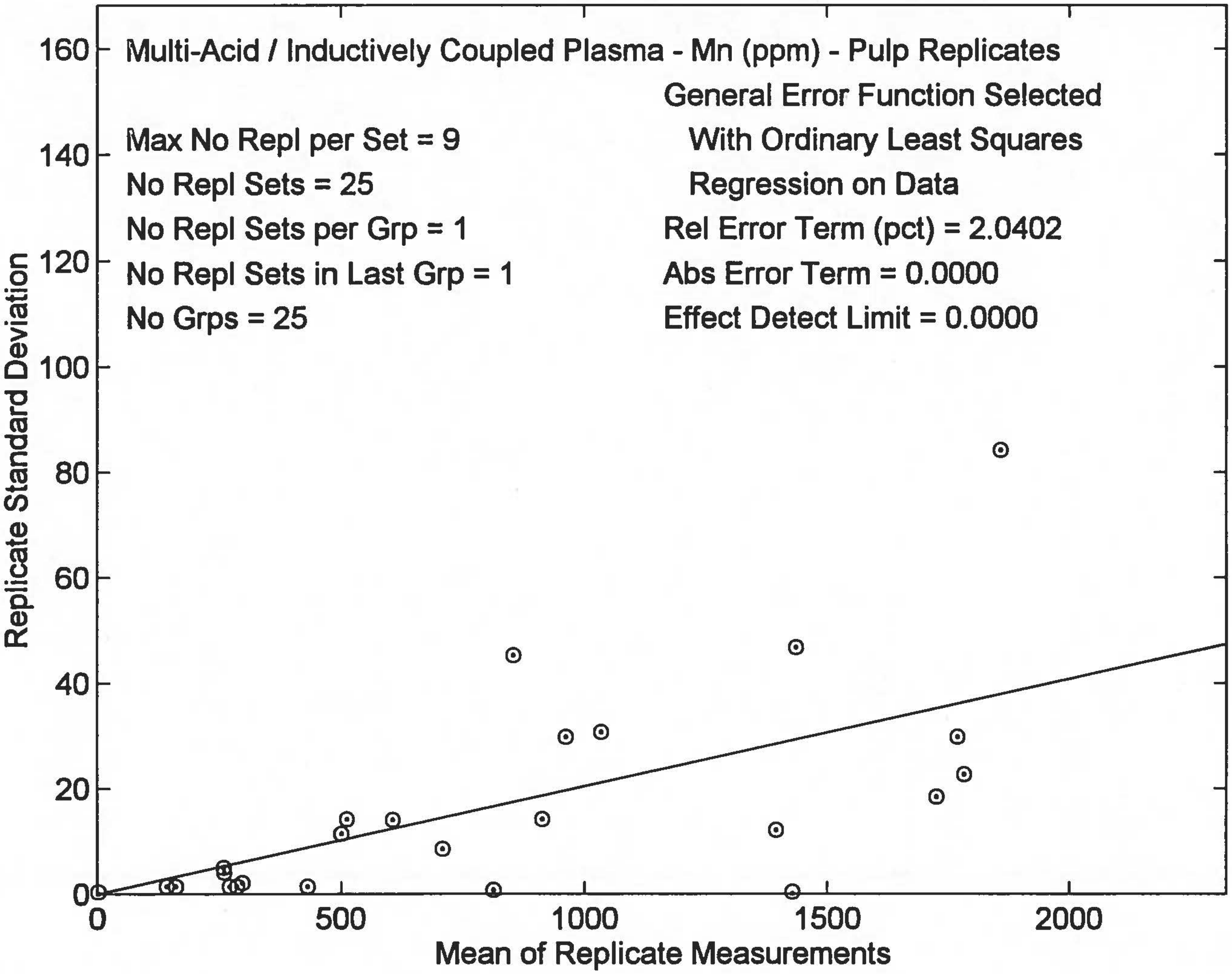

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Bi (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 23.2460
Abs Error Term = 0.0000
Effect Detect Limit = 0.0000
Replicate Standard Deviation
0
0.5
1
1.5
2
Mean of Replicate Measurements
0
0.5
1
1.5
2
2.5
3
3.5

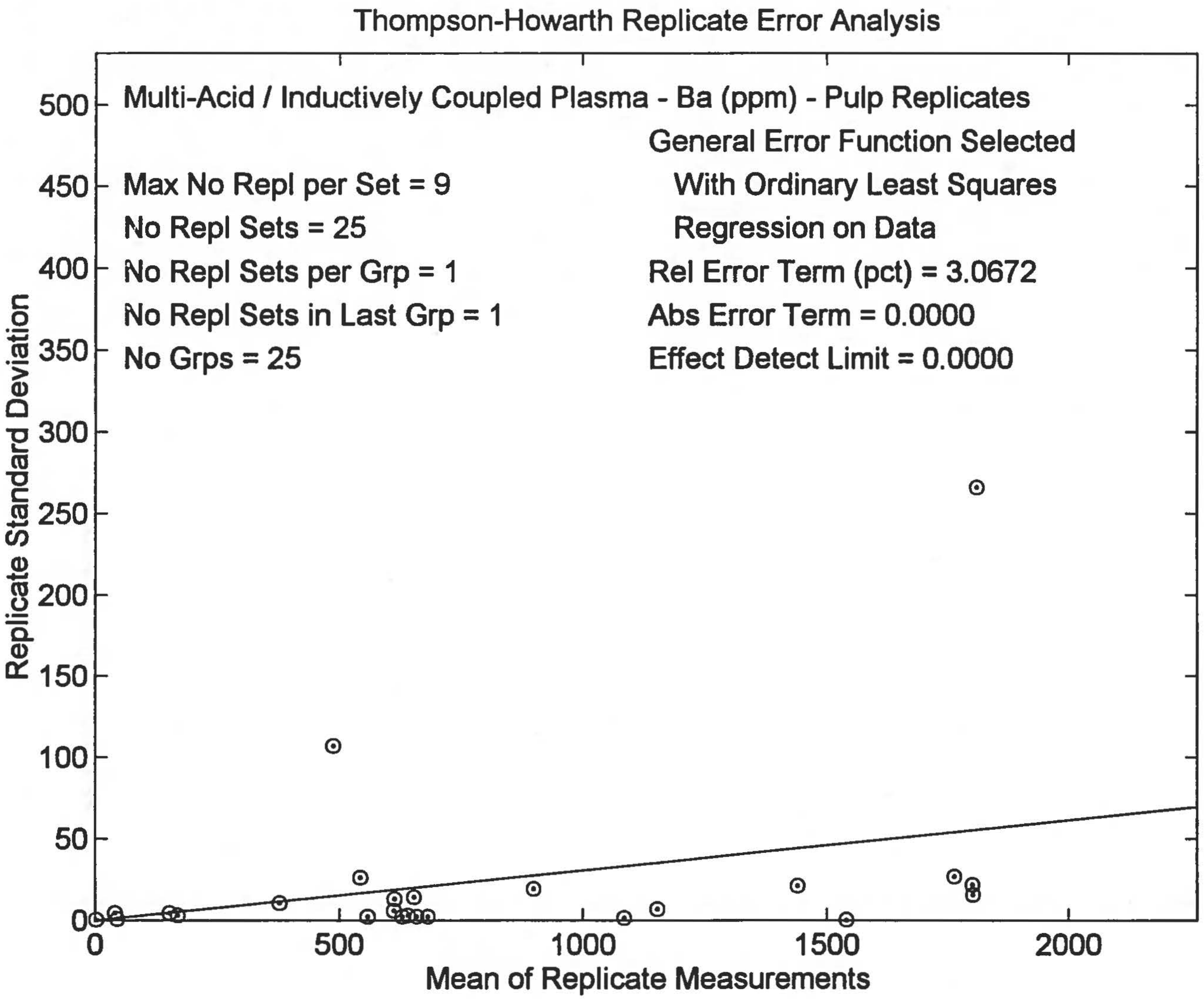

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - As (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 4.0004
Abs Error Term = 2.0532
Effect Detect Limit = 4.4636
Replicate Standard Deviation
0
5
10
15
20
0
50
100
150
200
250
300
Mean of Replicate Measurements

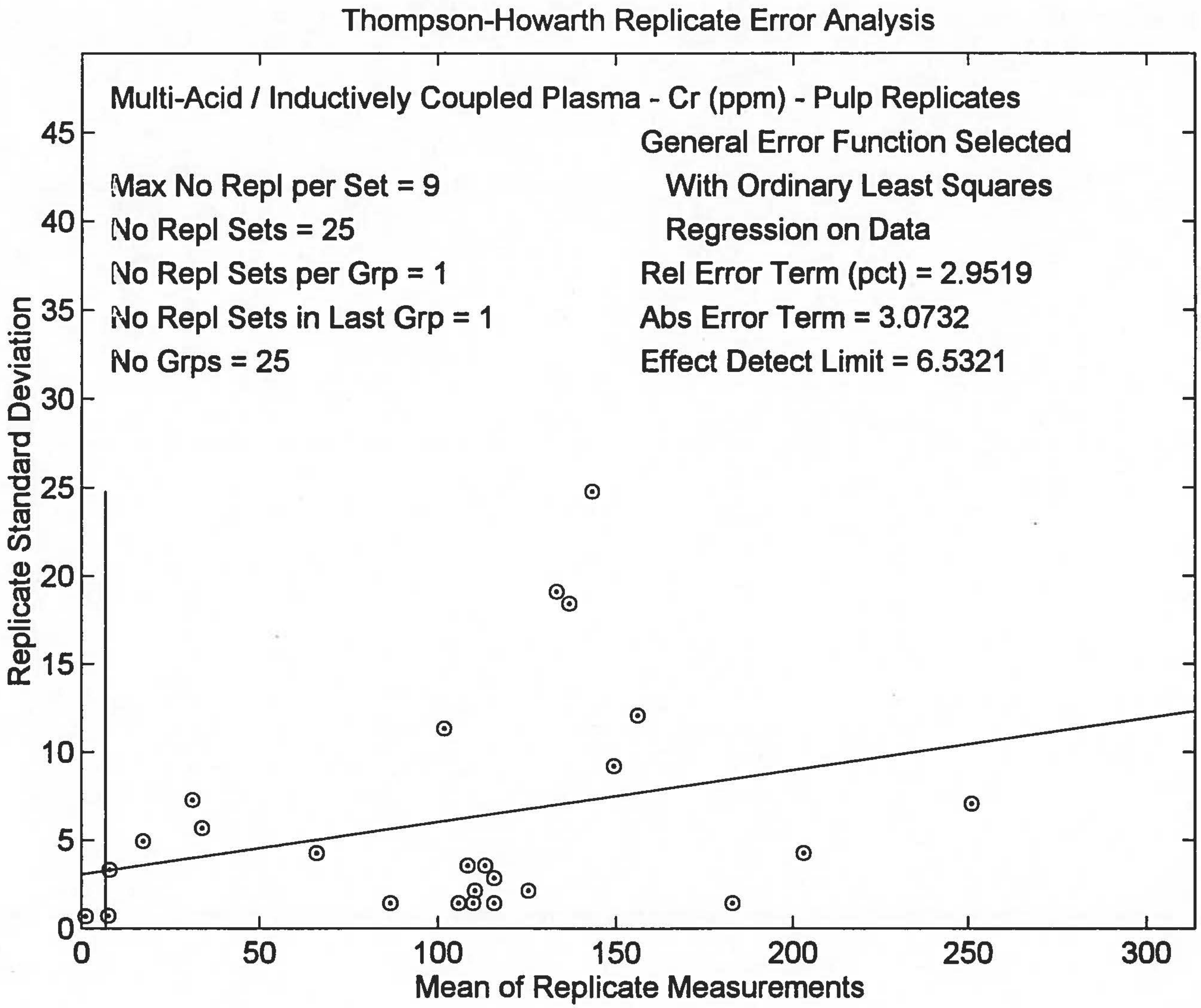

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Sb (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 62.2244
Abs Error Term = 0.0000
Effect Detect Limit = 0.0000
Replicate Standard Deviation
0
2
4
6
8
10
12
Mean of Replicate Measurements
0
1
2
3
4
5
6
7
8
9
10

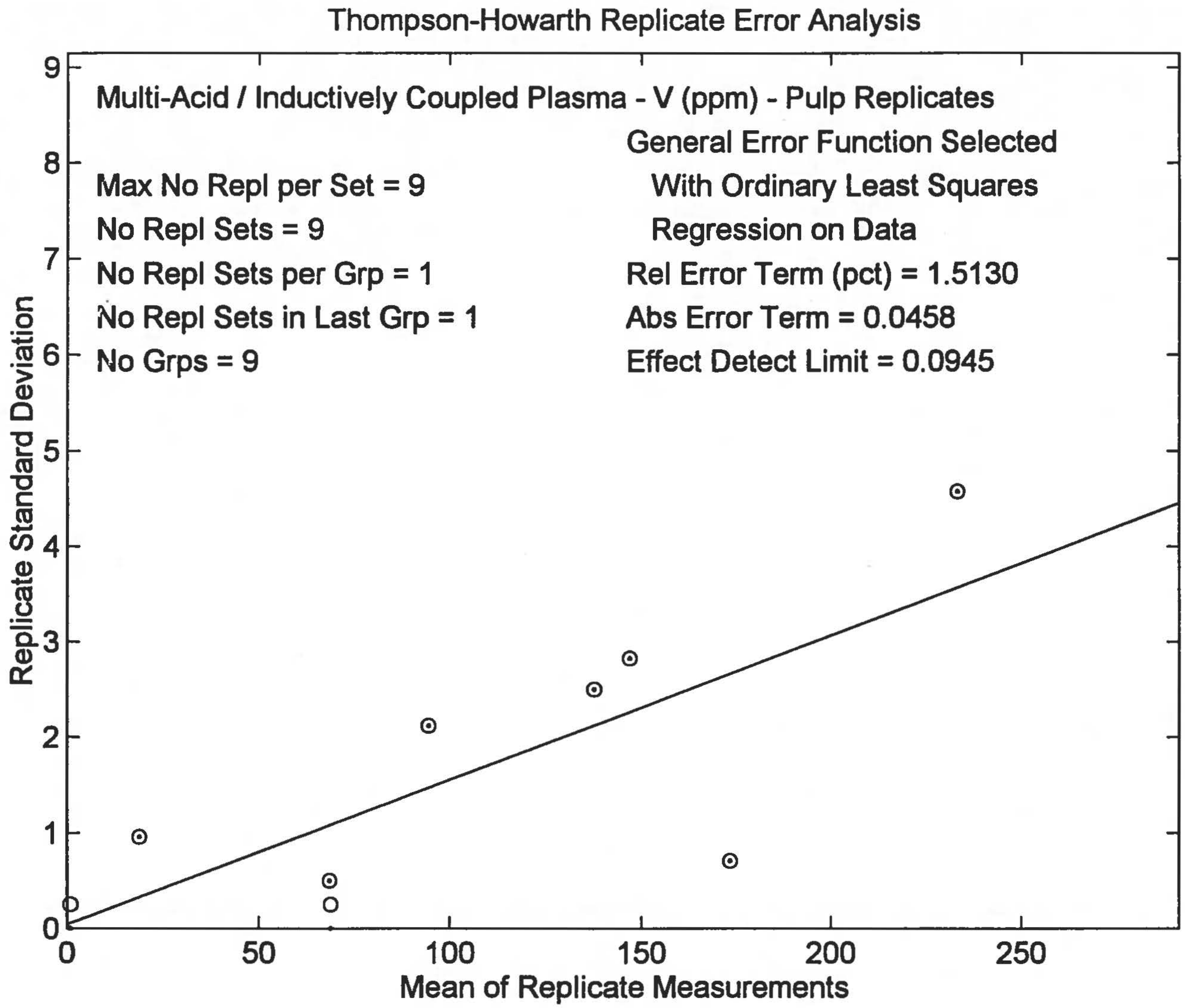

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Fe (pct) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 2.1608
Abs Error Term = 0.0000
Effect Detect Limit = 0.0000
Replicate Standard Deviation
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
8
Mean of Replicate Measurements

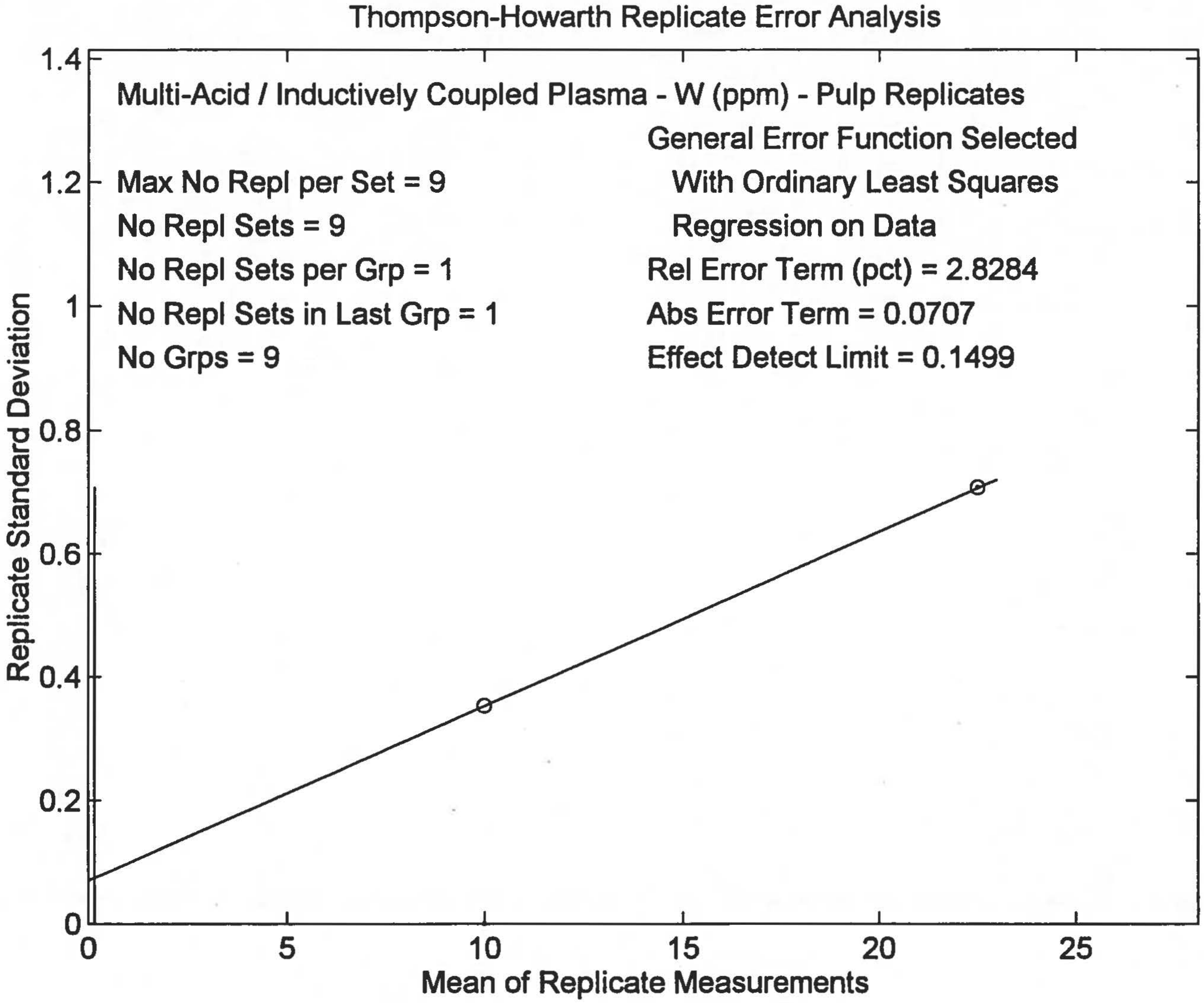
Thompson-Howarth Replicate Error Analysis

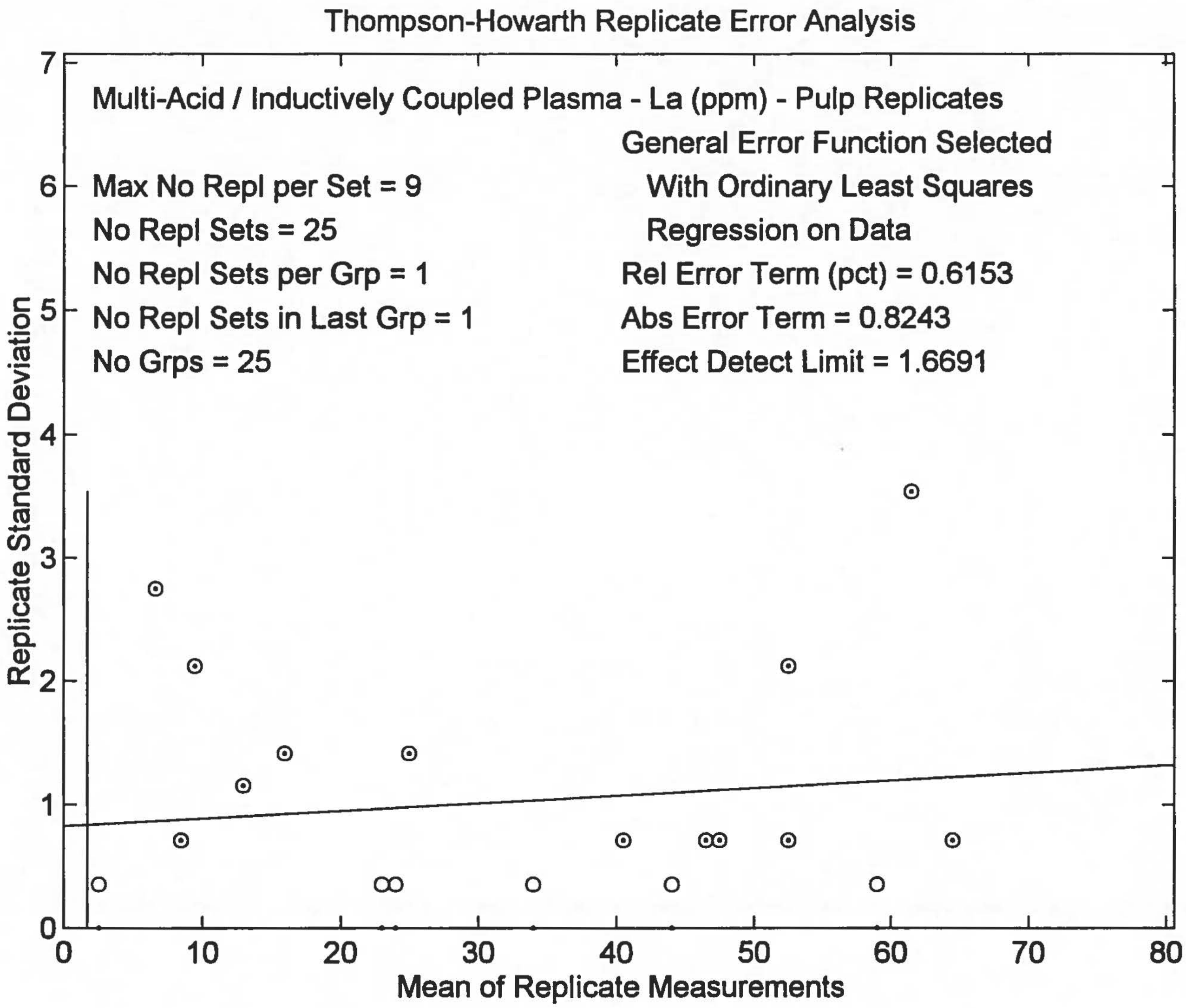


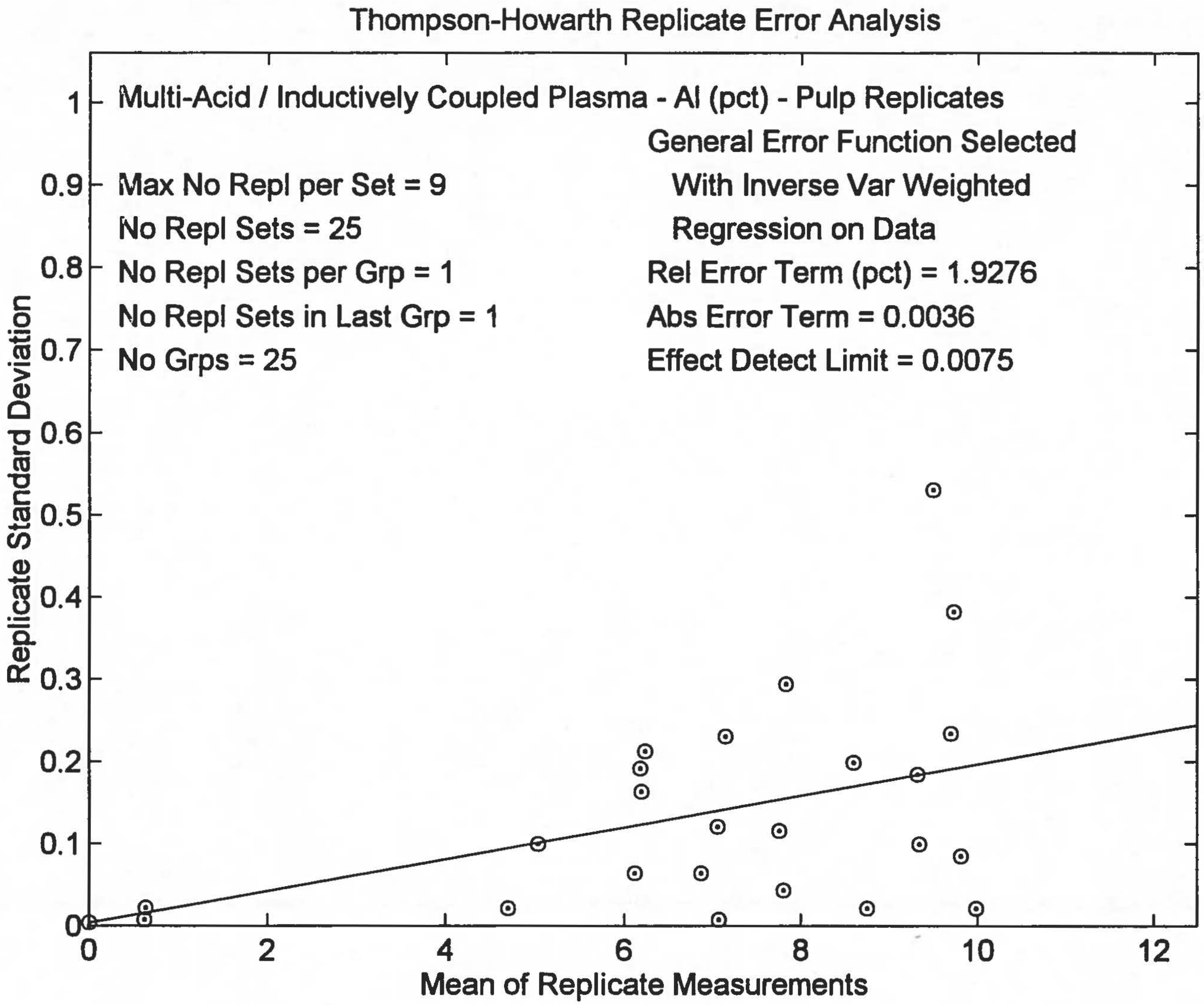

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Ba (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 3.0672
Abs Error Term = 0.0000
Effect Detect Limit = 0.0000
Replicate Standard Deviation
0
50
100
150
200
250
300
350
400
450
500
0
500
1000
1500
2000
Mean of Replicate Measurements

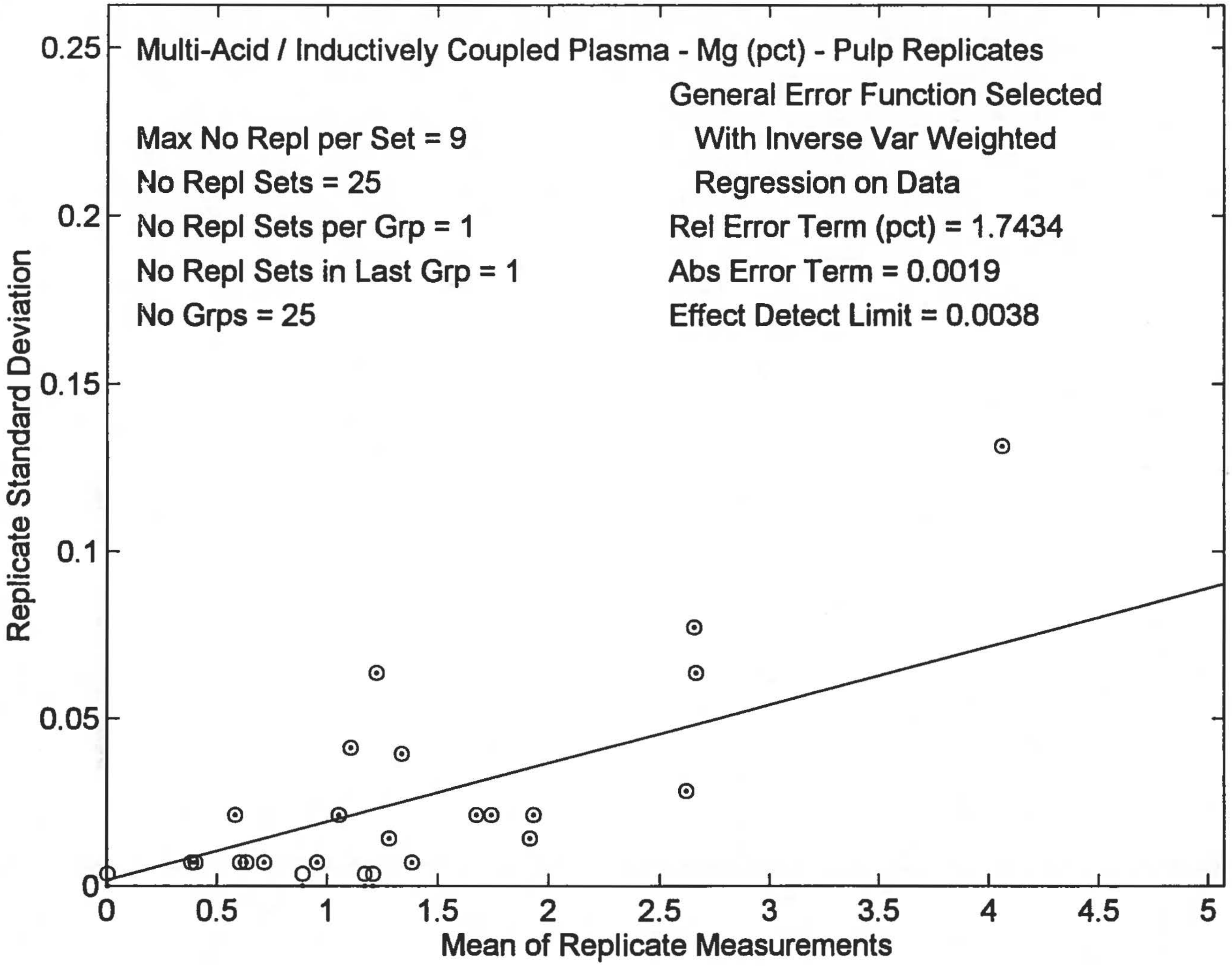

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Cr (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 2.9519
Abs Error Term = 3.0732
Effect Detect Limit = 6.5321
Replicate Standard Deviation
0
5
10
15
20
25
30
35
40
45
0
50
100
150
200
250
300
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - V (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 9
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 9
Rel Error Term (pct) = 1.5130
Abs Error Term = 0.0458
Effect Detect Limit = 0.0945
Replicate Standard Deviation
0
1
2
3
4
5
6
7
8
9
Mean of Replicate Measurements
0
50
100
150
200
250


Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - W (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 9
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 9
Rel Error Term (pct) = 2.8284
Abs Error Term = 0.0707
Effect Detect Limit = 0.1499
Replicate Standard Deviation
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
5
10
15
20
25
Mean of Replicate Measurements

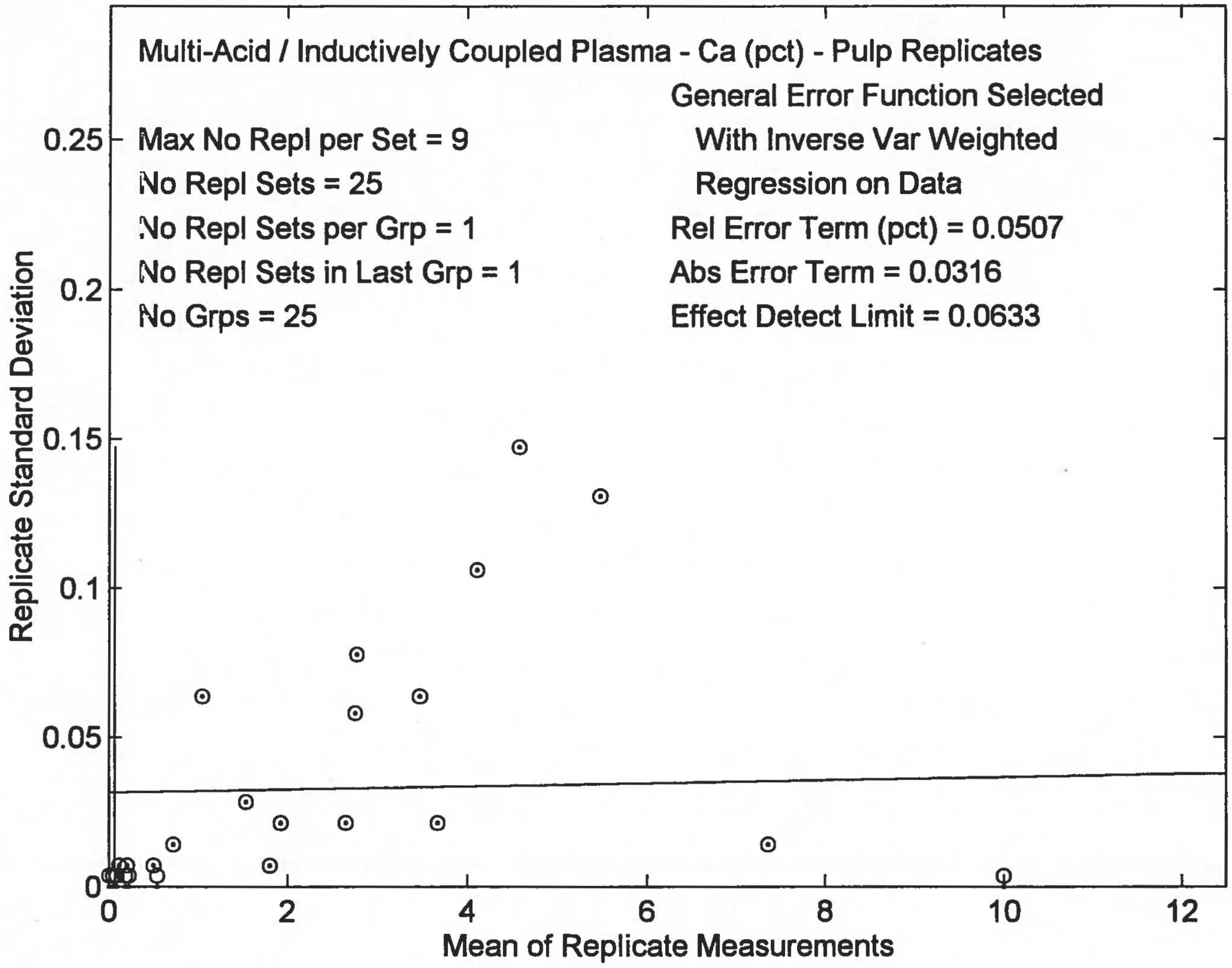

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - La (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 0.6153
Abs Error Term = 0.8243
Effect Detect Limit = 1.6691
Replicate Standard Deviation
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80
Mean of Replicate Measurements

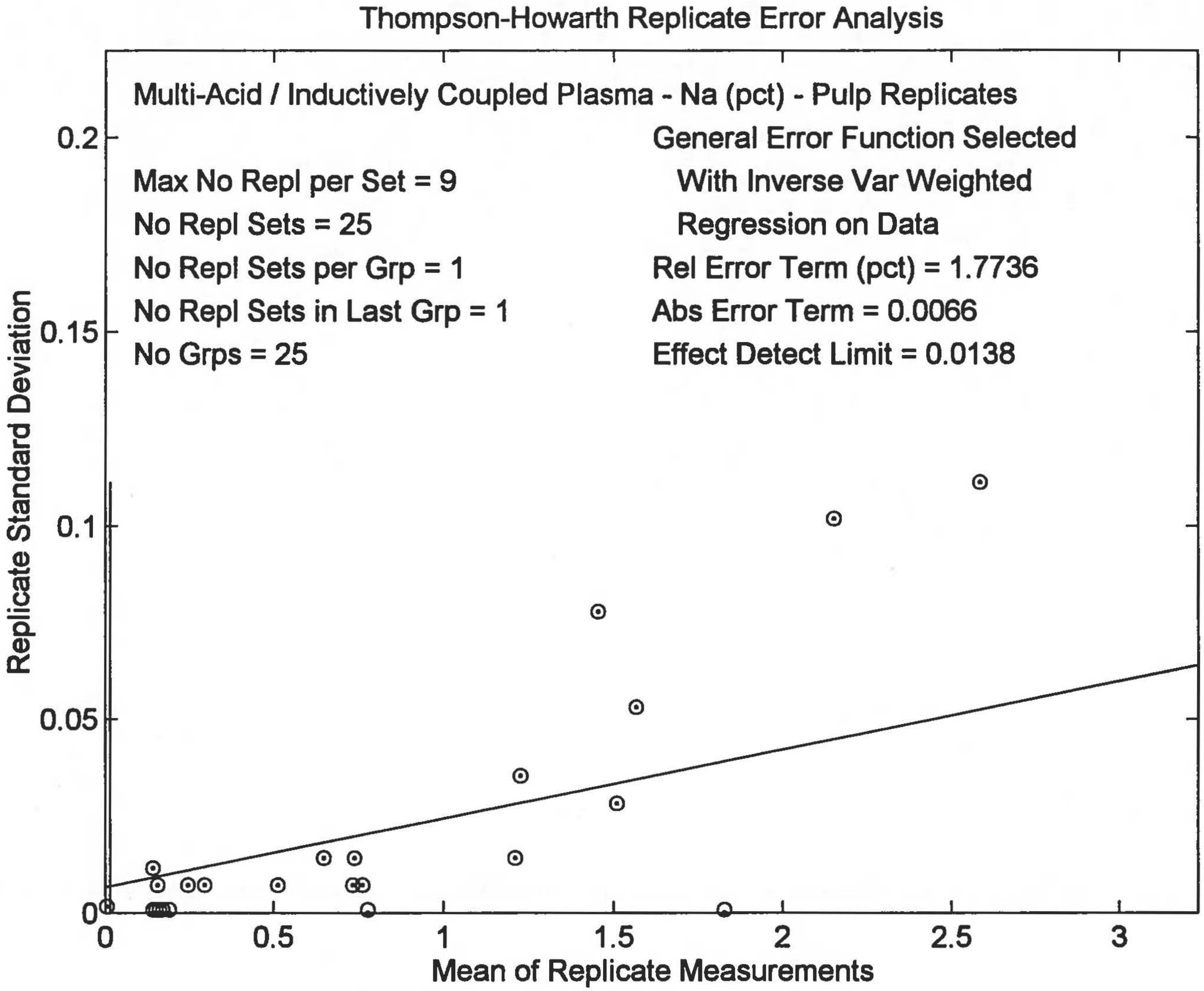

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Al (pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 1.9276
Abs Error Term = 0.0036
Effect Detect Limit = 0.0075
Replicate Standard Deviation
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Mean of Replicate Measurements
0
2
4
6
8
10
12

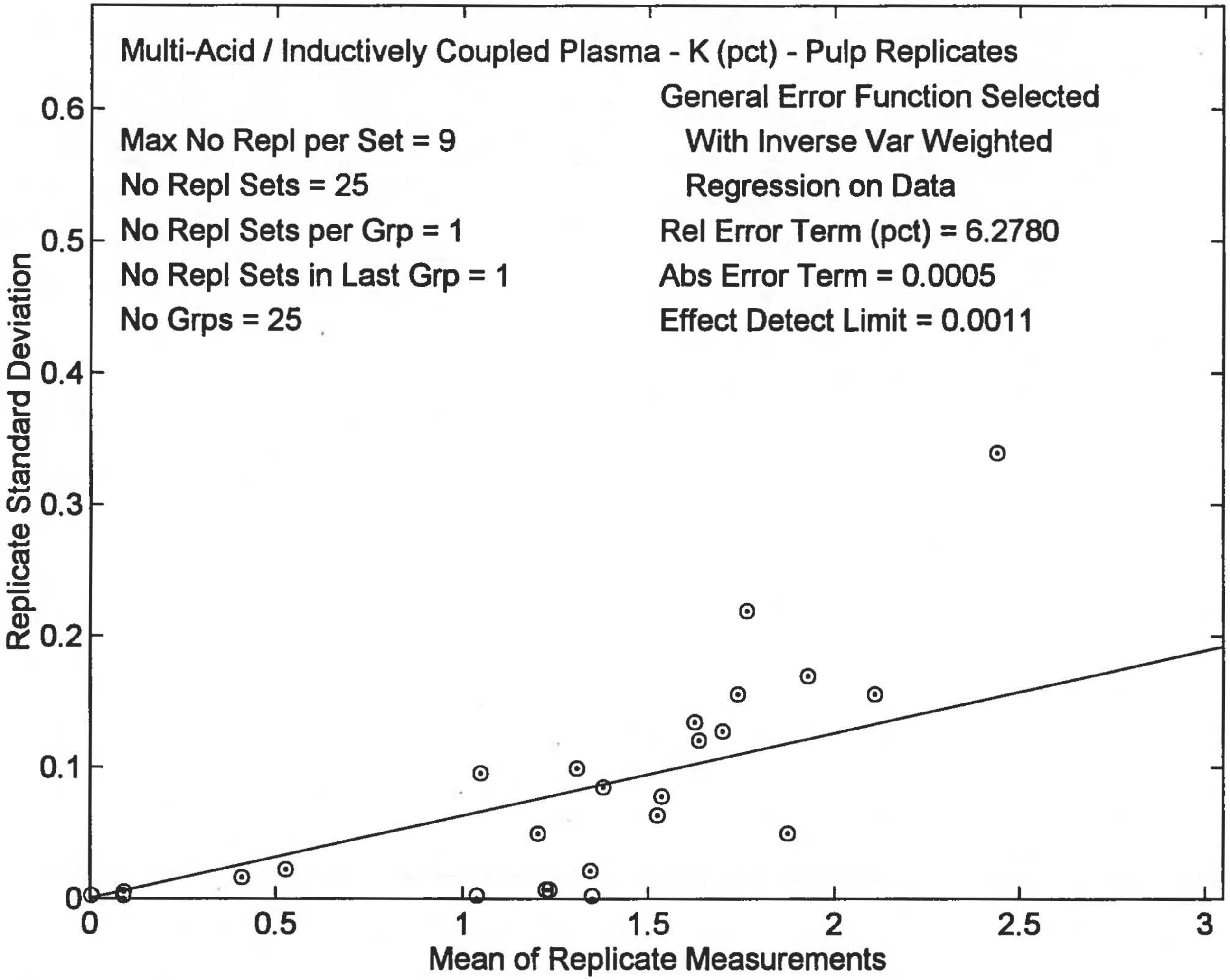


Thompson-Howarth Replicate Error Analysis

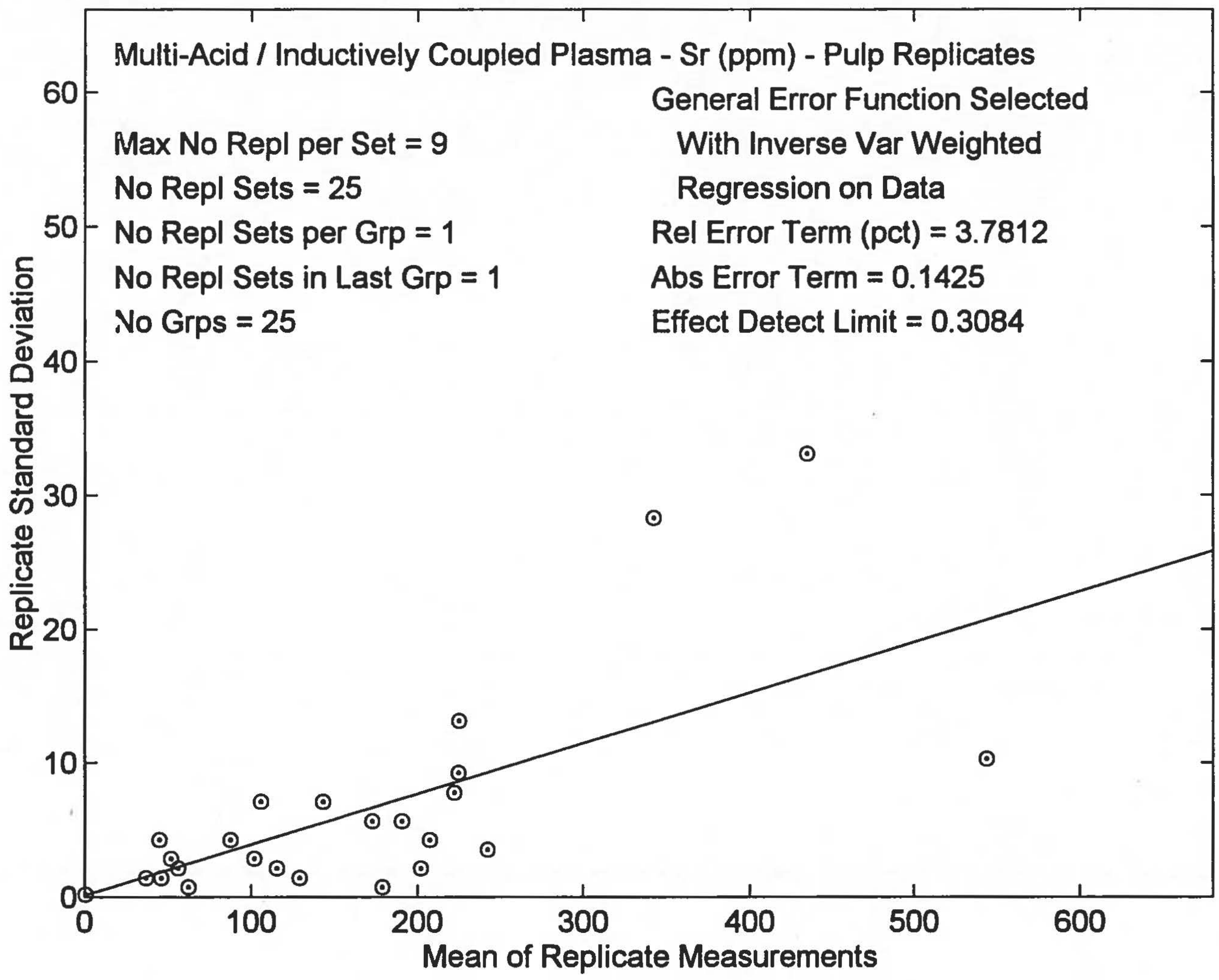
Thompson-Howarth Replicate Error Analysis



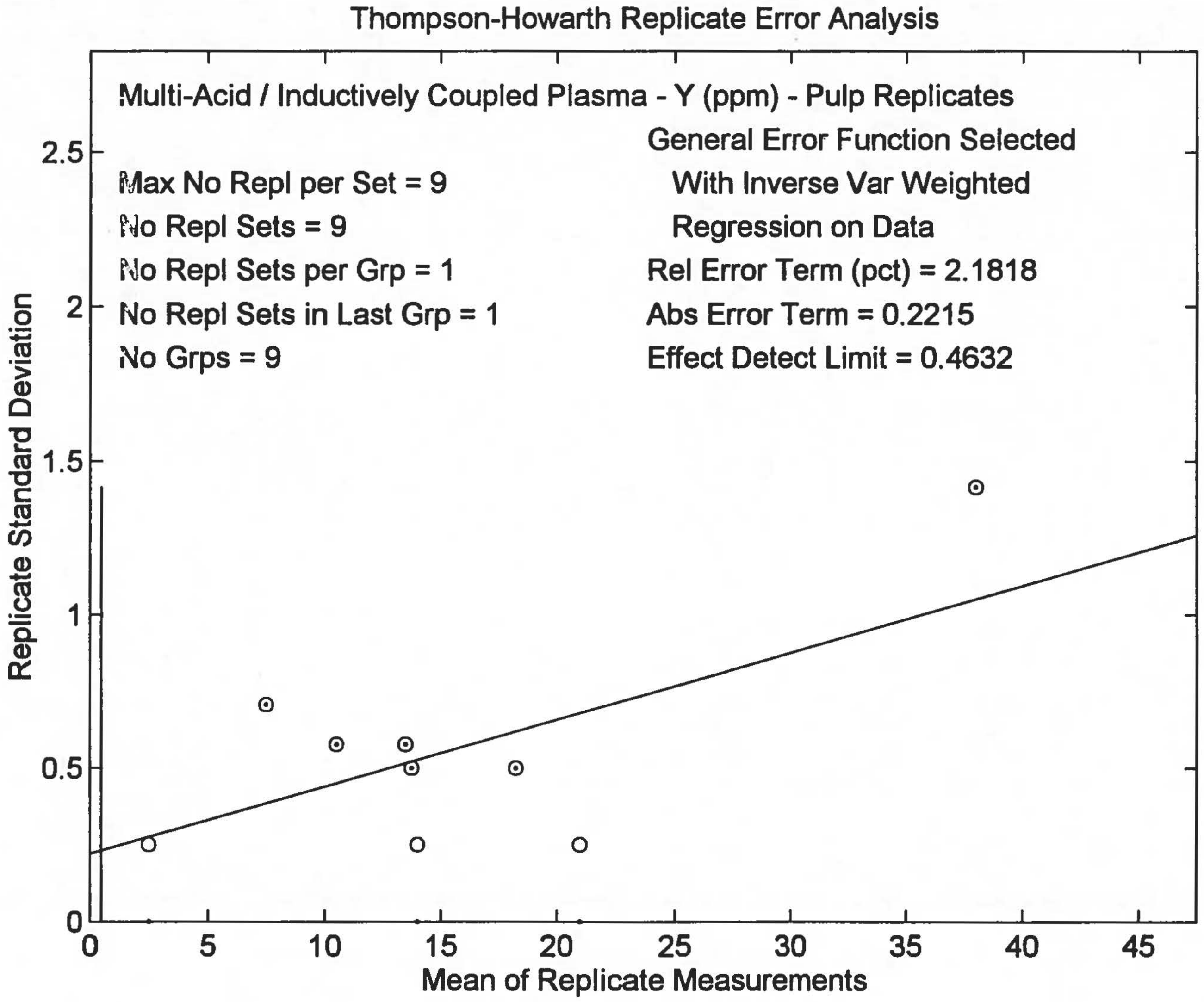

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Na (pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 1.7736
Abs Error Term = 0.0066
Effect Detect Limit = 0.0138
Replicate Standard Deviation
0
0.05
0.1
0.15
0.2
0
0.5
1
1.5
2
2.5
3
Mean of Replicate Measurements

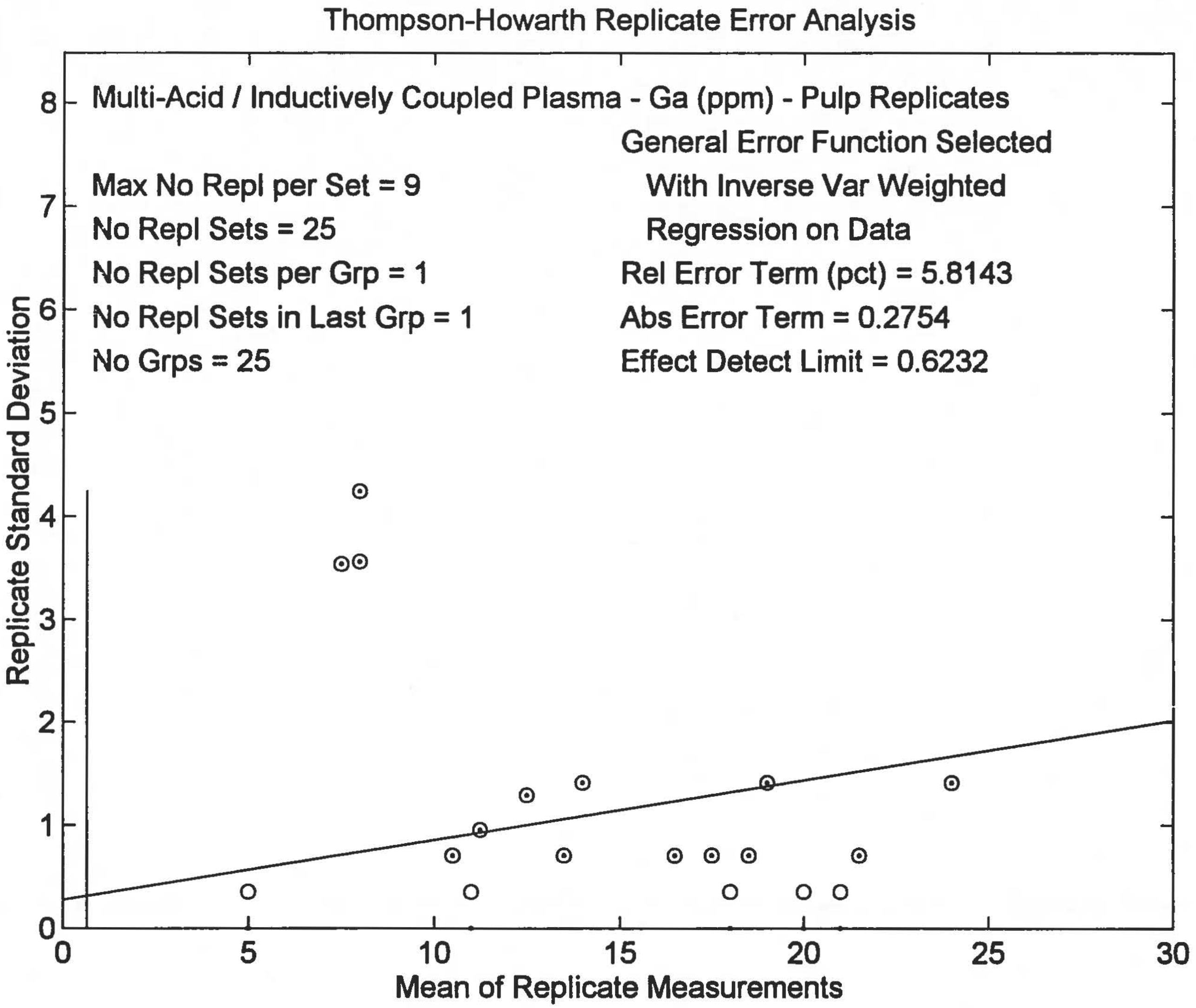


Thompson-Howarth Replicate Error Analysis

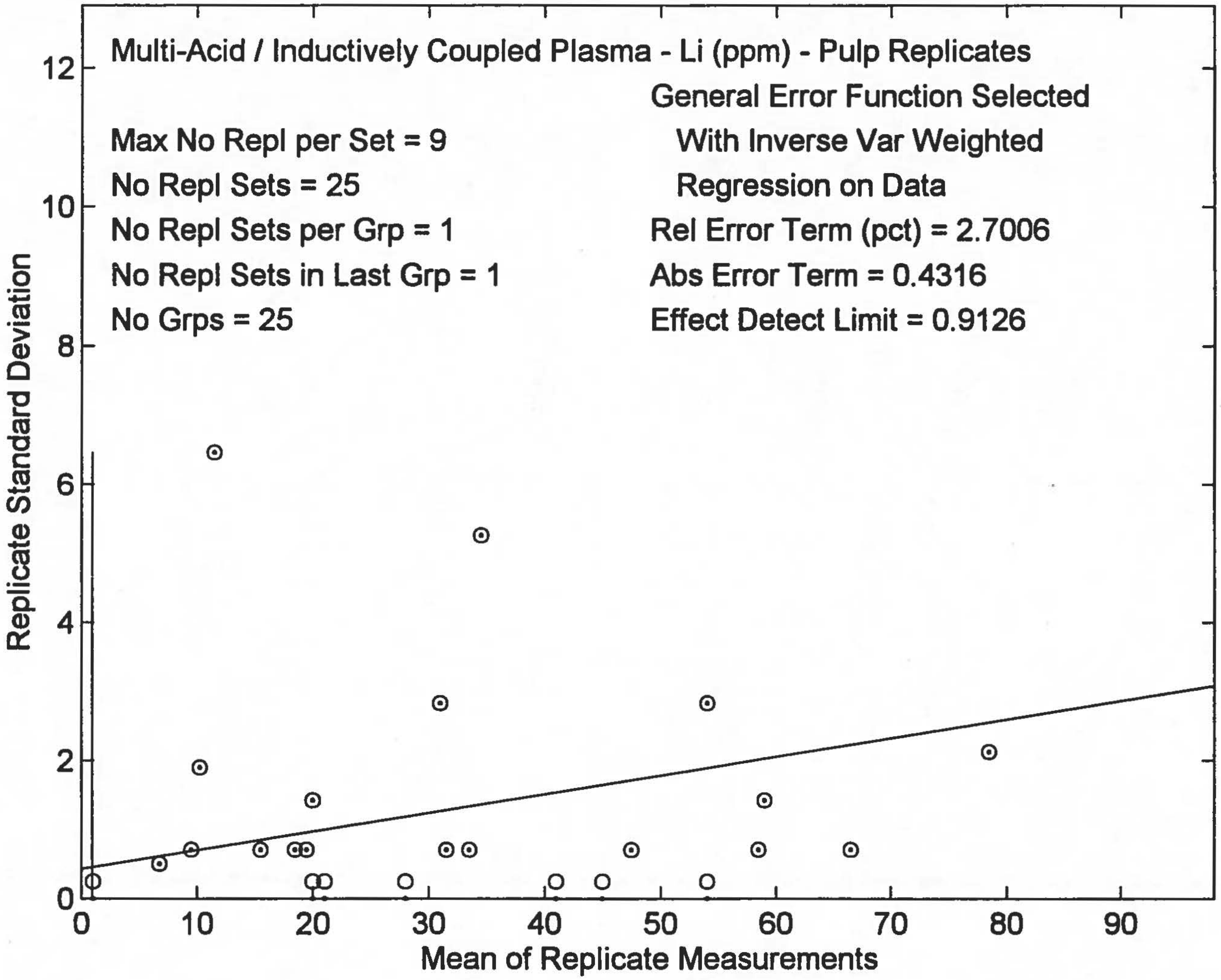


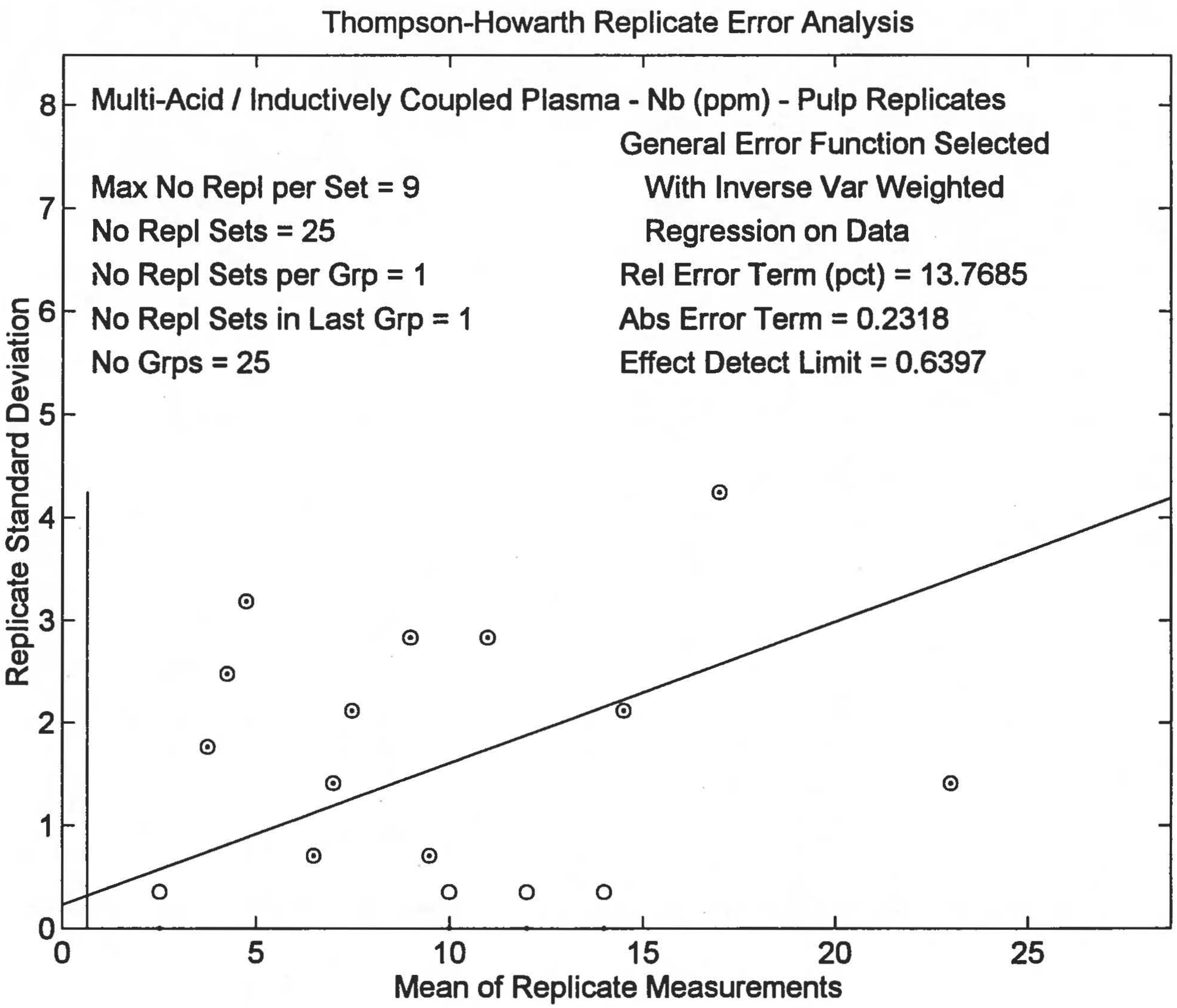
Thompson-Howarth Replicate Error Analysis

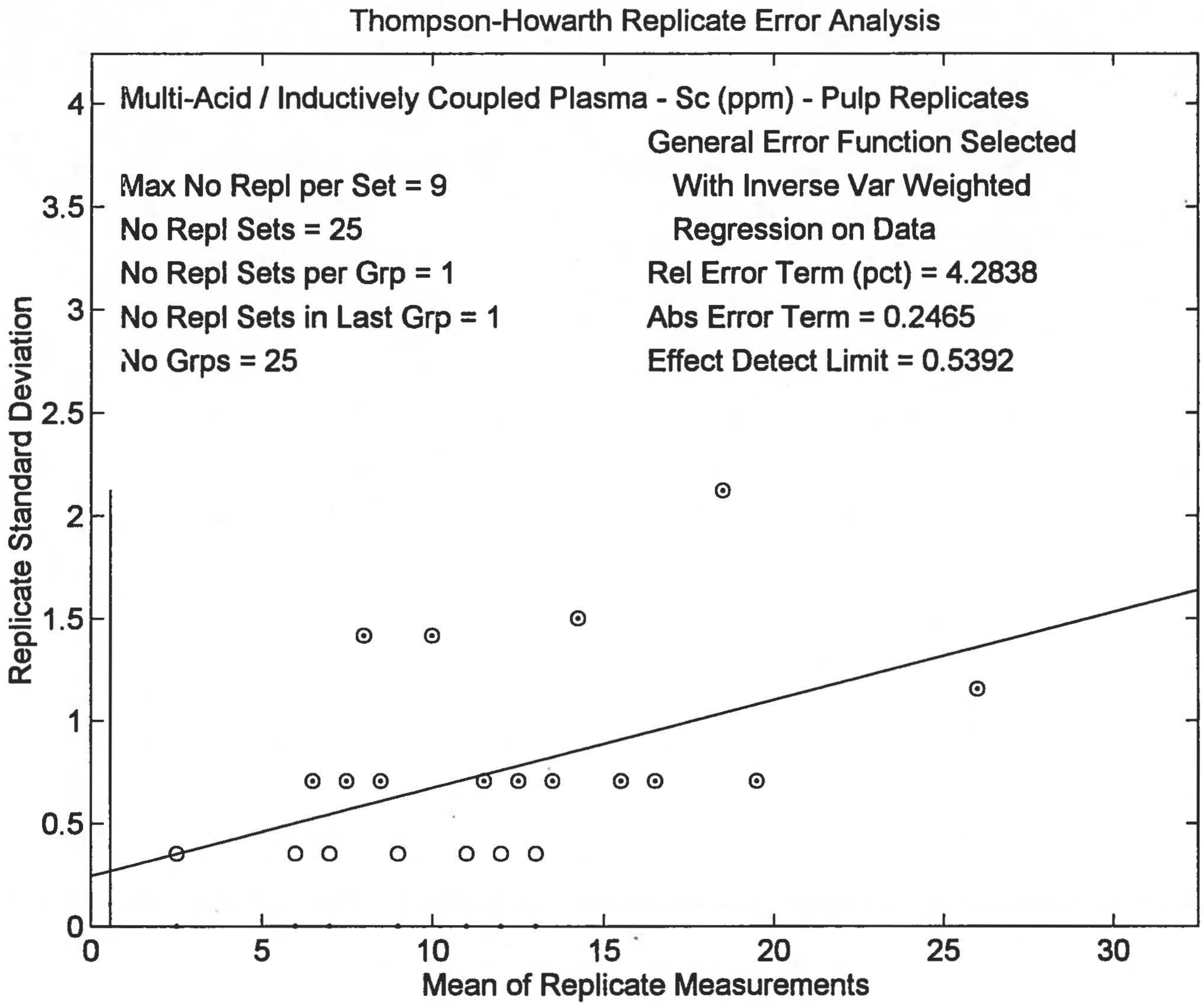

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Y (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 9
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 9
Rel Error Term (pct) = 2.1818
Abs Error Term = 0.2215
Effect Detect Limit = 0.4632
Replicate Standard Deviation
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25
30
35
40
45
Mean of Replicate Measurements

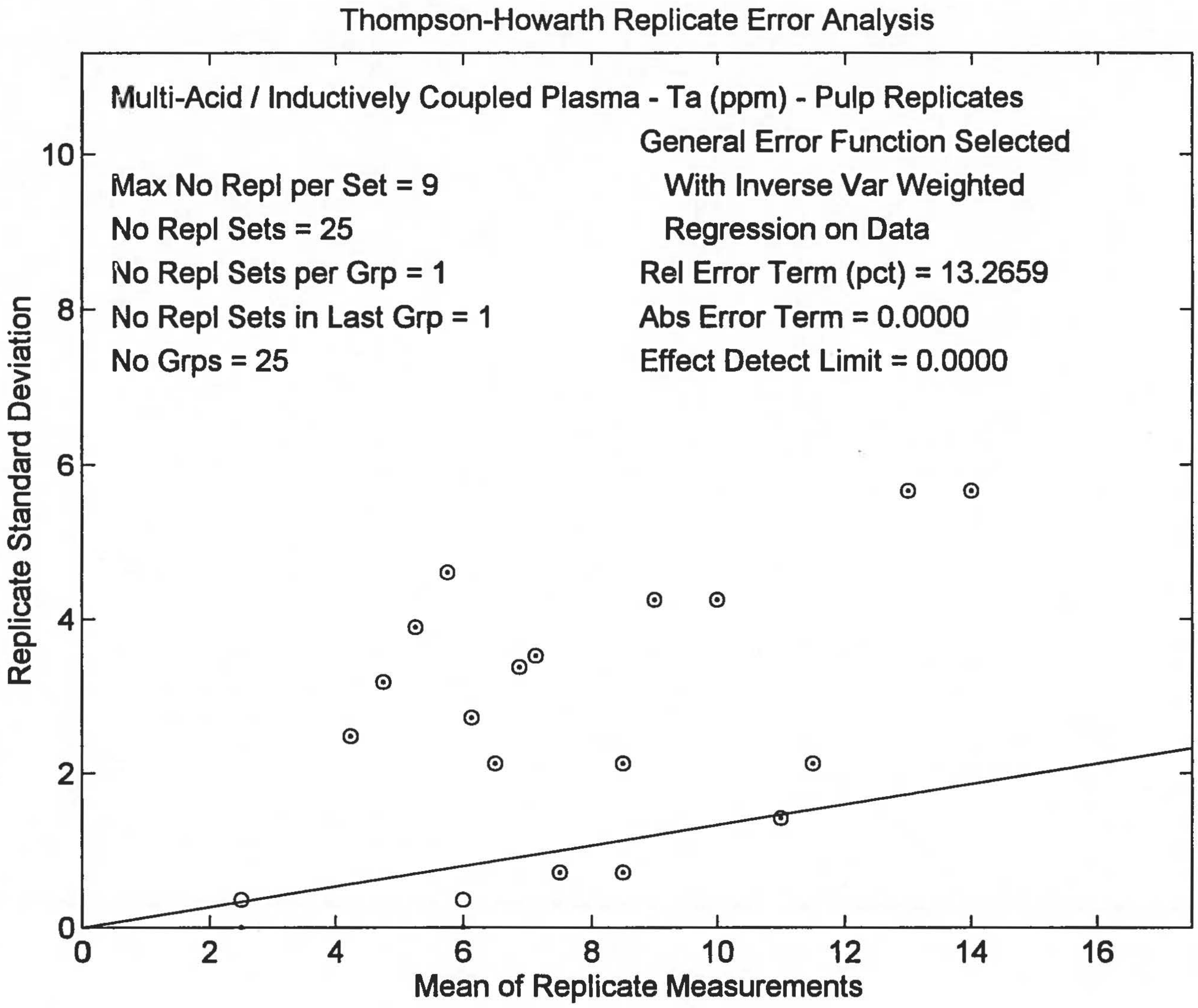

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Ga (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 5.8143
Abs Error Term = 0.2754
Effect Detect Limit = 0.6232
Replicate Standard Deviation
0
1
2
3
4
5
6
7
8
Mean of Replicate Measurements
0
5
10
15
20
25
30

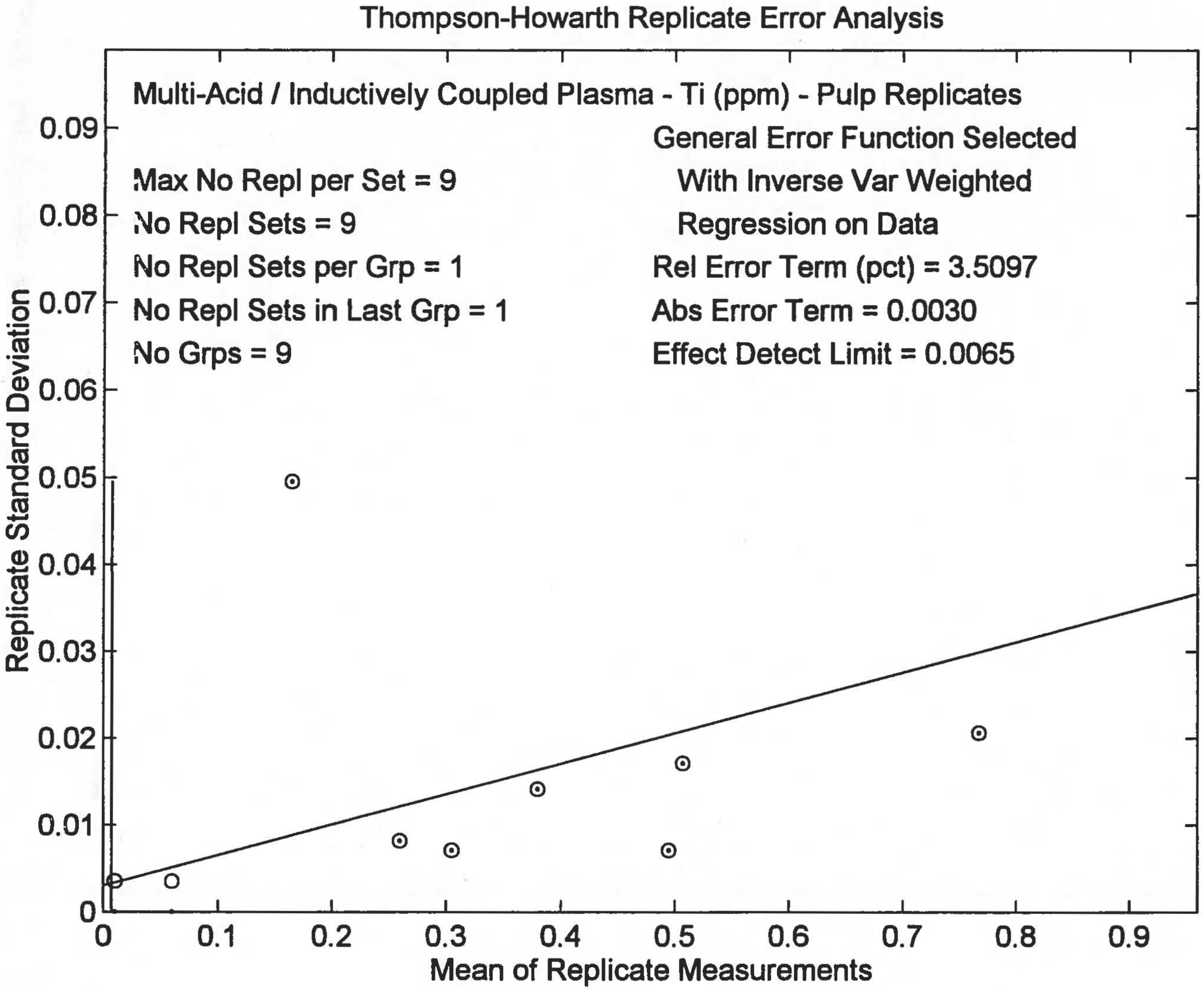
Thompson-Howarth Replicate Error Analysis

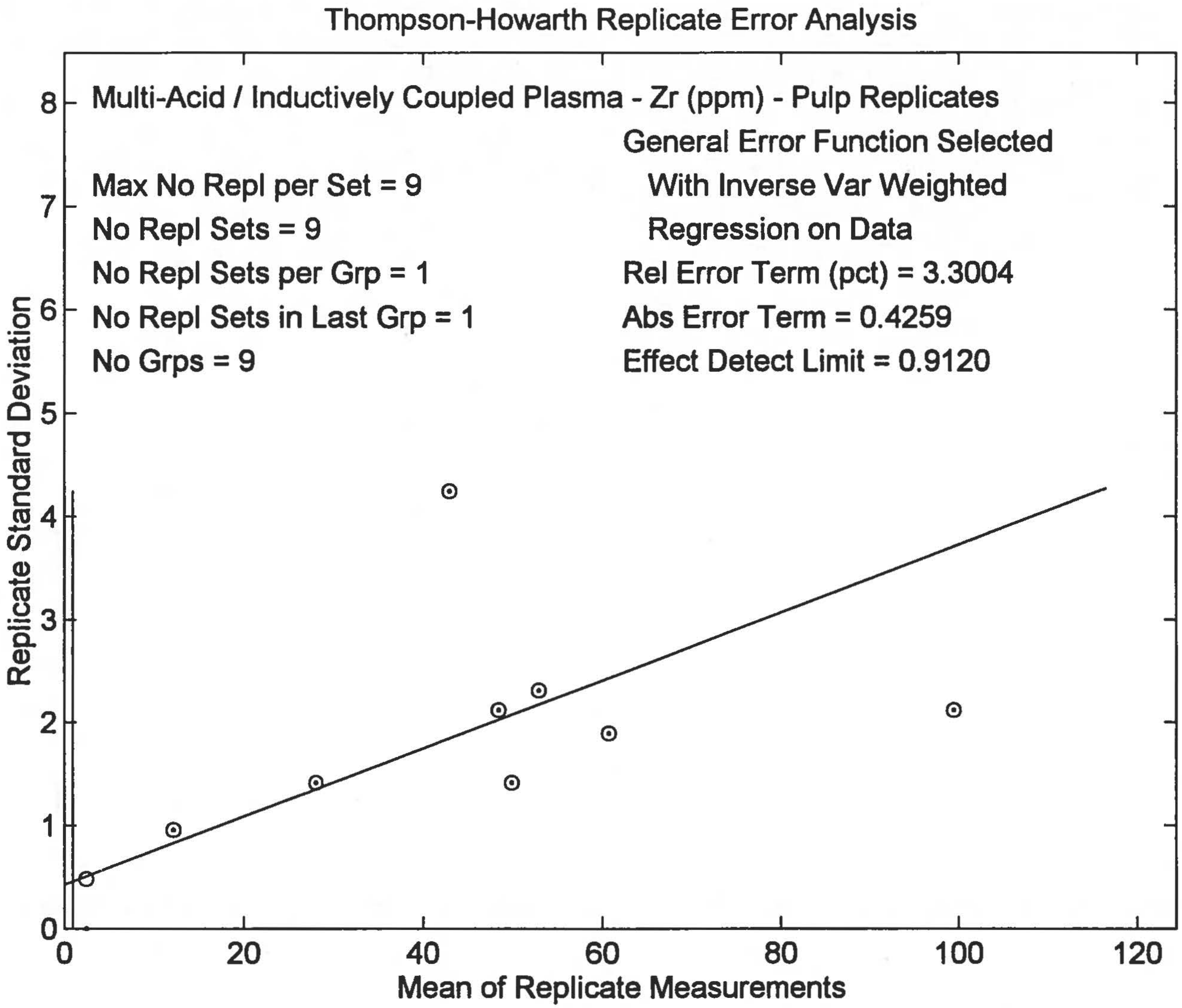


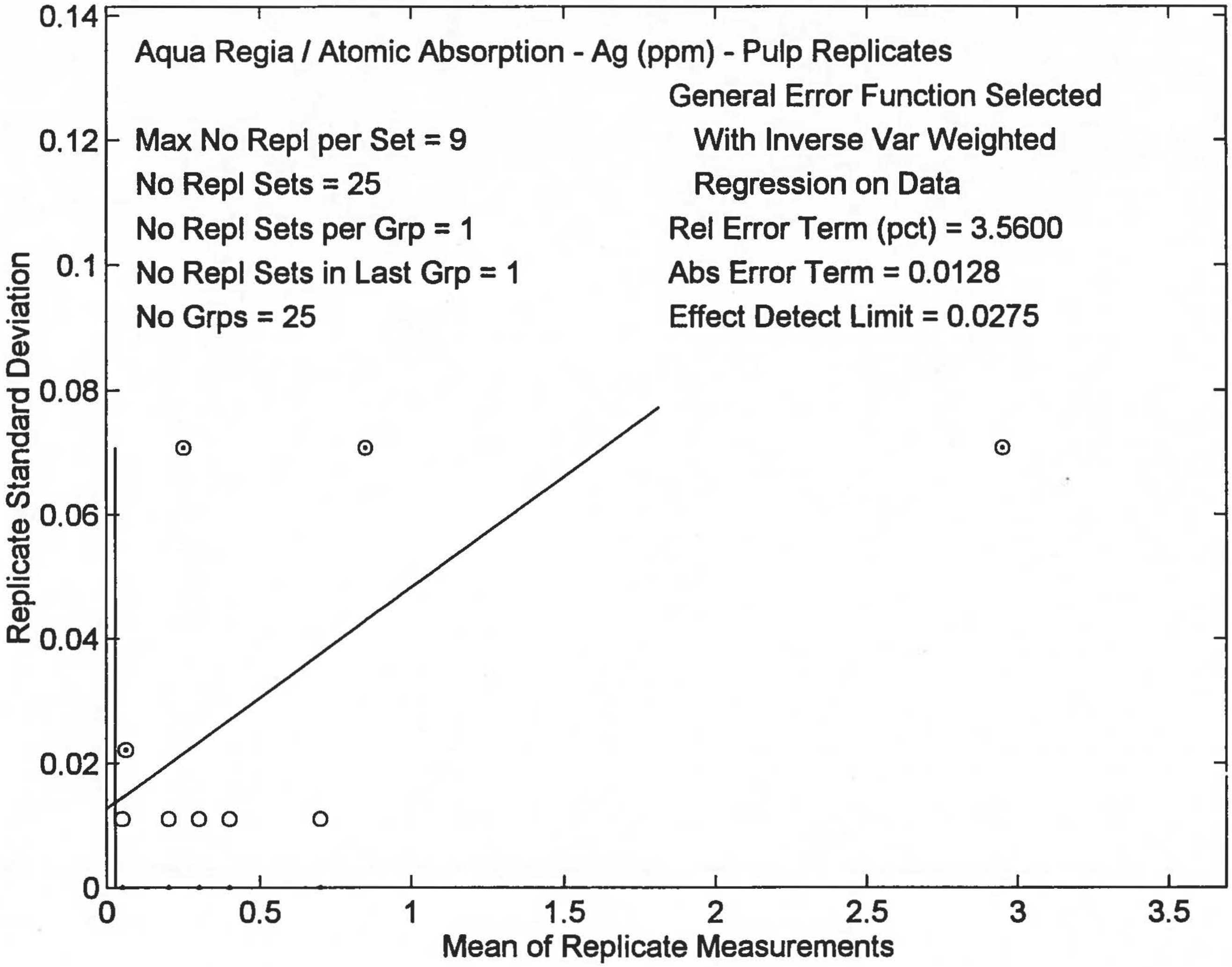

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Nb (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 13.7685
Abs Error Term = 0.2318
Effect Detect Limit = 0.6397
Replicate Standard Deviation
0
1
2
3
4
5
6
7
8
0
5
10
15
20
25
Mean of Replicate Measurements

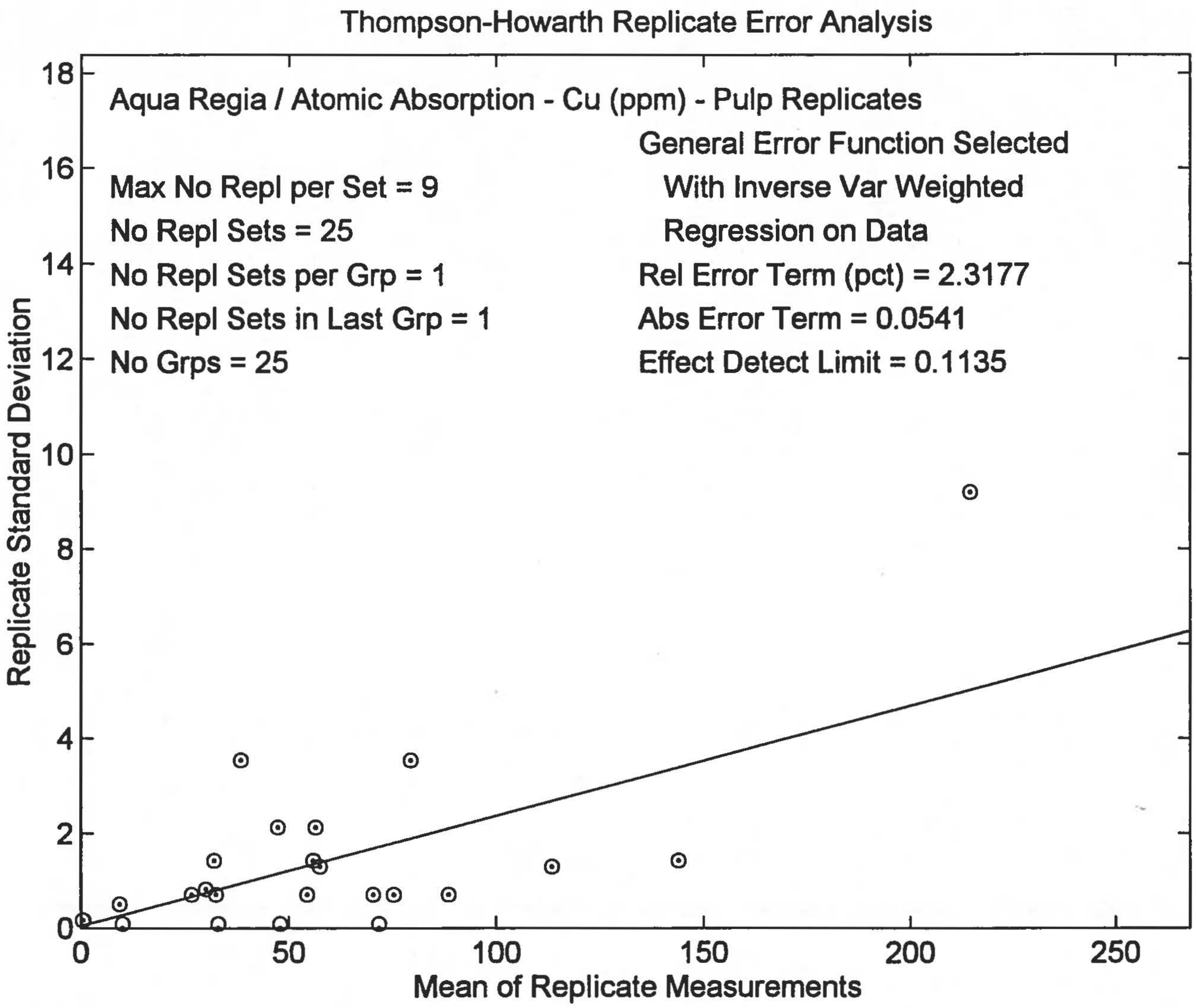

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Sc (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 4.2838
Abs Error Term = 0.2465
Effect Detect Limit = 0.5392
Replicate Standard Deviation
0
0.5
1
1.5
2
2.5
3
3.5
4
Mean of Replicate Measurements
0
5
10
15
20
25
30

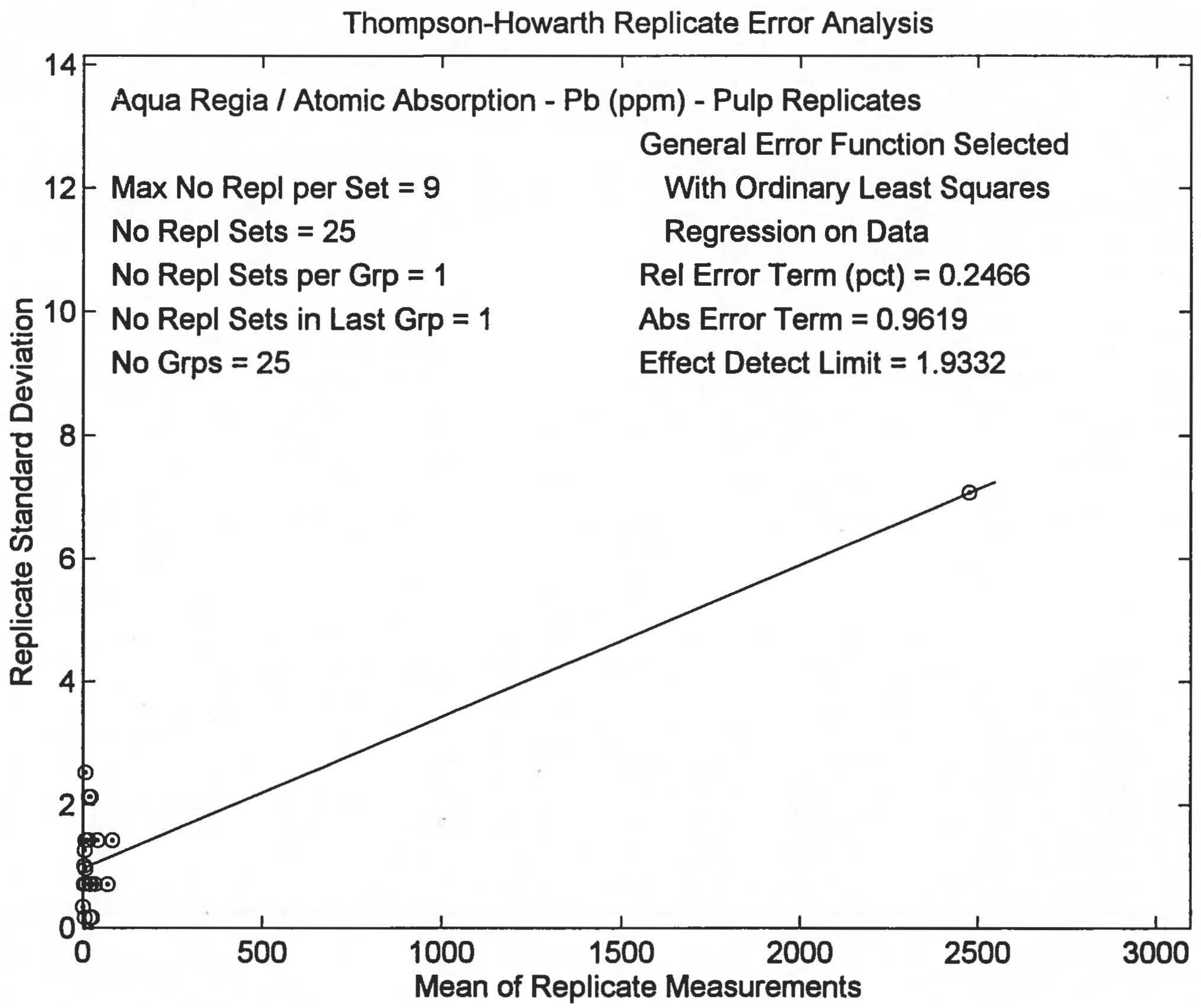

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Ta (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 13.2659
Abs Error Term = 0.0000
Effect Detect Limit = 0.0000
Replicate Standard Deviation
0
2
4
6
8
10
Mean of Replicate Measurements
0
2
4
6
8
10
12
14
16

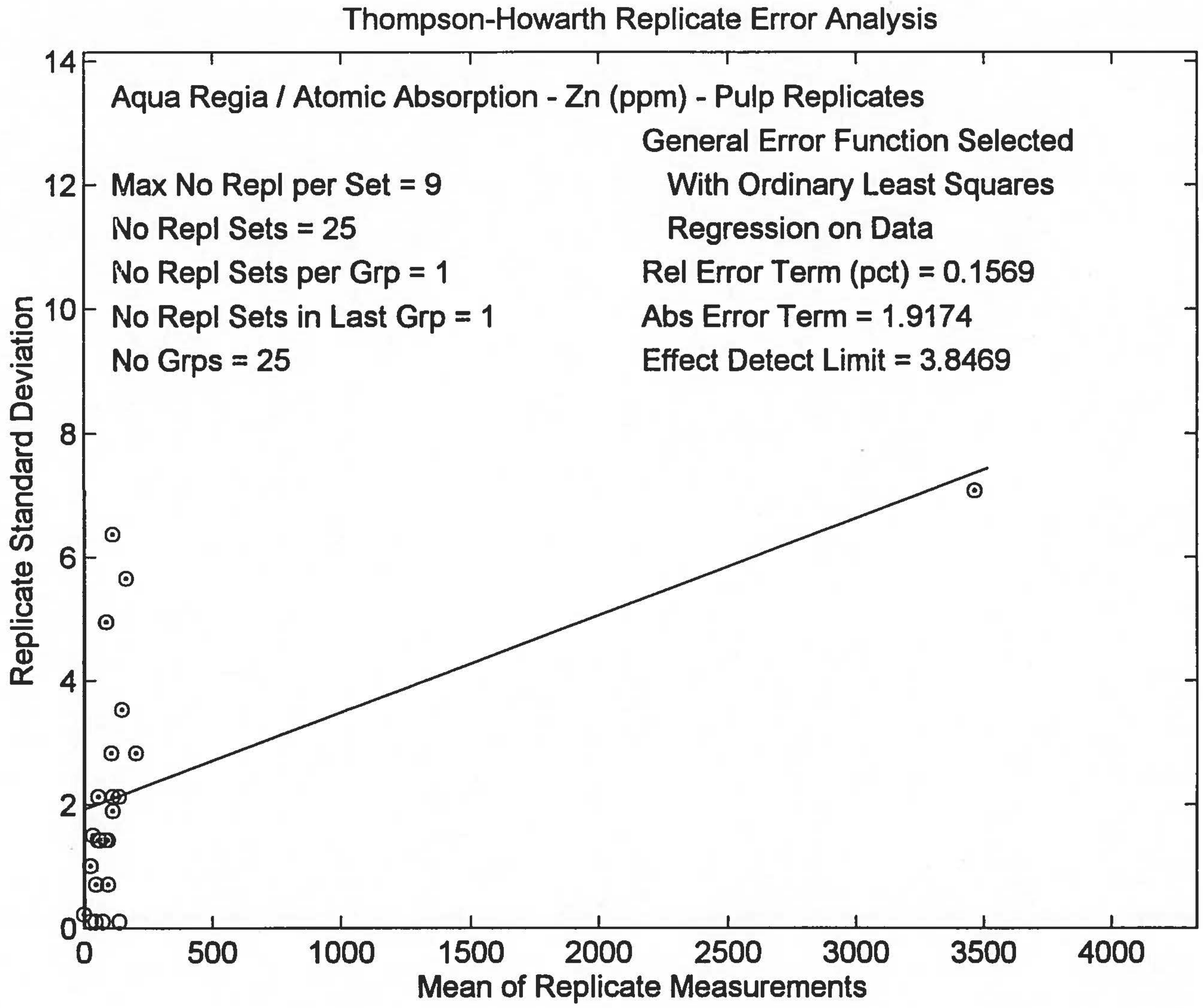

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Ti (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 9
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 9
Rel Error Term (pct) = 3.5097
Abs Error Term = 0.0030
Effect Detect Limit = 0.0065
Replicate Standard Deviation
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Mean of Replicate Measurements

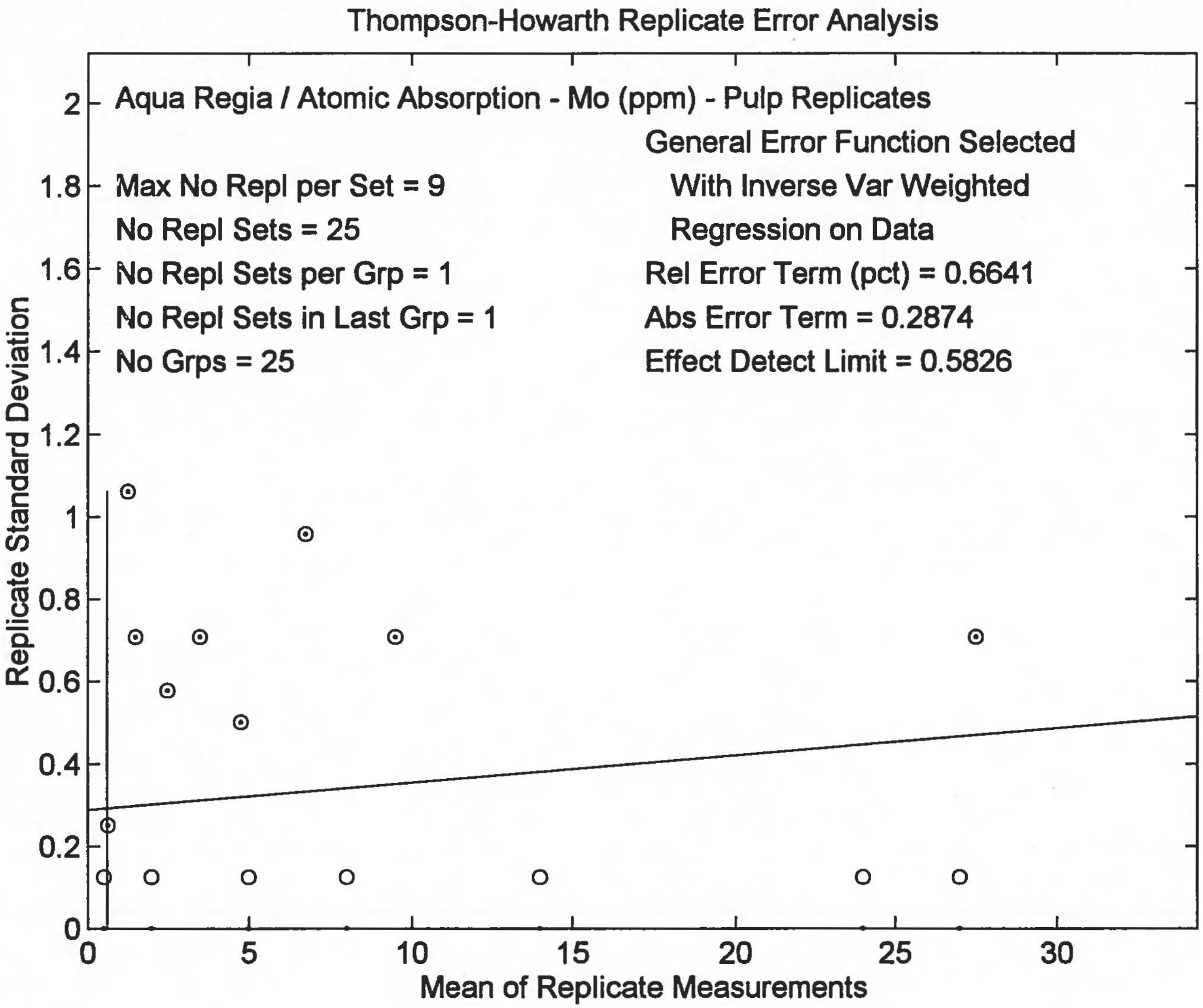

Thompson-Howarth Replicate Error Analysis
Multi-Acid / Inductively Coupled Plasma - Zr (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 9
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 9
Rel Error Term (pct) = 3.3004
Abs Error Term = 0.4259
Effect Detect Limit = 0.9120
Replicate Standard Deviation
0
1
2
3
4
5
6
7
8
Mean of Replicate Measurements
0
20
40
60
80
100
120

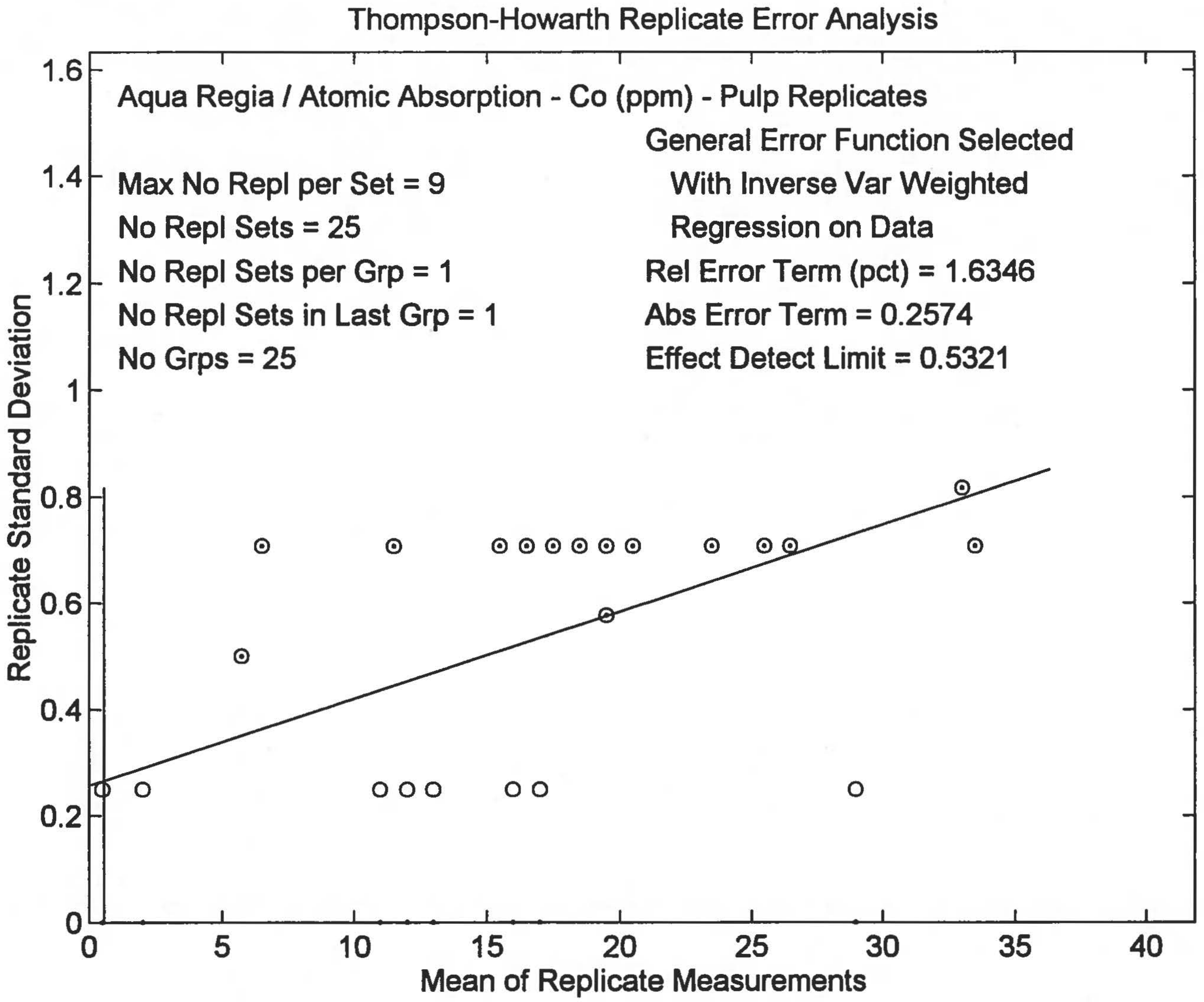

Thompson-Howarth Replicate Error Analysis

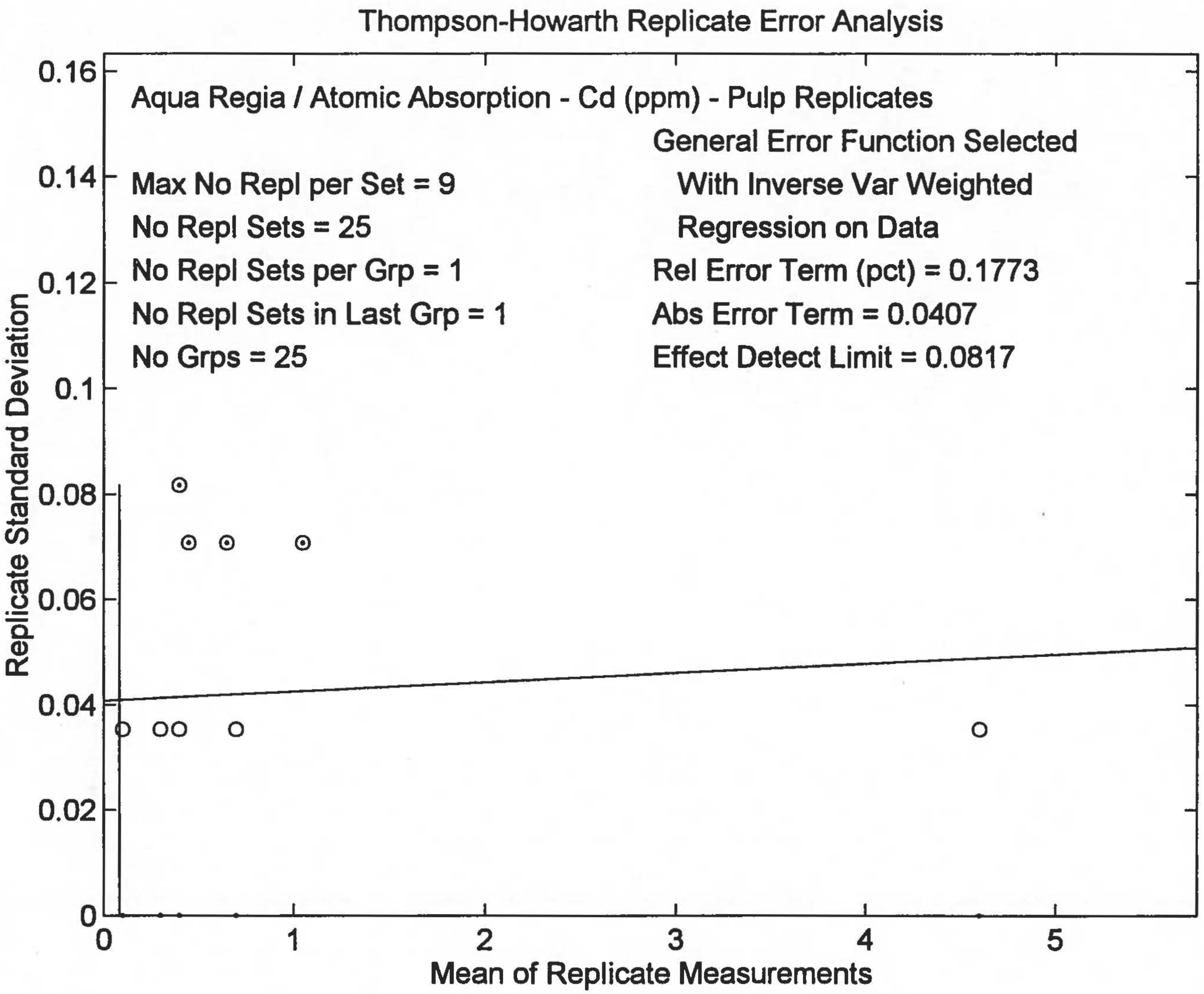

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Cu (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 2.3177
Abs Error Term = 0.0541
Effect Detect Limit = 0.1135
Replicate Standard Deviation
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
Mean of Replicate Measurements

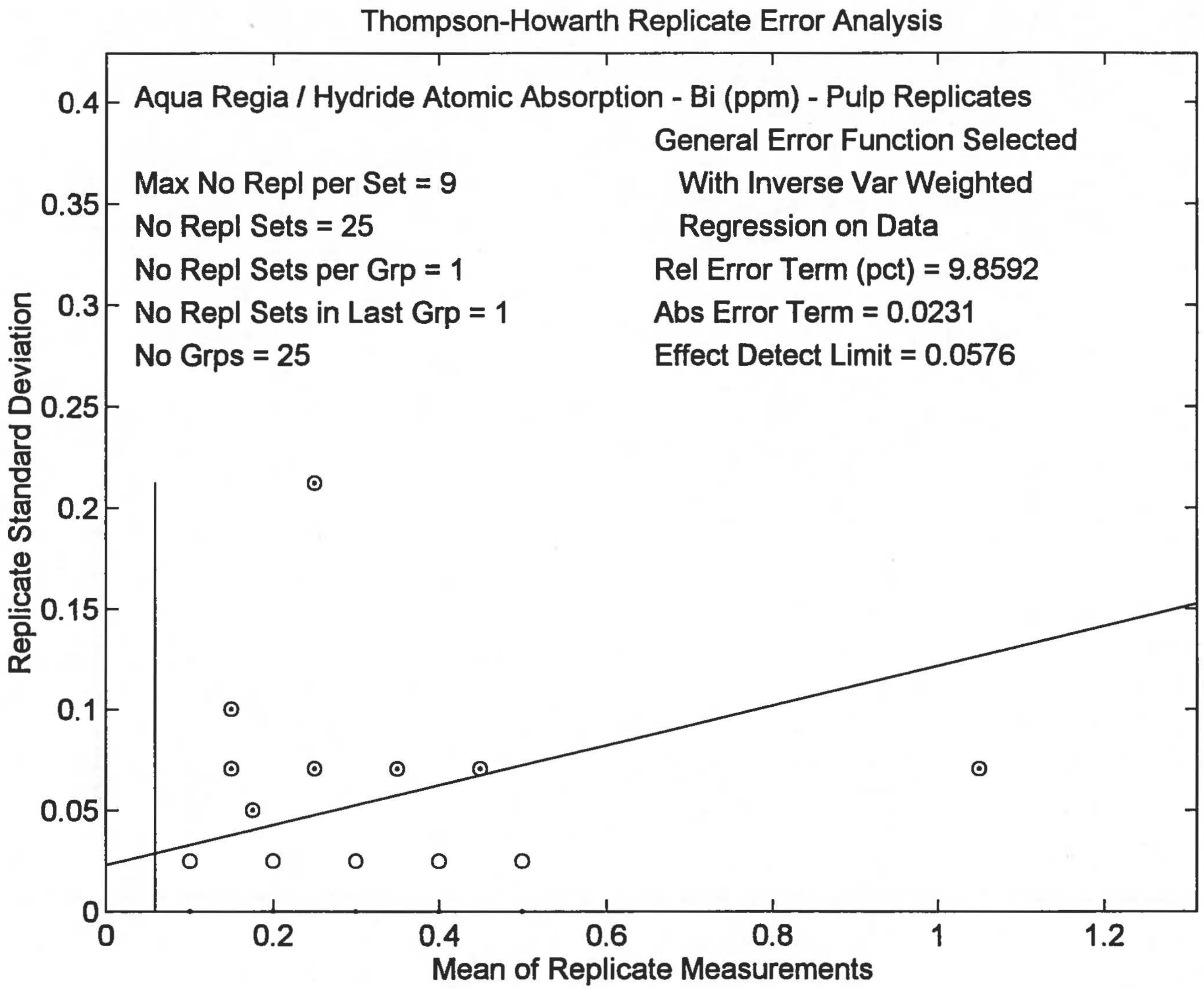

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Pb (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 0.2466
Abs Error Term = 0.9619
Effect Detect Limit = 1.9332
Replicate Standard Deviation
0
2
4
6
8
10
12
14
0
500
1000
1500
2000
2500
3000
Mean of Replicate Measurements

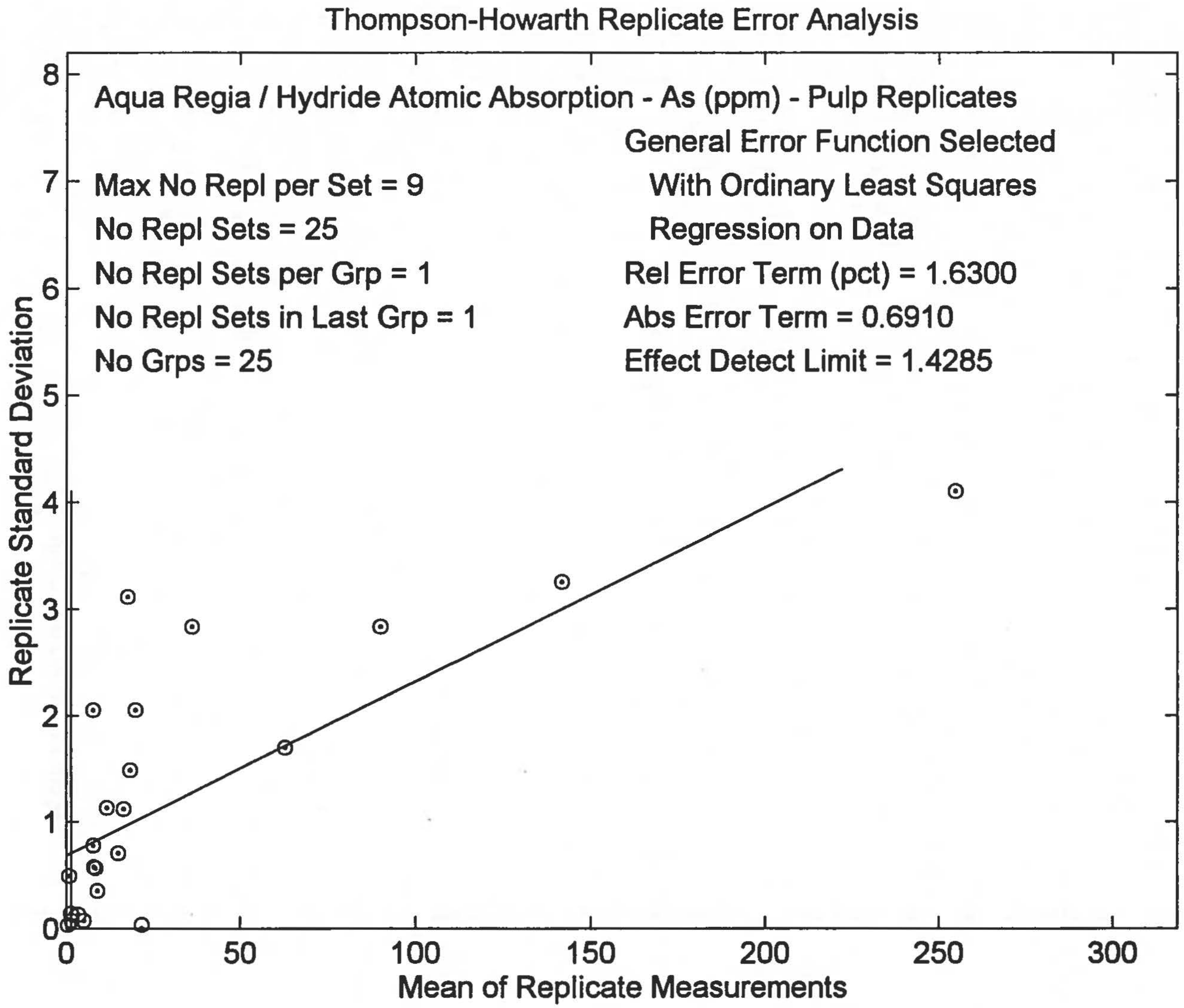

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Zn (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 0.1569
Abs Error Term = 1.9174
Effect Detect Limit = 3.8469
Replicate Standard Deviation
0
2
4
6
8
10
12
14
0
500
1000
1500
2000
2500
3000
3500
4000
Mean of Replicate Measurements

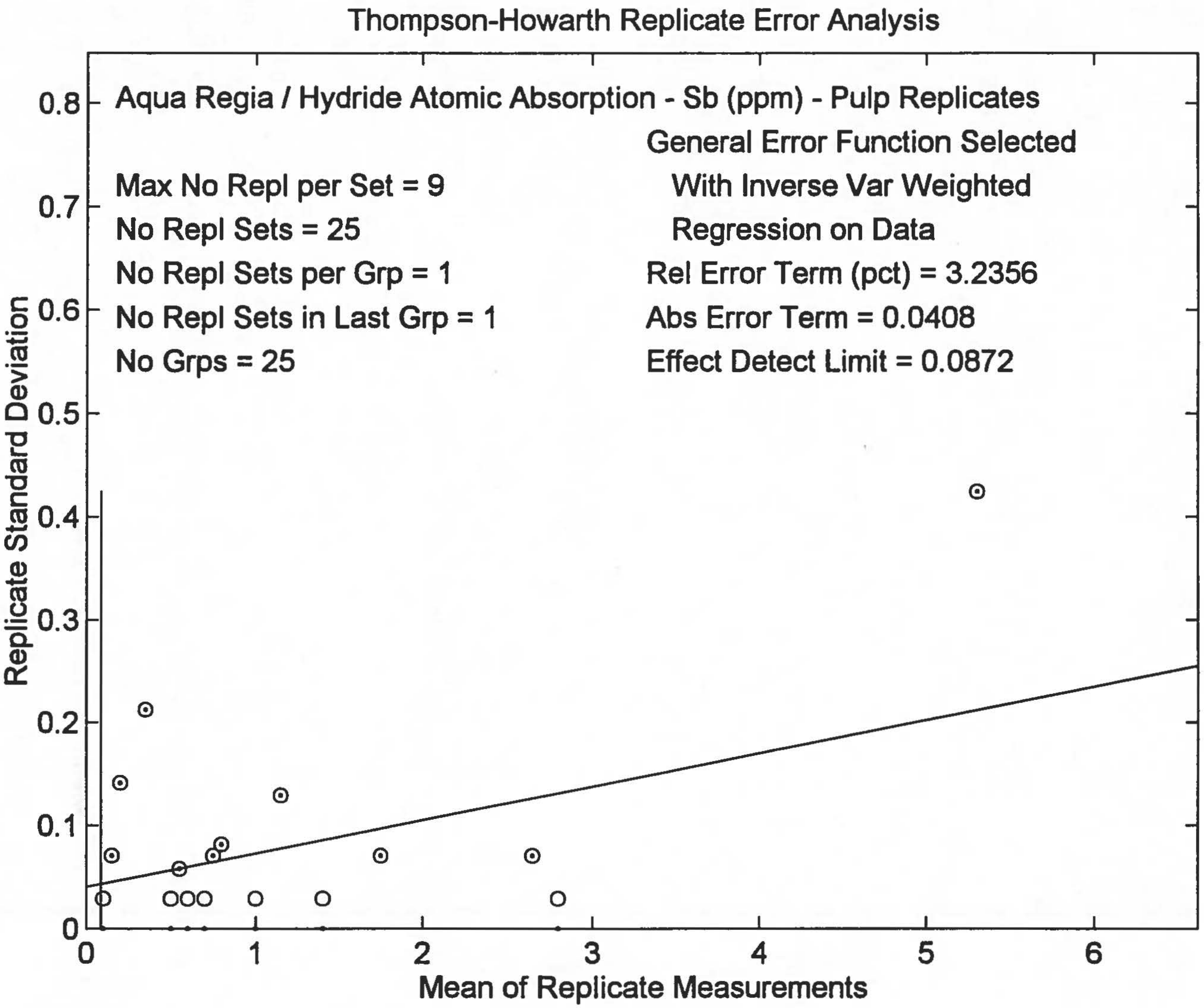

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Mo (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 0.6641
Abs Error Term = 0.2874
Effect Detect Limit = 0.5826
Replicate Standard Deviation
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
Mean of Replicate Measurements

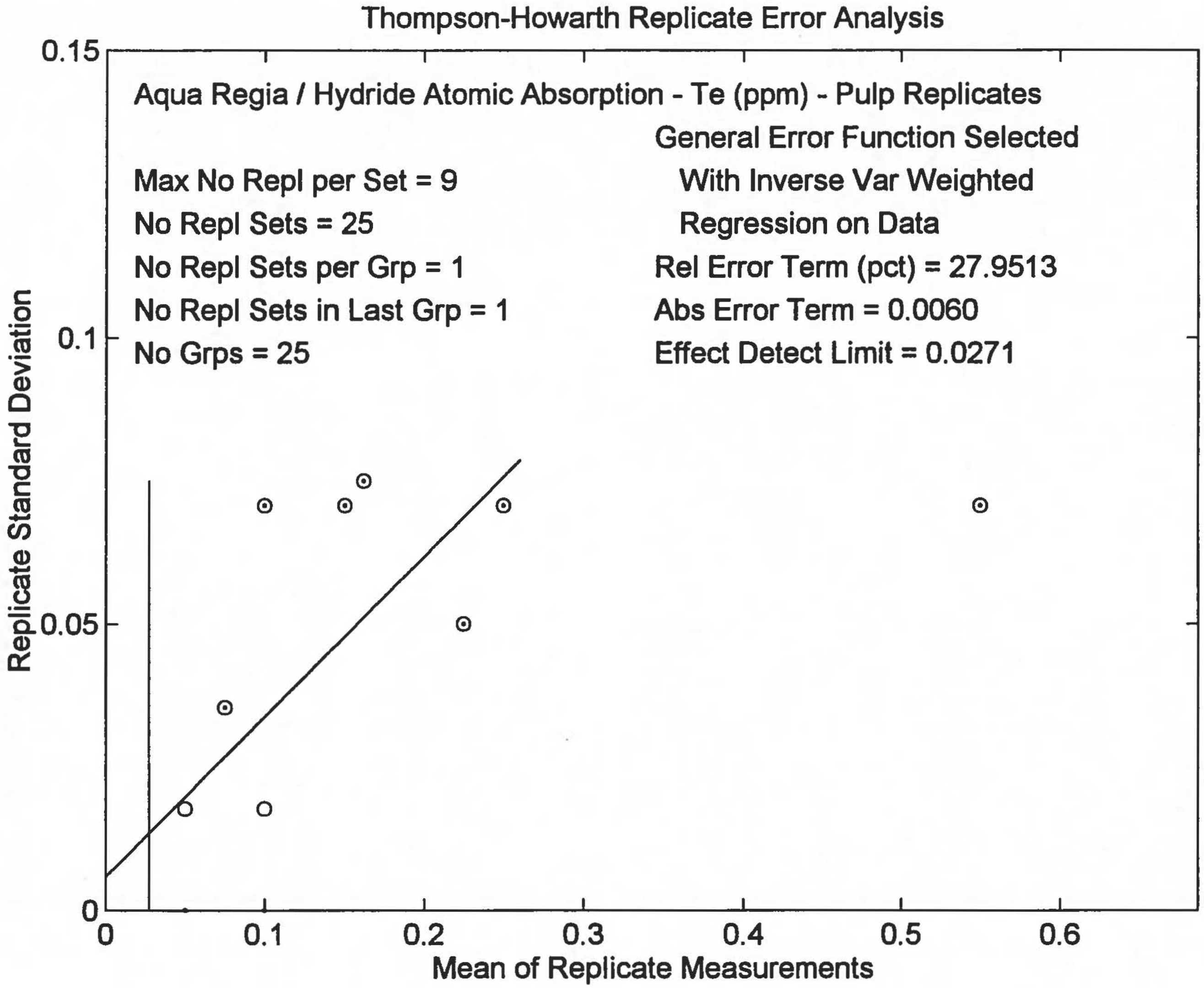

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Co (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 1.6346
Abs Error Term = 0.2574
Effect Detect Limit = 0.5321
Replicate Standard Deviation
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Mean of Replicate Measurements
0
5
10
15
20
25
30
35
40

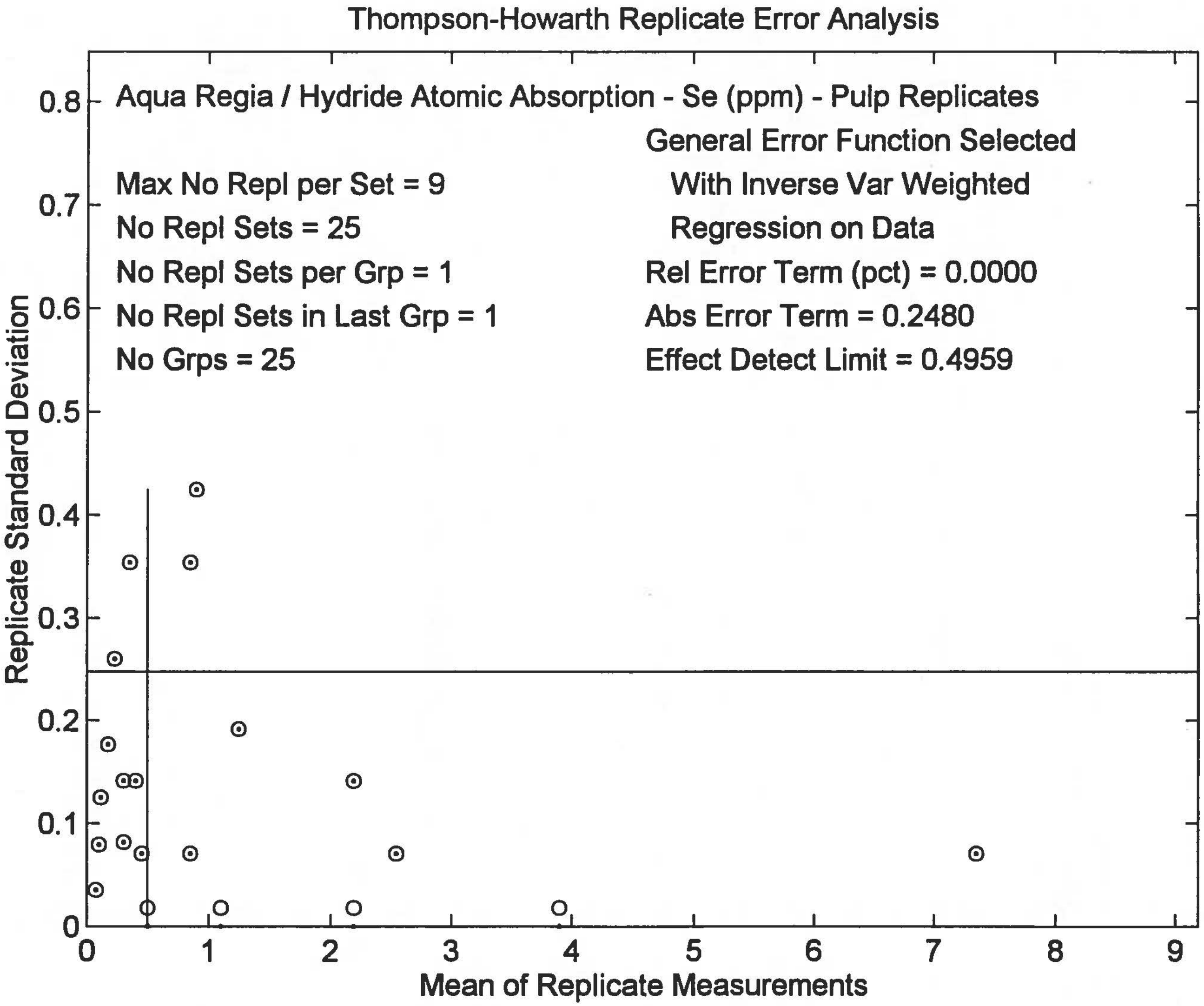

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Atomic Absorption - Cd (ppm) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Rel Error Term (pct) = 0.1773
Abs Error Term = 0.0407
Effect Detect Limit = 0.0817
Replicate Standard Deviation
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Aqua Regia / Hydride Atomic Absorption - Bi (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 9.8592
Abs Error Term = 0.0231
Effect Detect Limit = 0.0576
Replicate Standard Deviation
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Mean of Replicate Measurements
0
0.2
0.4
0.6
0.8
1
1.2

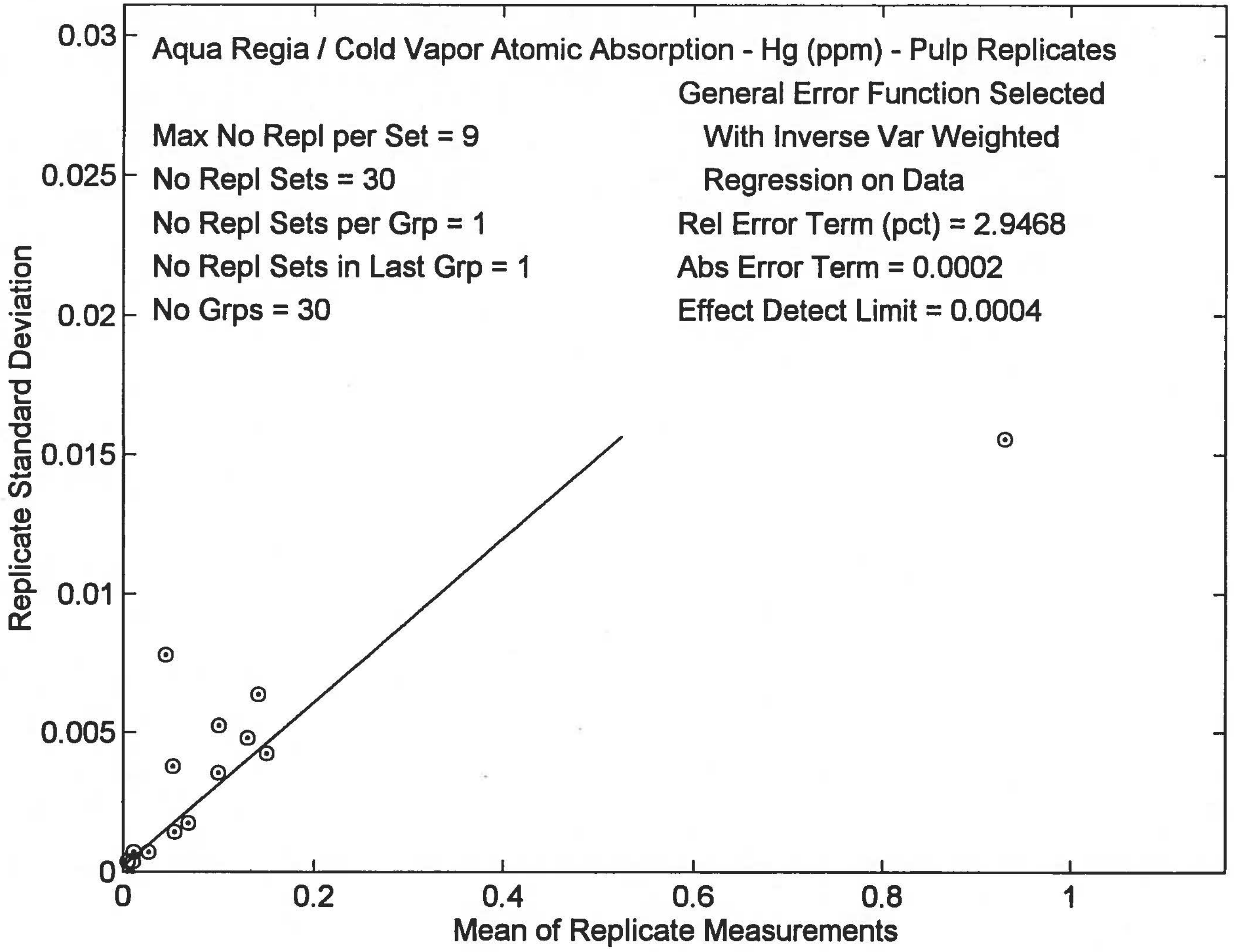

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Hydride Atomic Absorption - As (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 1.6300
Abs Error Term = 0.6910
Effect Detect Limit = 1.4285
Replicate Standard Deviation
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
300
Mean of Replicate Measurements

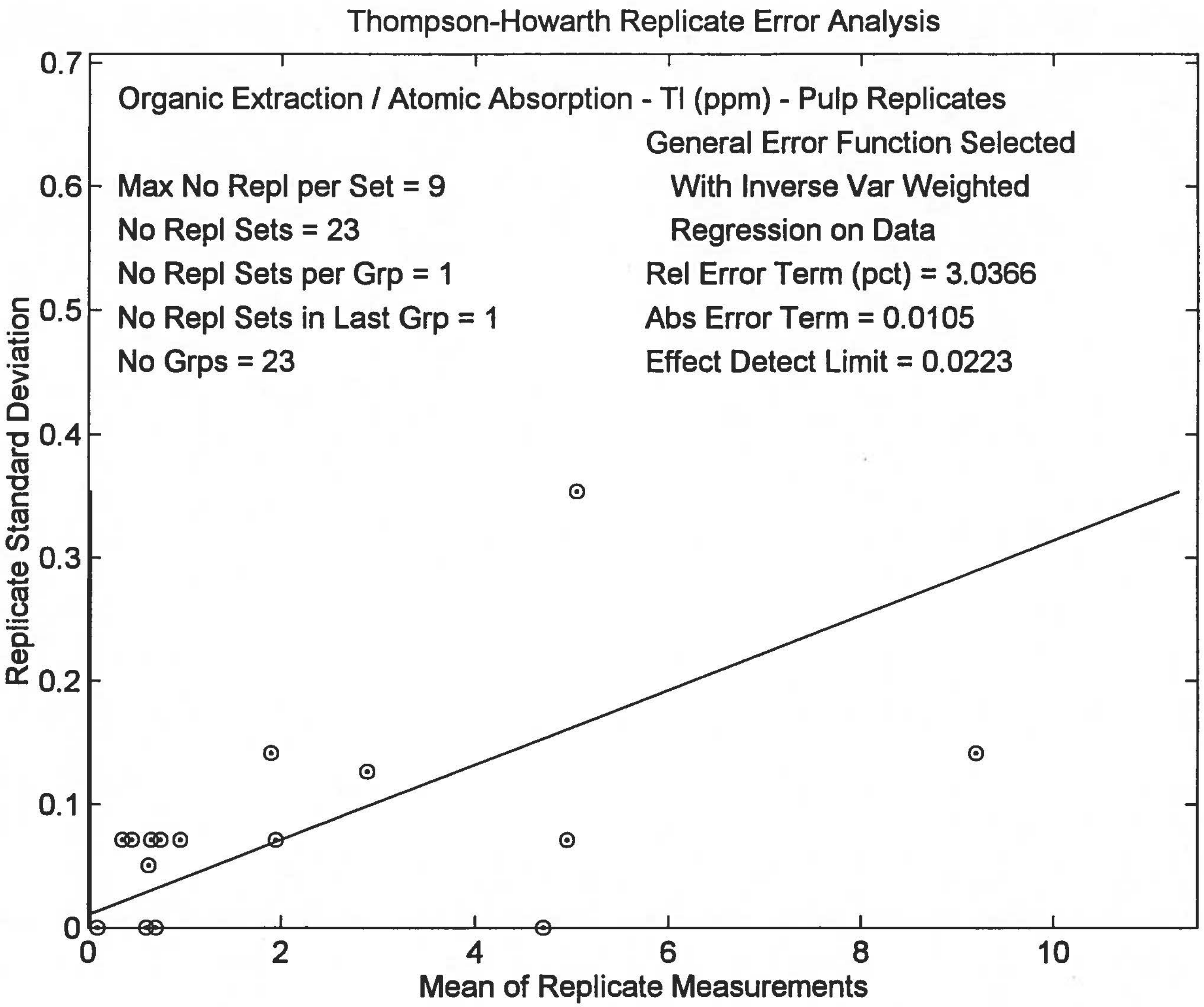

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Hydride Atomic Absorption - Sb (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 3.2356
Abs Error Term = 0.0408
Effect Detect Limit = 0.0872
Replicate Standard Deviation
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
Mean of Replicate Measurements

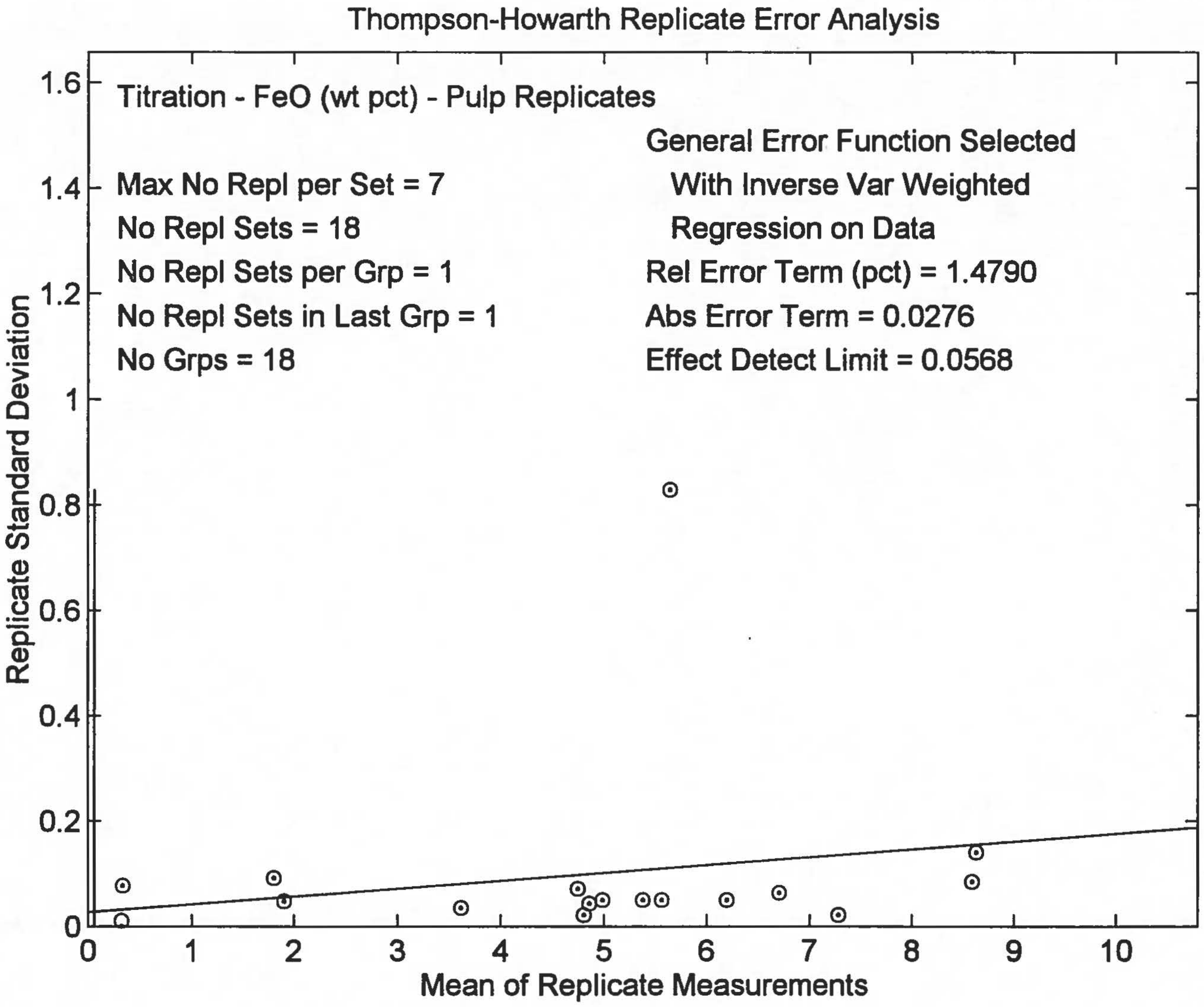

Thompson-Howarth Replicate Error Analysis
Aqua Regia / Hydride Atomic Absorption - Te (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 27.9513
Abs Error Term = 0.0060
Effect Detect Limit = 0.0271
Replicate Standard Deviation
0.15
0.1
0.05
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Aqua Regia / Hydride Atomic Absorption - Se (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 25
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 25
Rel Error Term (pct) = 0.0000
Abs Error Term = 0.2480
Effect Detect Limit = 0.4959
Replicate Standard Deviation
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Mean of Replicate Measurements
0
1
2
3
4
5
6
7
8
9

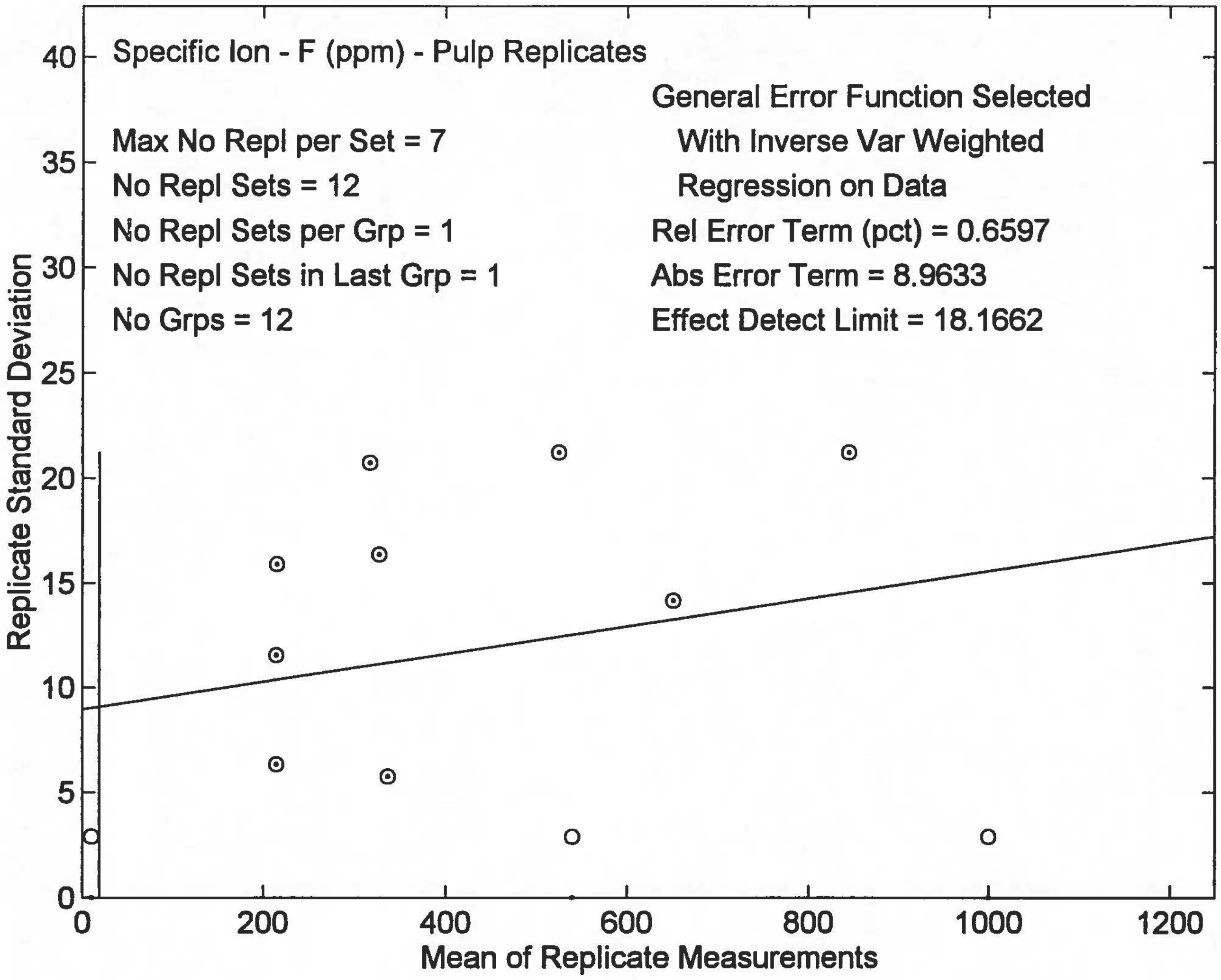
Thompson-Howarth Replicate Error Analysis

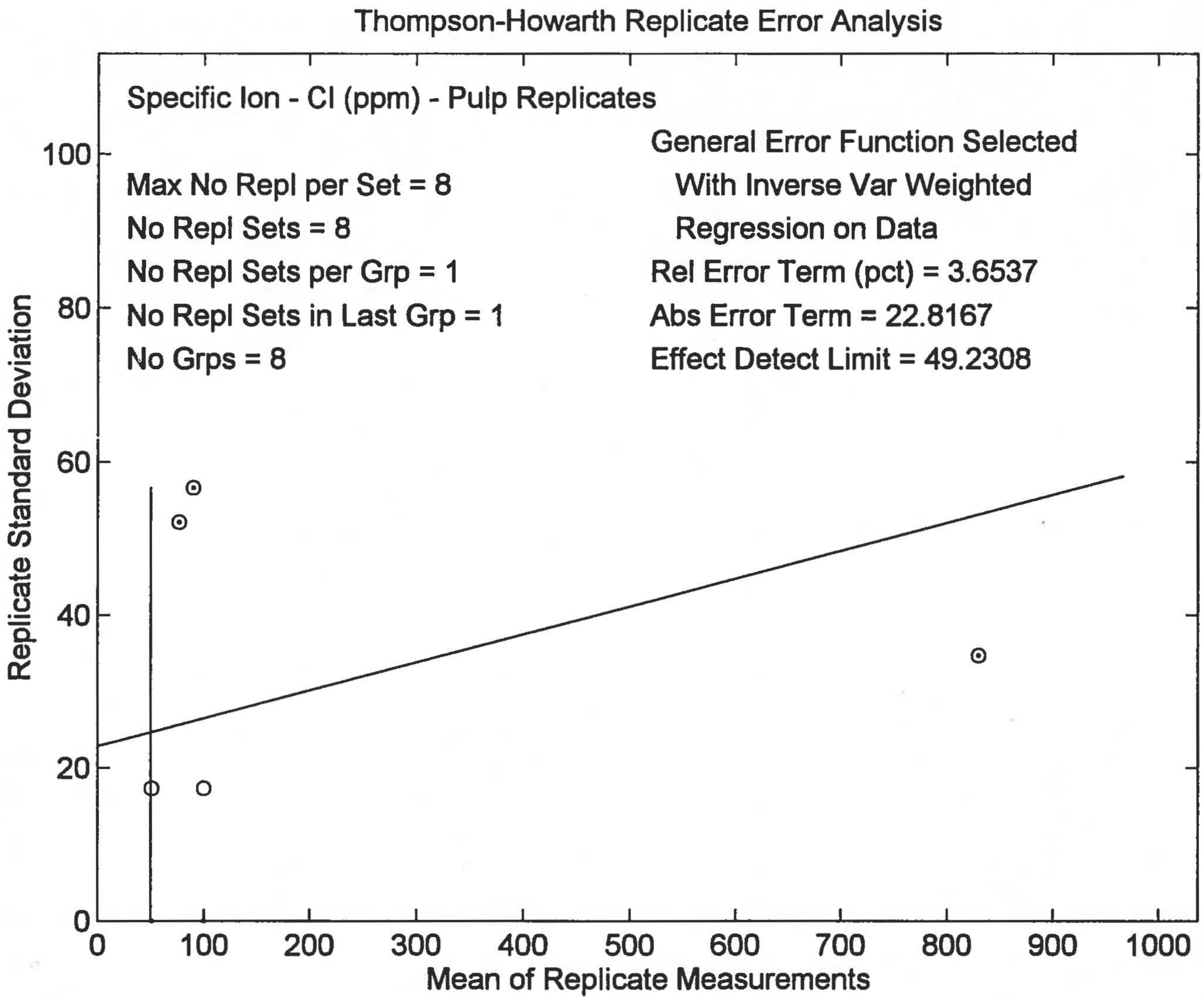


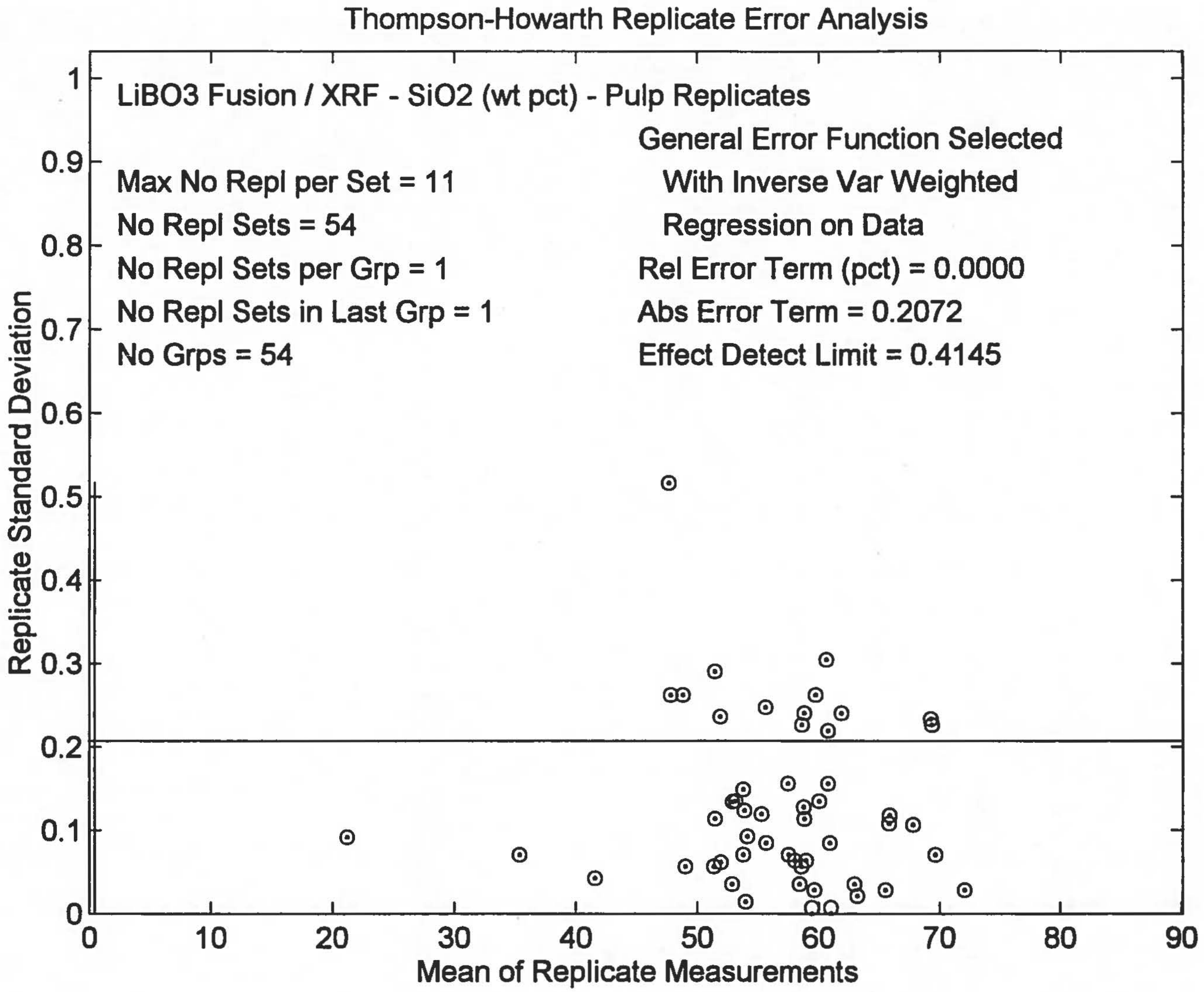

Thompson-Howarth Replicate Error Analysis
Organic Extraction / Atomic Absorption - Tl (ppm) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 23
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 23
Rel Error Term (pct) = 3.0366
Abs Error Term = 0.0105
Effect Detect Limit = 0.0223
Replicate Standard Deviation
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Titration - FeO (wt pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 7
No Repl Sets = 18
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 18
Rel Error Term (pct) = 1.4790
Abs Error Term = 0.0276
Effect Detect Limit = 0.0568
Replicate Standard Deviation
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Mean of Replicate Measurements
0
1
2
3
4
5
6
7
8
9
10

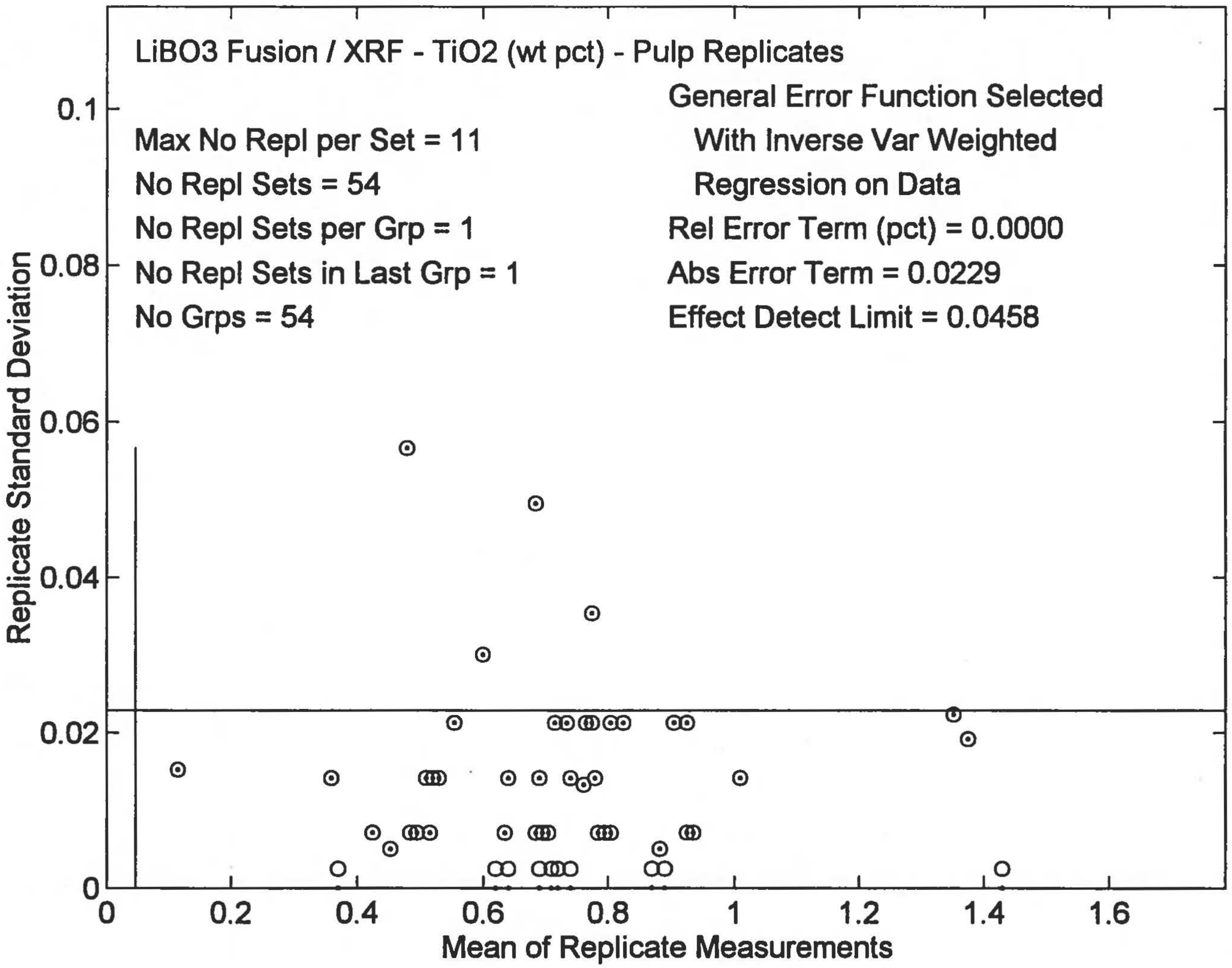
Thompson-Howarth Replicate Error Analysis

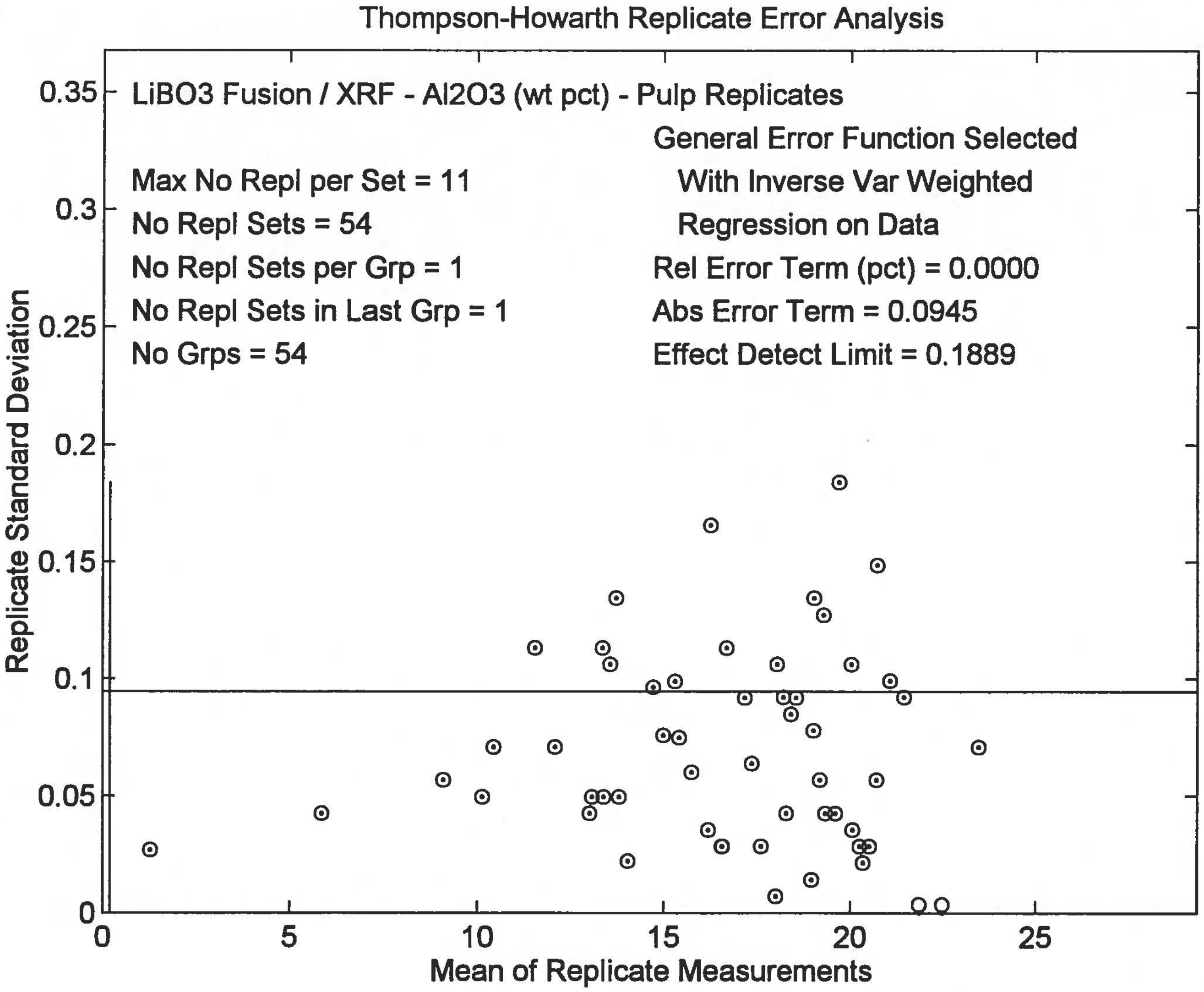


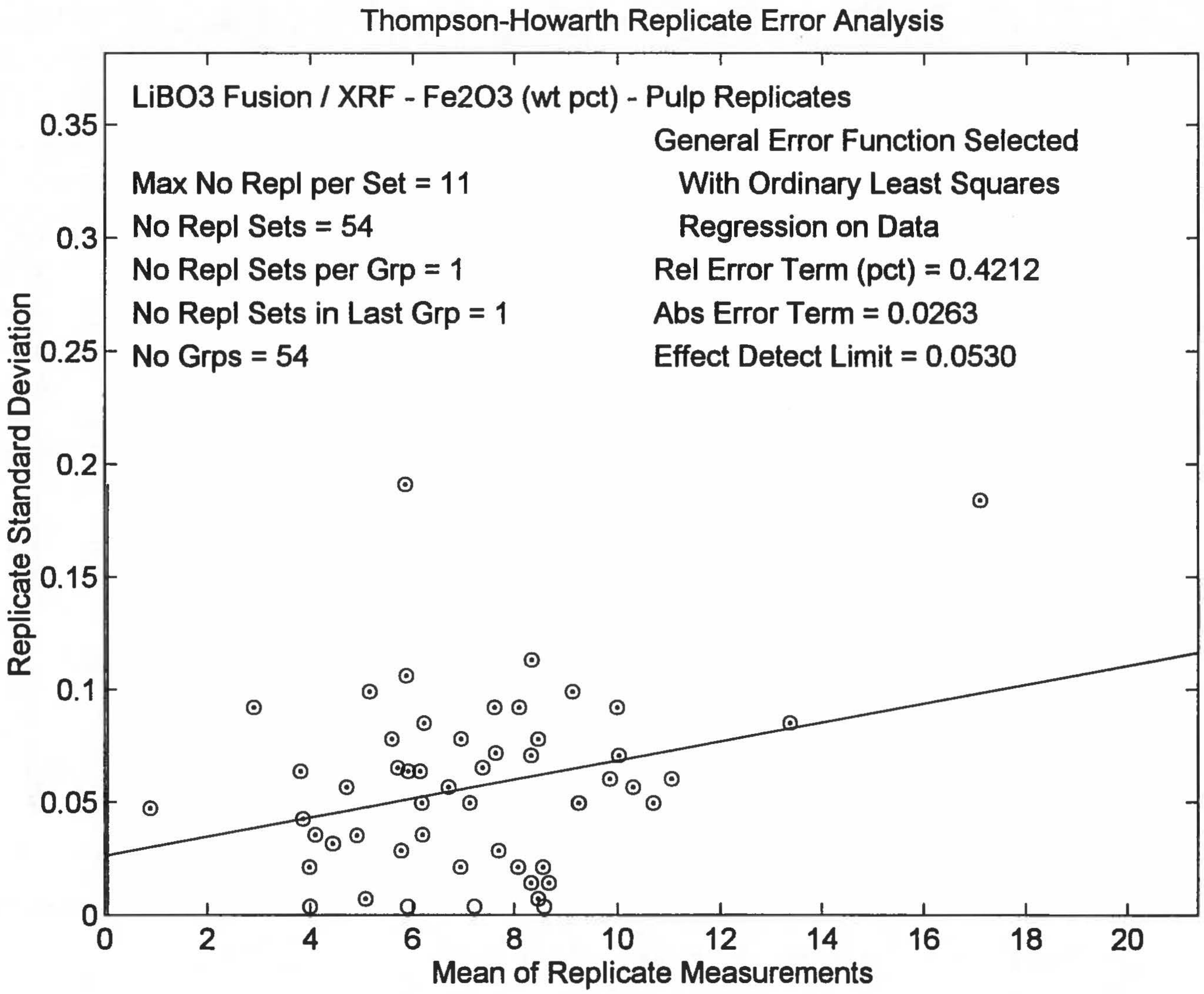

Thompson-Howarth Replicate Error Analysis
Specific Ion - Cl (ppm) - Pulp Replicates
Max No Repl per Set = 8
No Repl Sets = 8
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 8
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Rel Error Term (pct) = 3.6537
Abs Error Term = 22.8167
Effect Detect Limit = 49.2308
Replicate Standard Deviation
0
20
40
60
80
100
0
100
200
300
400
500
600
700
800
900
1000
Mean of Replicate Measurements

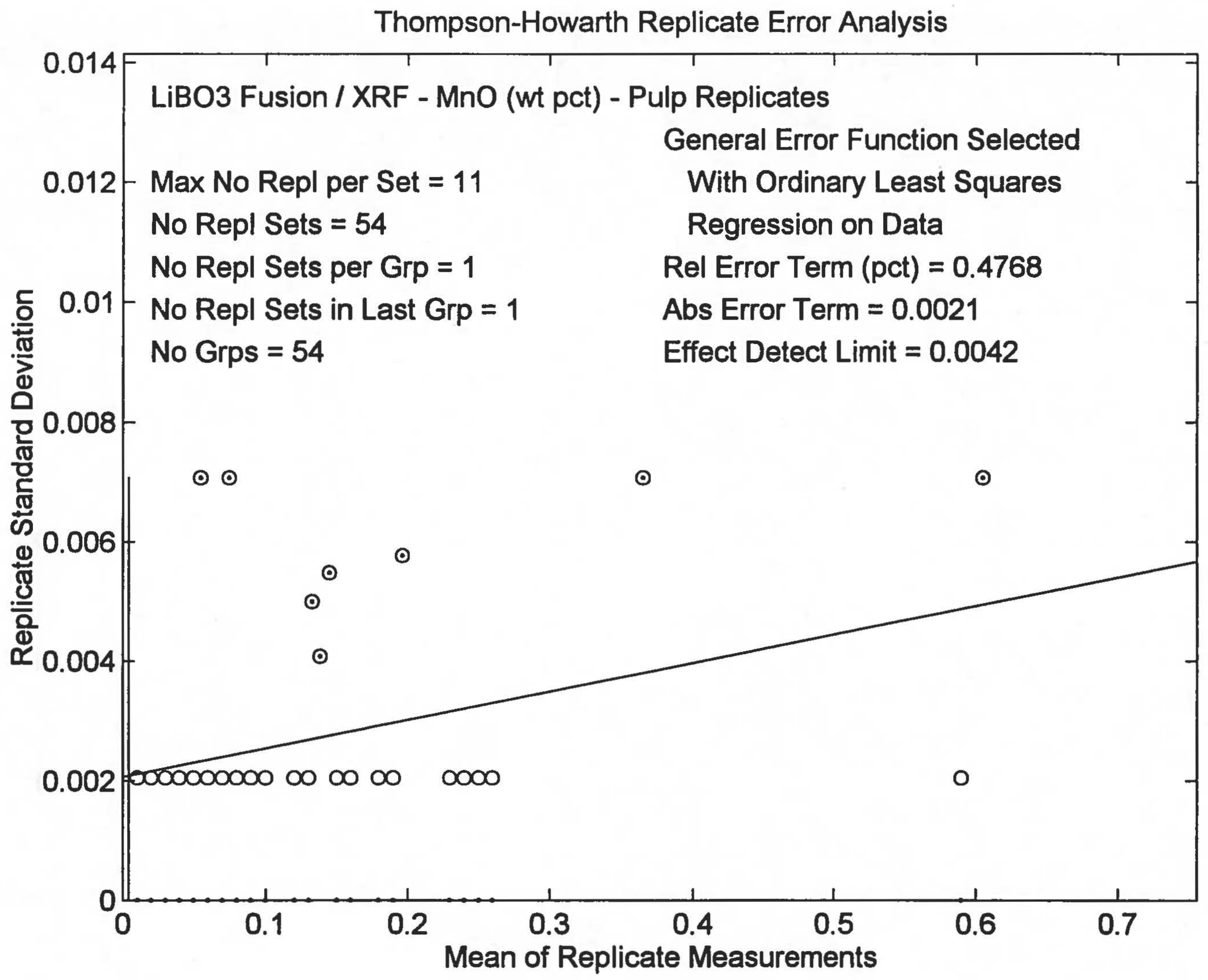

Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - SiO2 (wt pct) - Pulp Replicates
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Rel Error Term (pct) = 0.0000
Abs Error Term = 0.2072
Effect Detect Limit = 0.4145
Replicate Standard Deviation
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Mean of Replicate Measurements
0
10
20
30
40
50
60
70
80
90

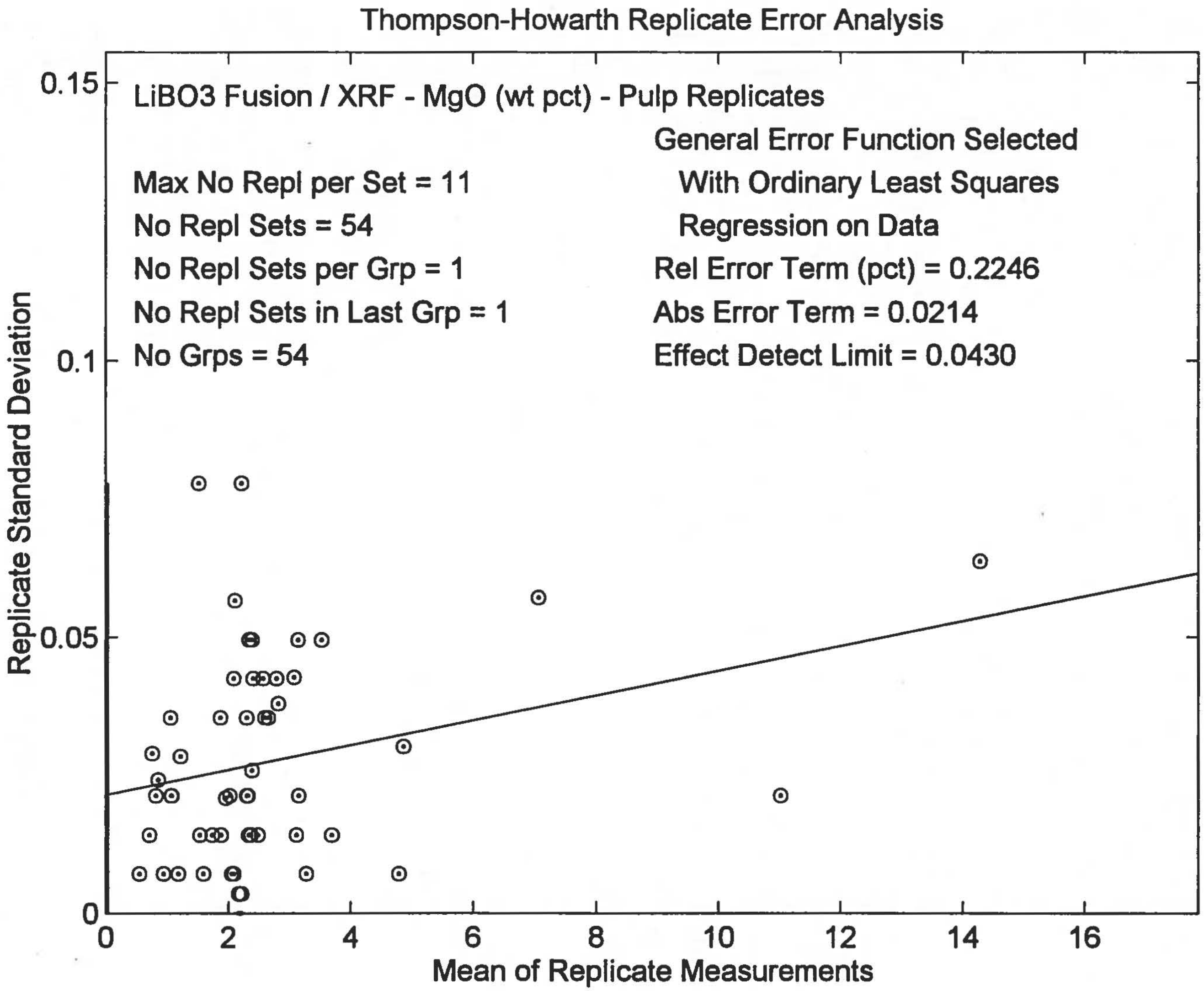
Thompson-Howarth Replicate Error Analysis

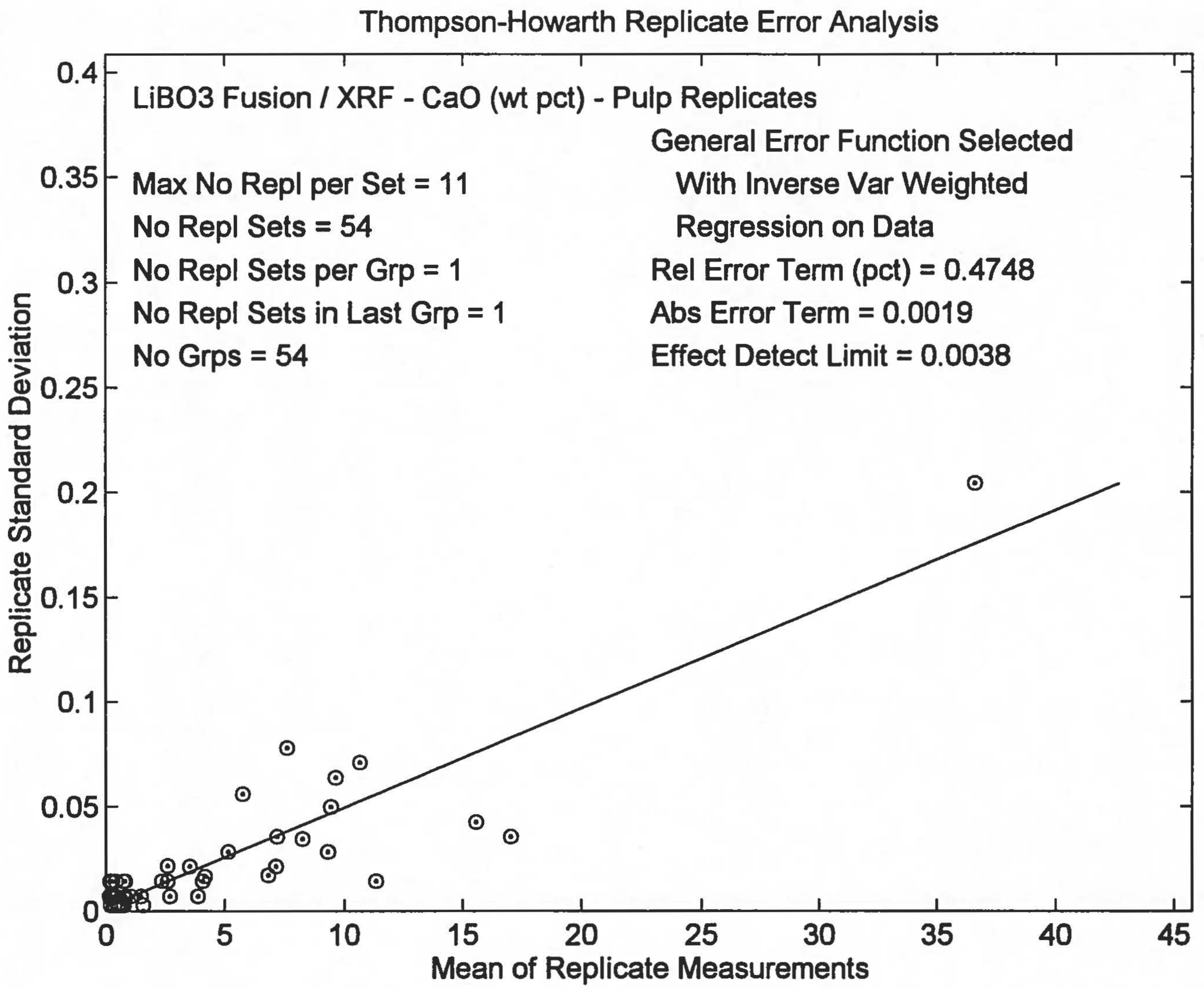



Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - Al2O3 (wt pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
Rel Error Term (pct) = 0.0000
Abs Error Term = 0.0945
Effect Detect Limit = 0.1889
Replicate Standard Deviation
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
15
20
25
Mean of Replicate Measurements

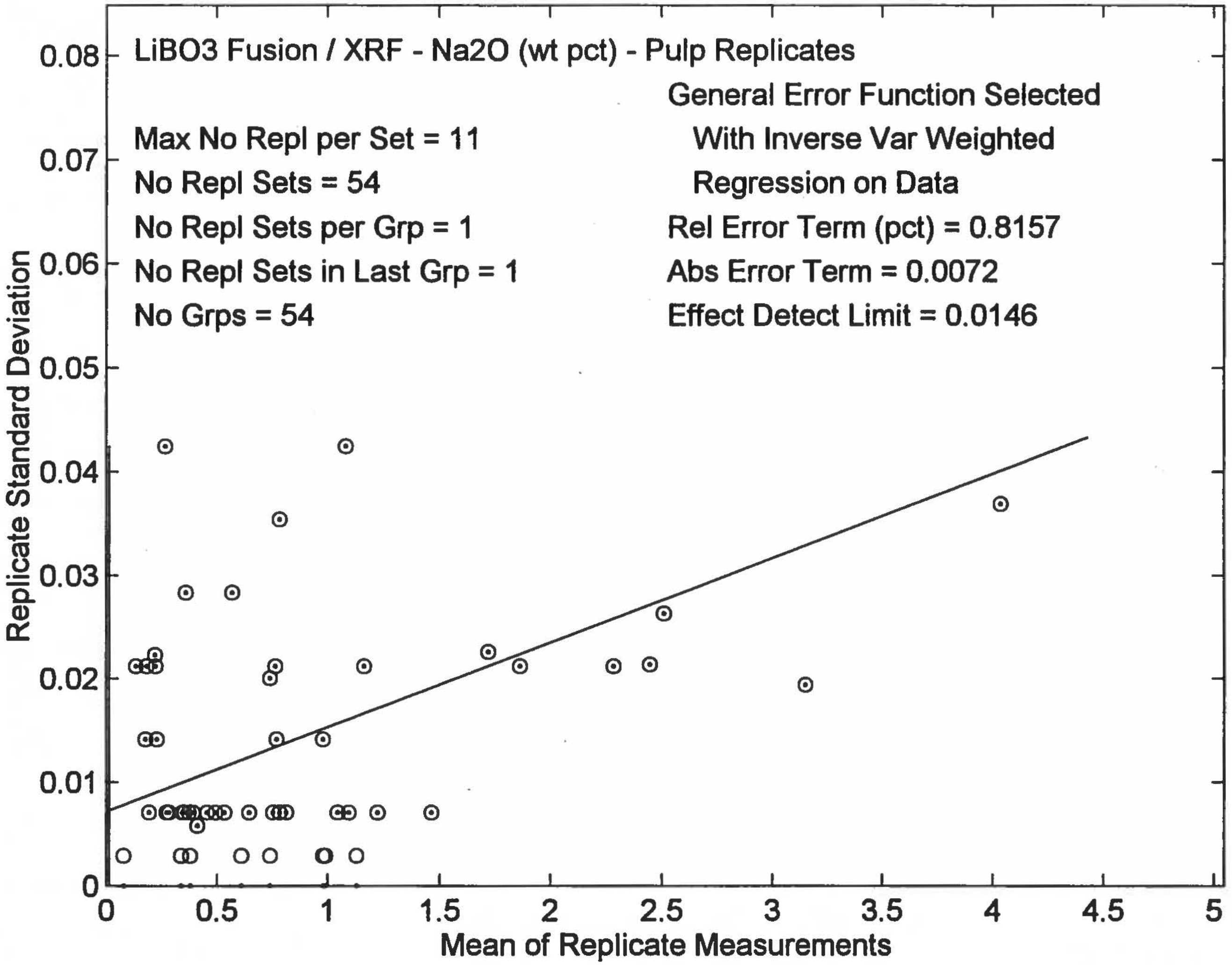

Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - Fe2O3 (wt pct) - Pulp Replicates
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.4212
Abs Error Term = 0.0263
Effect Detect Limit = 0.0530
Replicate Standard Deviation
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0
2
4
6
8
10
12
14
16
18
20
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - MnO (wt pct) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
Rel Error Term (pct) = 0.4768
Abs Error Term = 0.0021
Effect Detect Limit = 0.0042
Replicate Standard Deviation
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Mean of Replicate Measurements

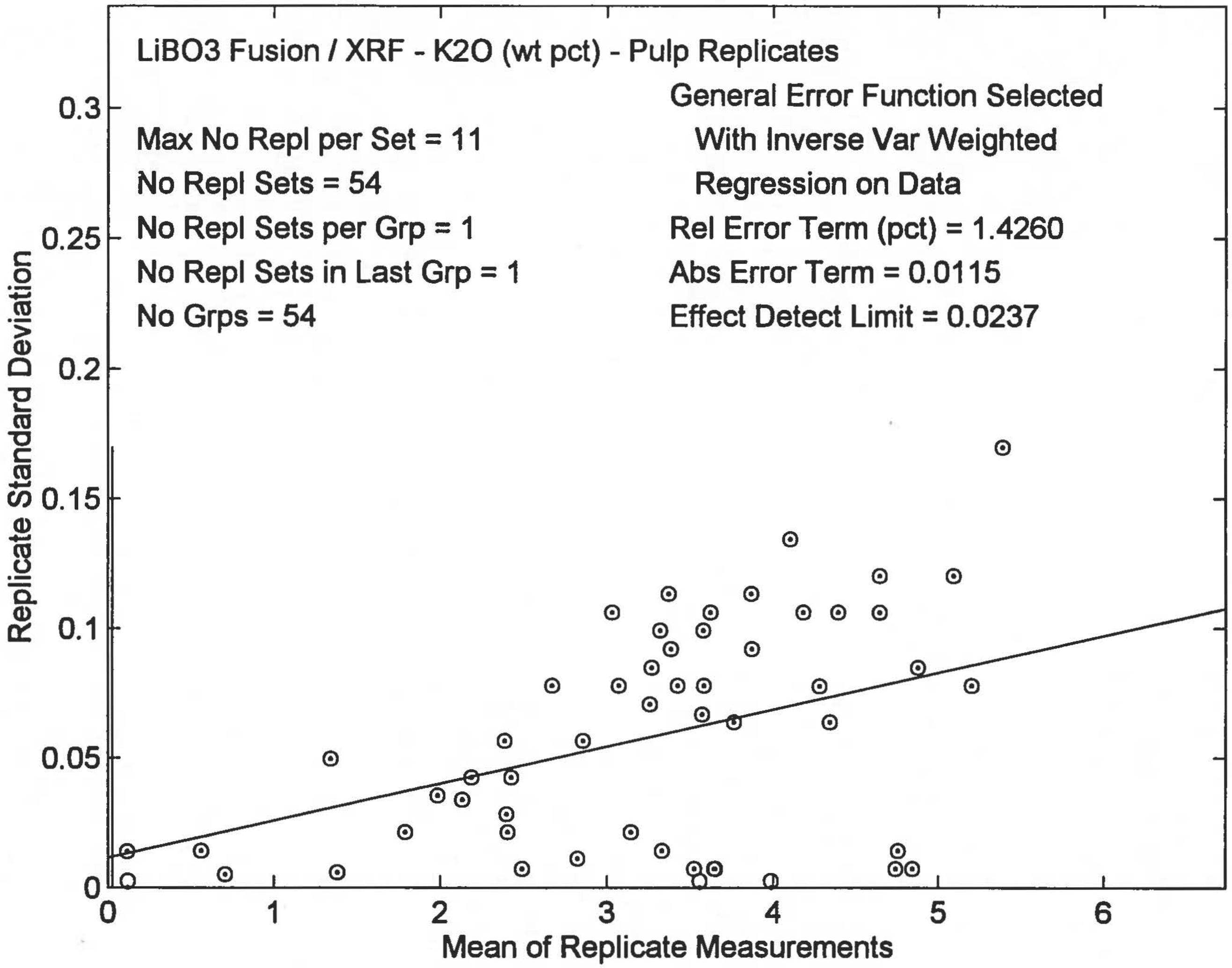

Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - MgO (wt pct) - Pulp Replicates
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.2246
Abs Error Term = 0.0214
Effect Detect Limit = 0.0430
Replicate Standard Deviation
0.15
0.1
0.05
0
0
2
4
6
8
10
12
14
16
Mean of Replicate Measurements

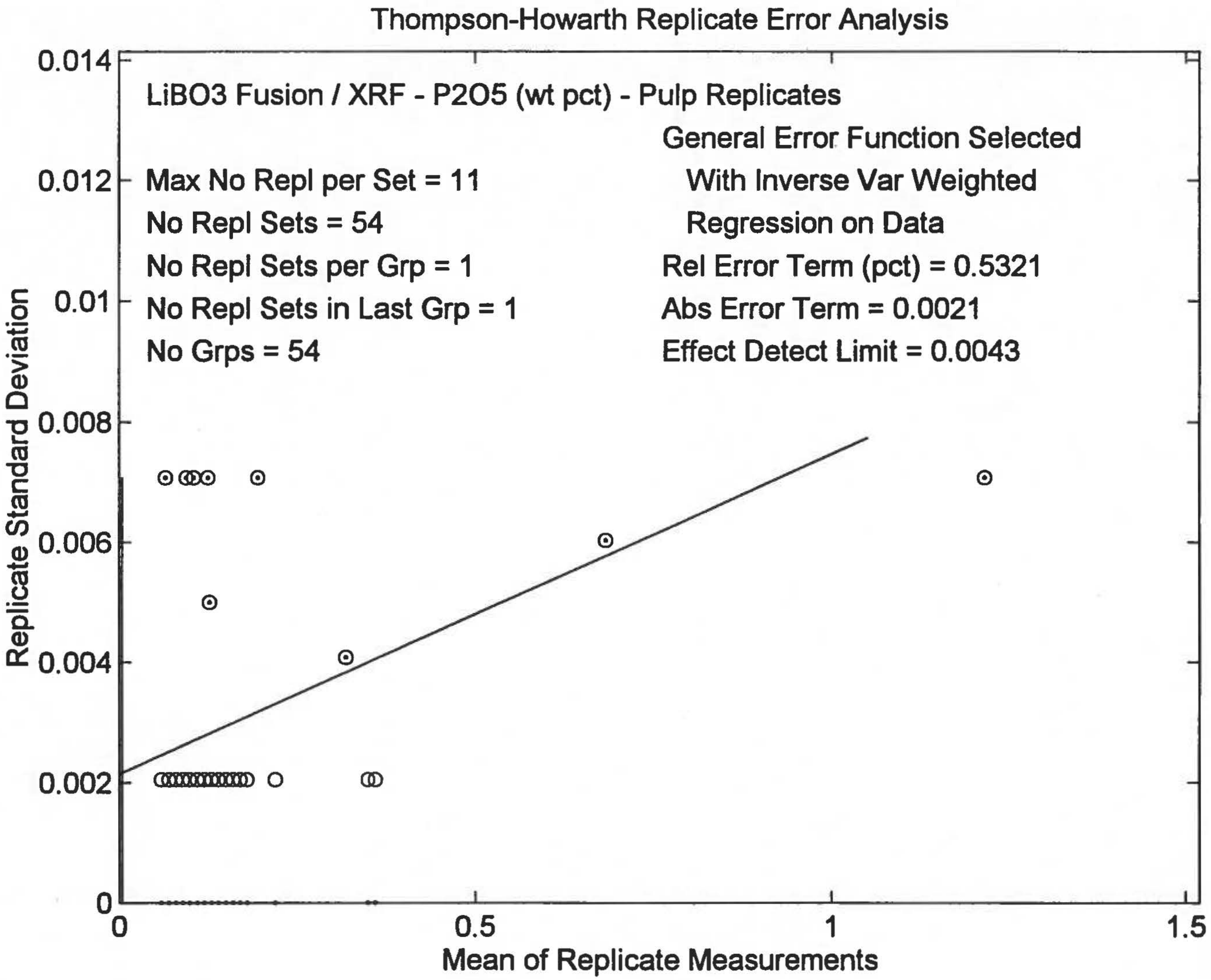

Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - CaO (wt pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
Rel Error Term (pct) = 0.4748
Abs Error Term = 0.0019
Effect Detect Limit = 0.0038
Replicate Standard Deviation
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Mean of Replicate Measurements
0
5
10
15
20
25
30
35
40
45

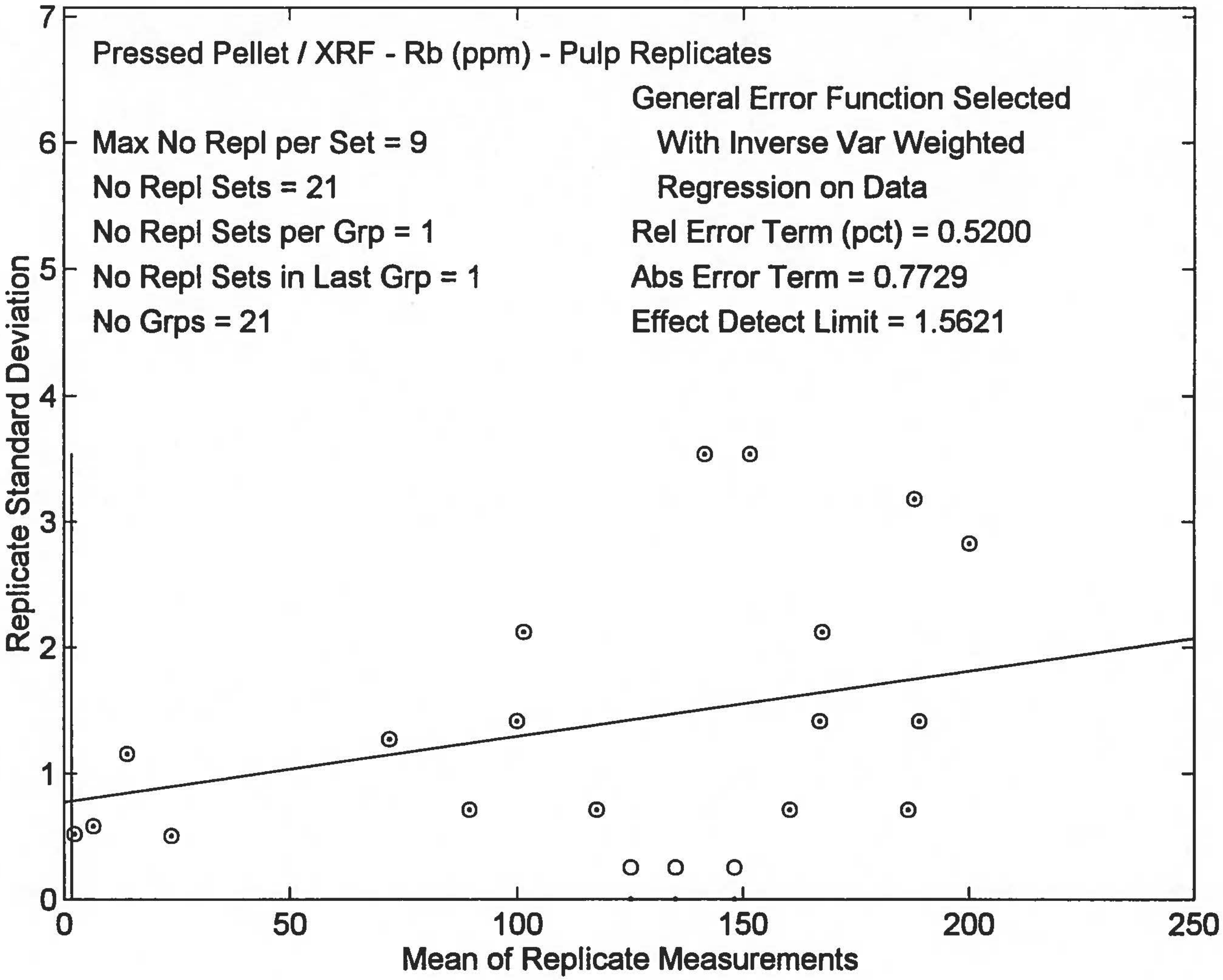
Thompson-Howarth Replicate Error Analysis



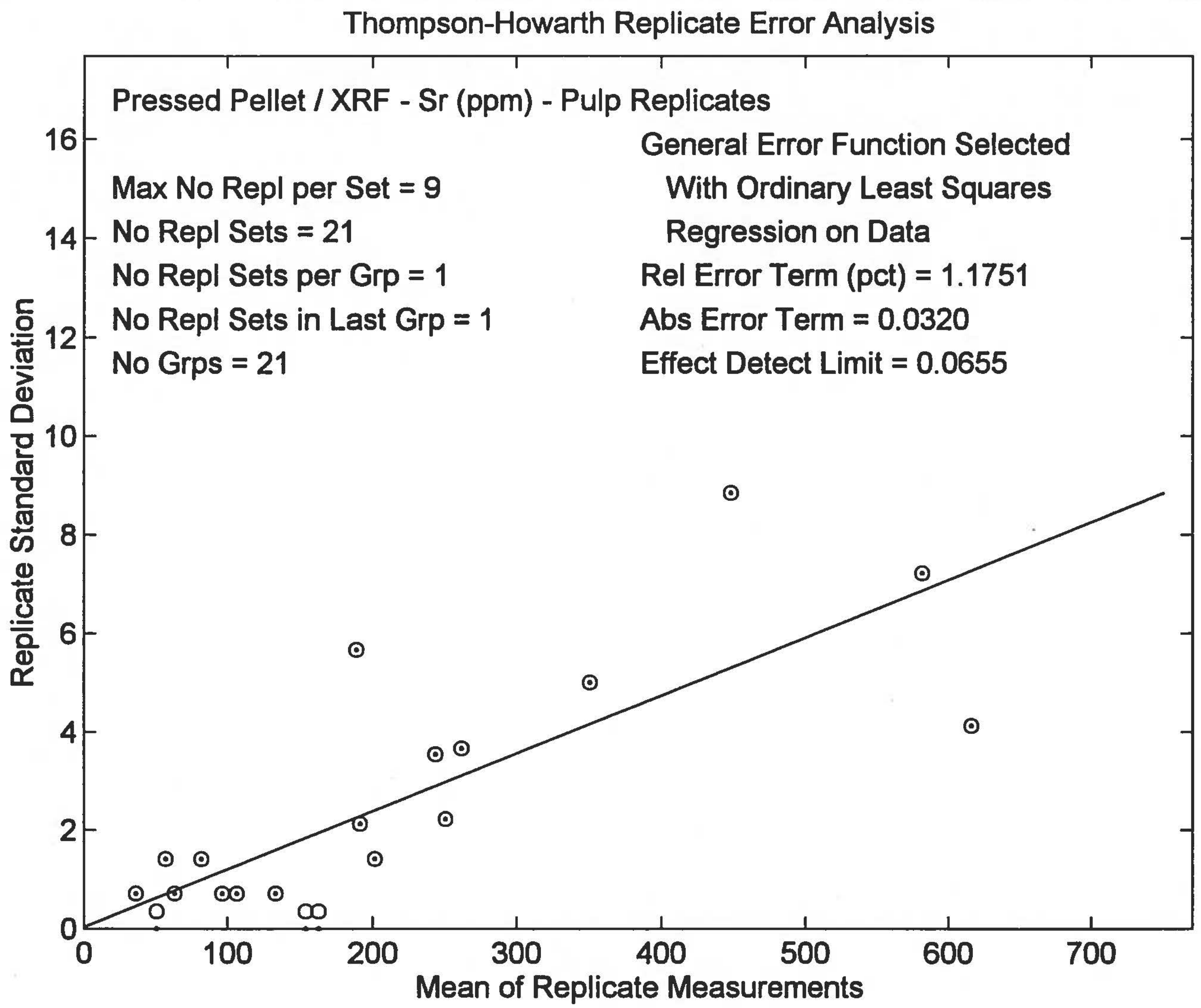
Thompson-Howarth Replicate Error Analysis

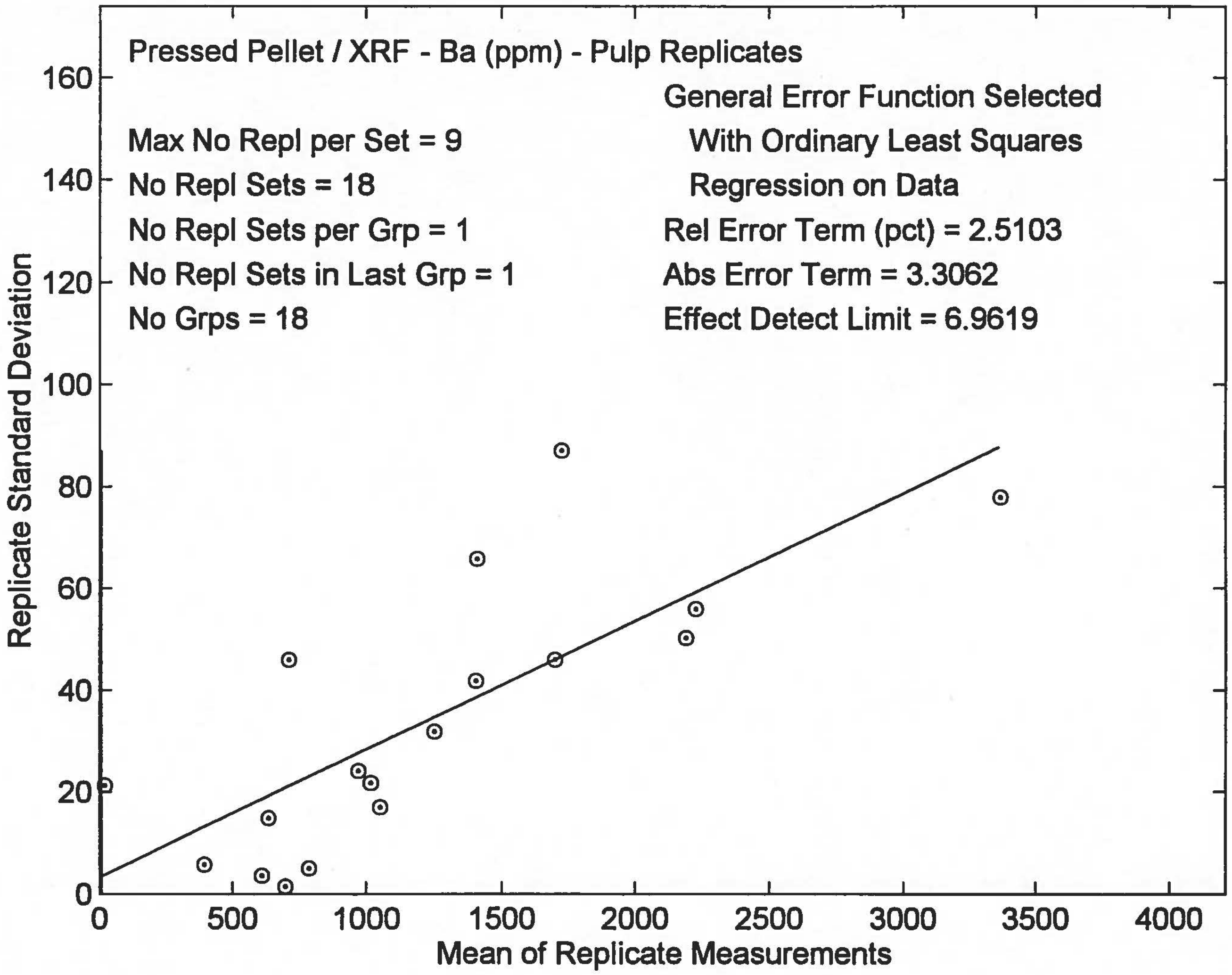



Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - P2O5 (wt pct) - Pulp Replicates
General Error Function Selected
With Inverse Var Weighted
Regression on Data
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
Rel Error Term (pct) = 0.5321
Abs Error Term = 0.0021
Effect Detect Limit = 0.0043
Replicate Standard Deviation
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mean of Replicate Measurements
0
0.5
1
1.5



Thompson-Howarth Replicate Error Analysis


Thompson-Howarth Replicate Error Analysis
Pressed Pellet / XRF - Sr (ppm) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 21
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 21
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 1.1751
Abs Error Term = 0.0320
Effect Detect Limit = 0.0655
Replicate Standard Deviation
0
2
4
6
8
10
12
14
16
Mean of Replicate Measurements
0
100
200
300
400
500
600
700

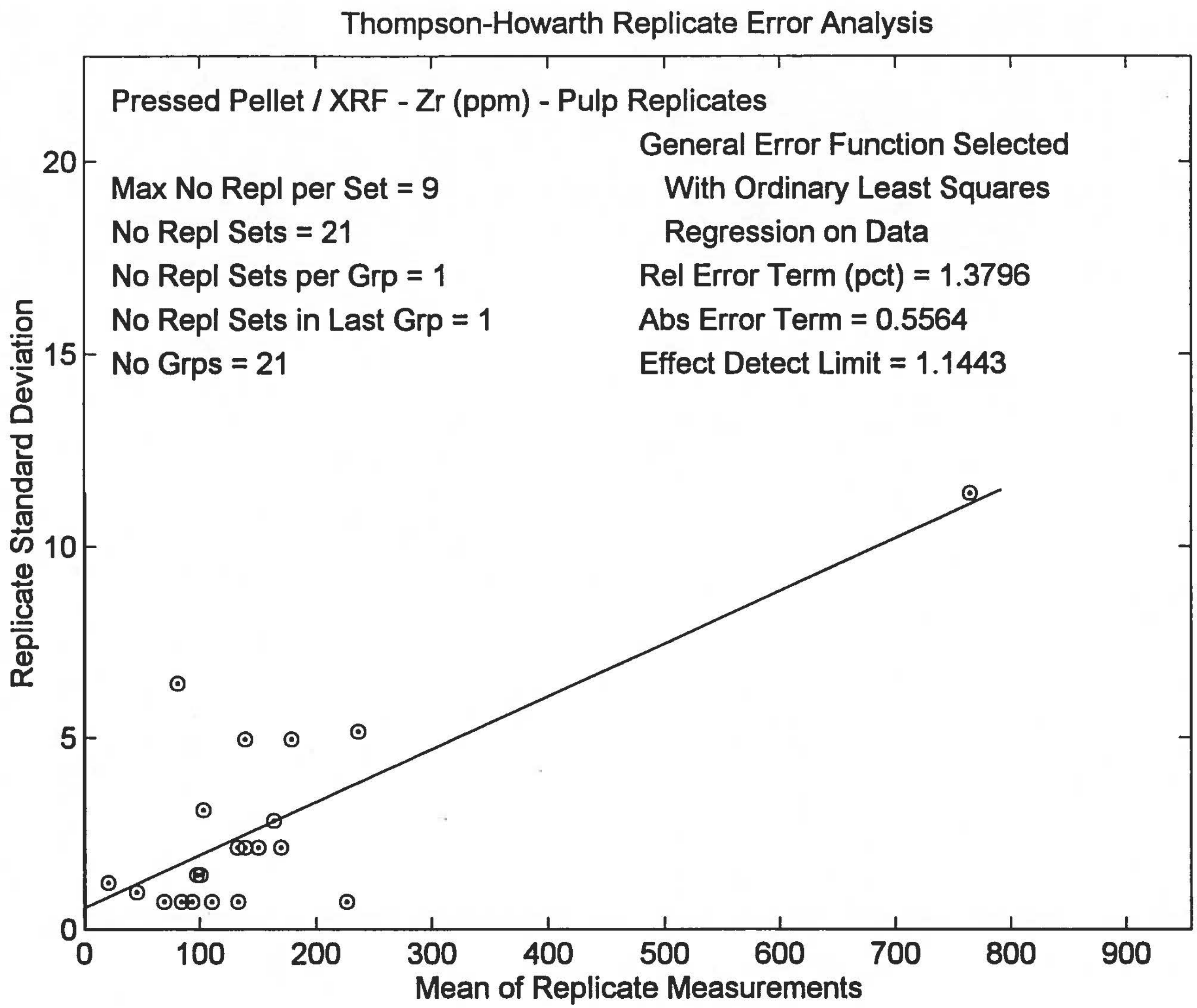


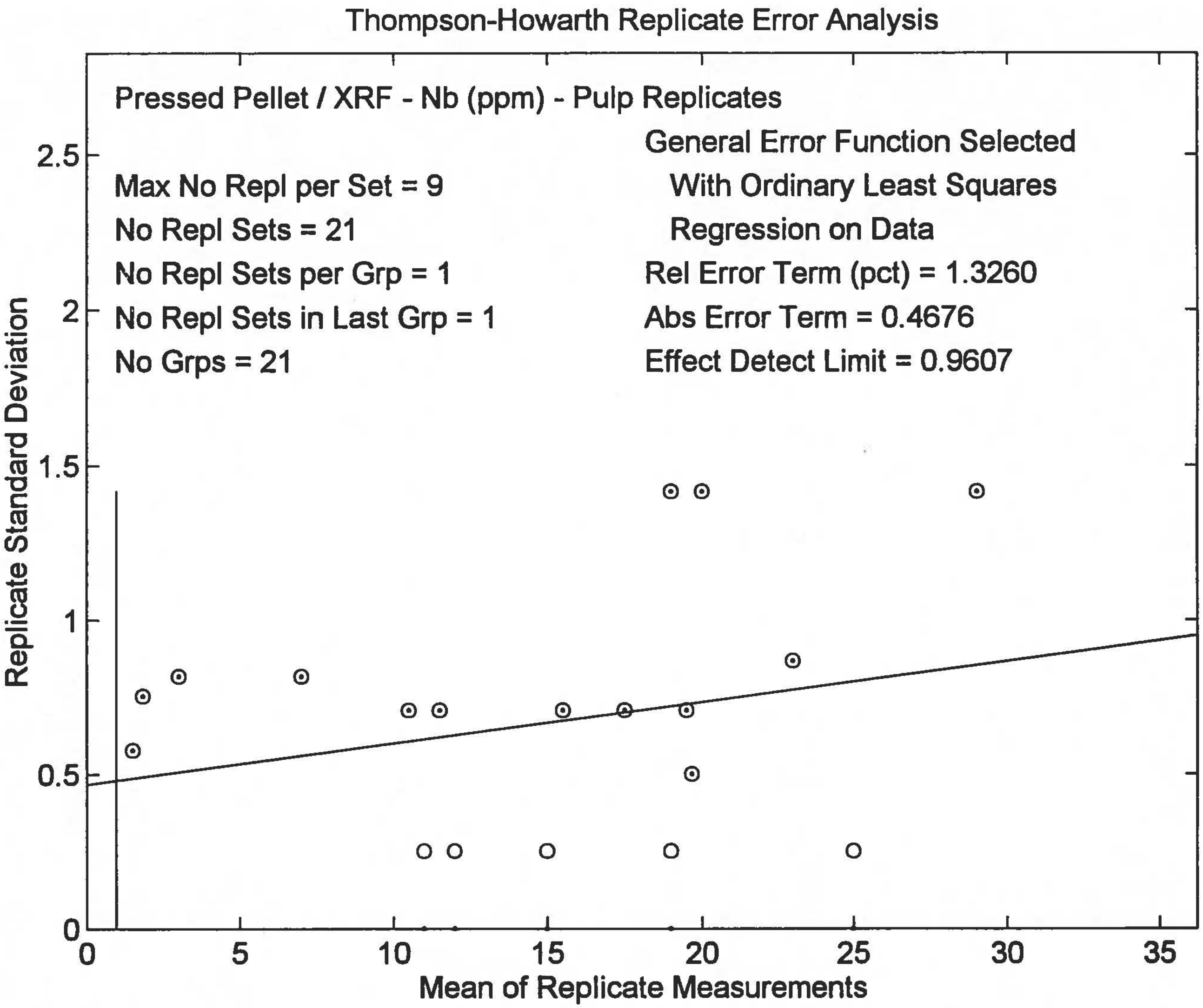
Thompson-Howarth Replicate Error Analysis

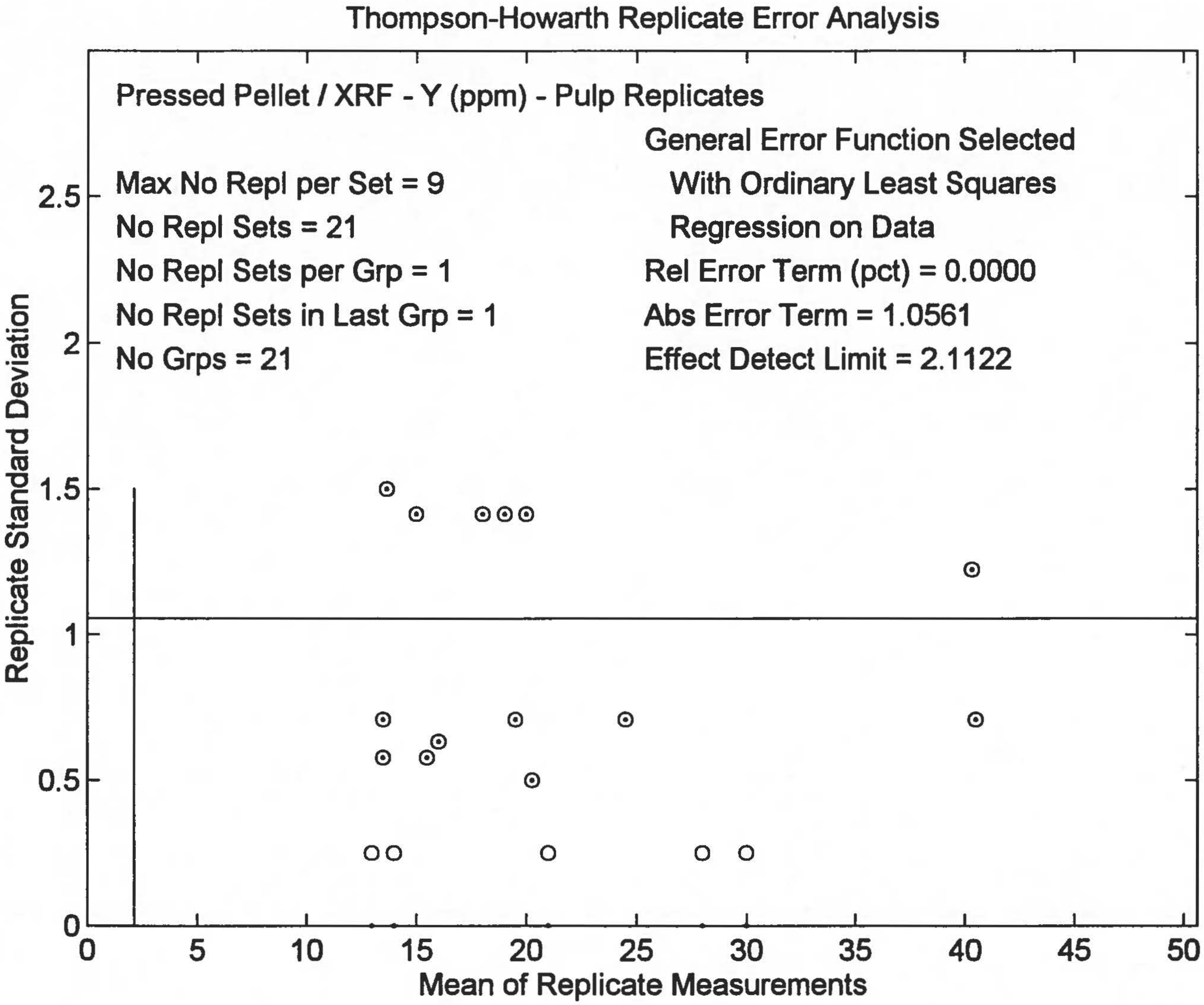
Pressed Pellet / XRF - Ba (ppm) - Pulp Replicates

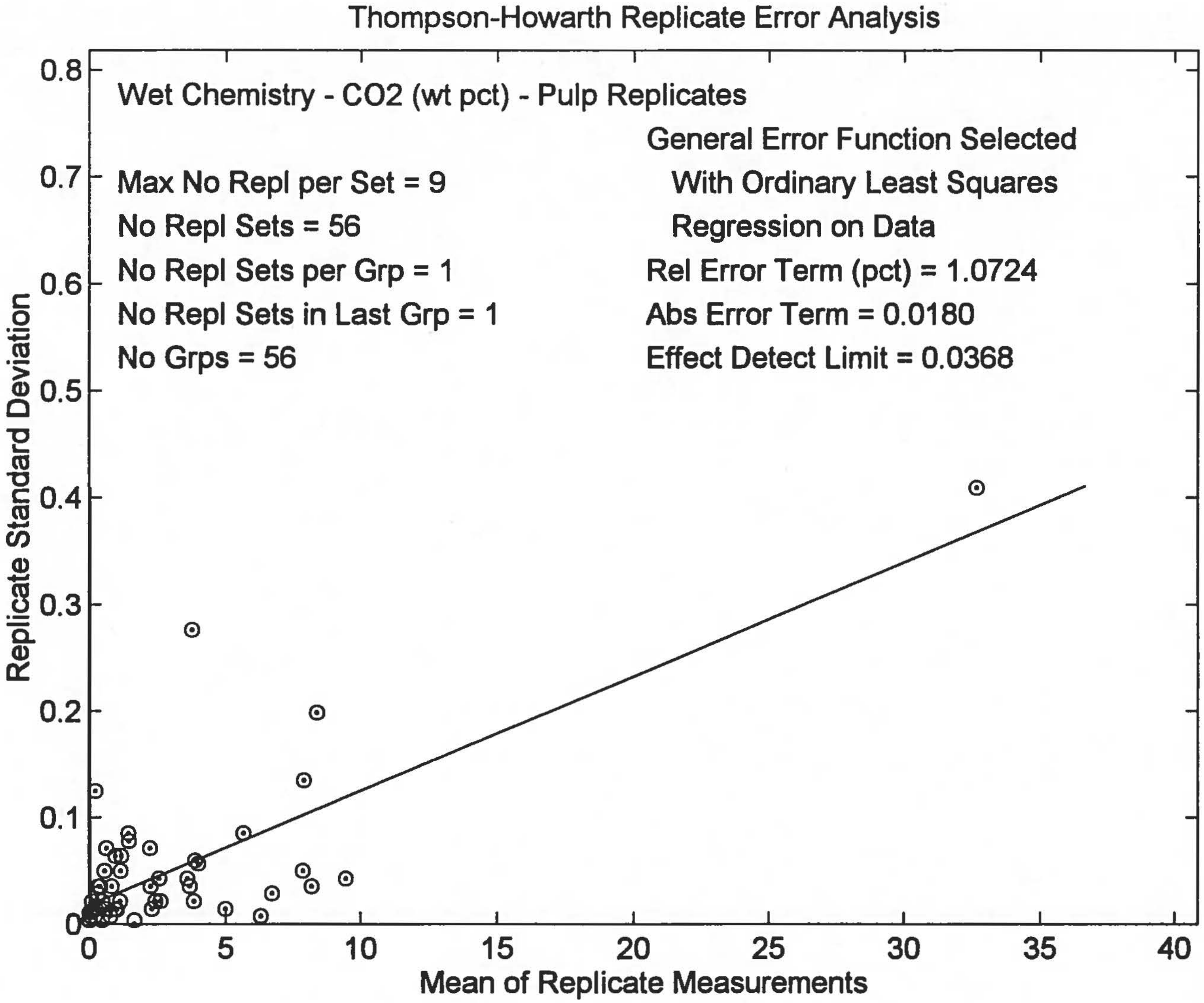
Max No Repl per Set = 9
No Repl Sets = 18
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 18

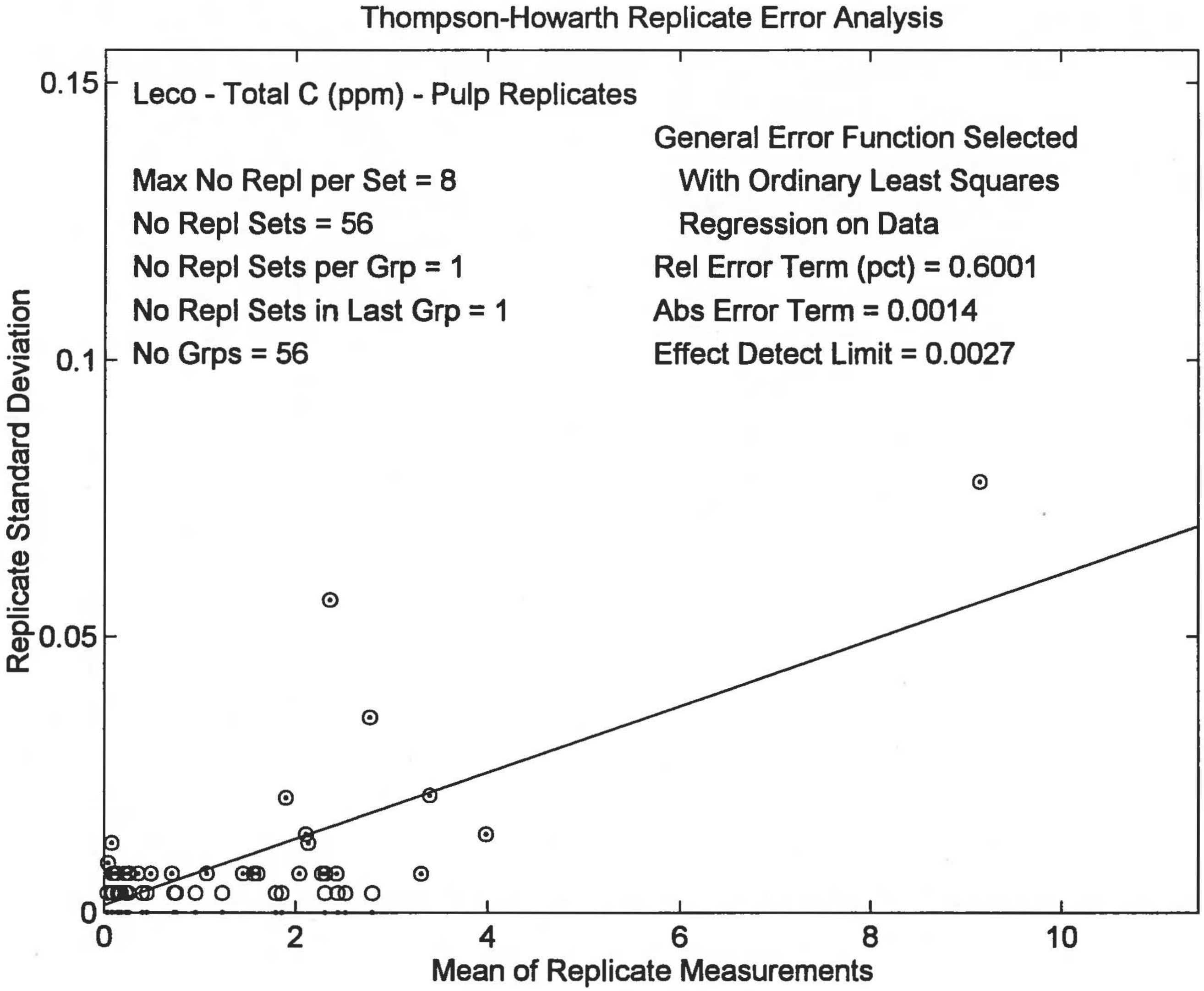
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 2.5103
Abs Error Term = 3.3062
Effect Detect Limit = 6.9619

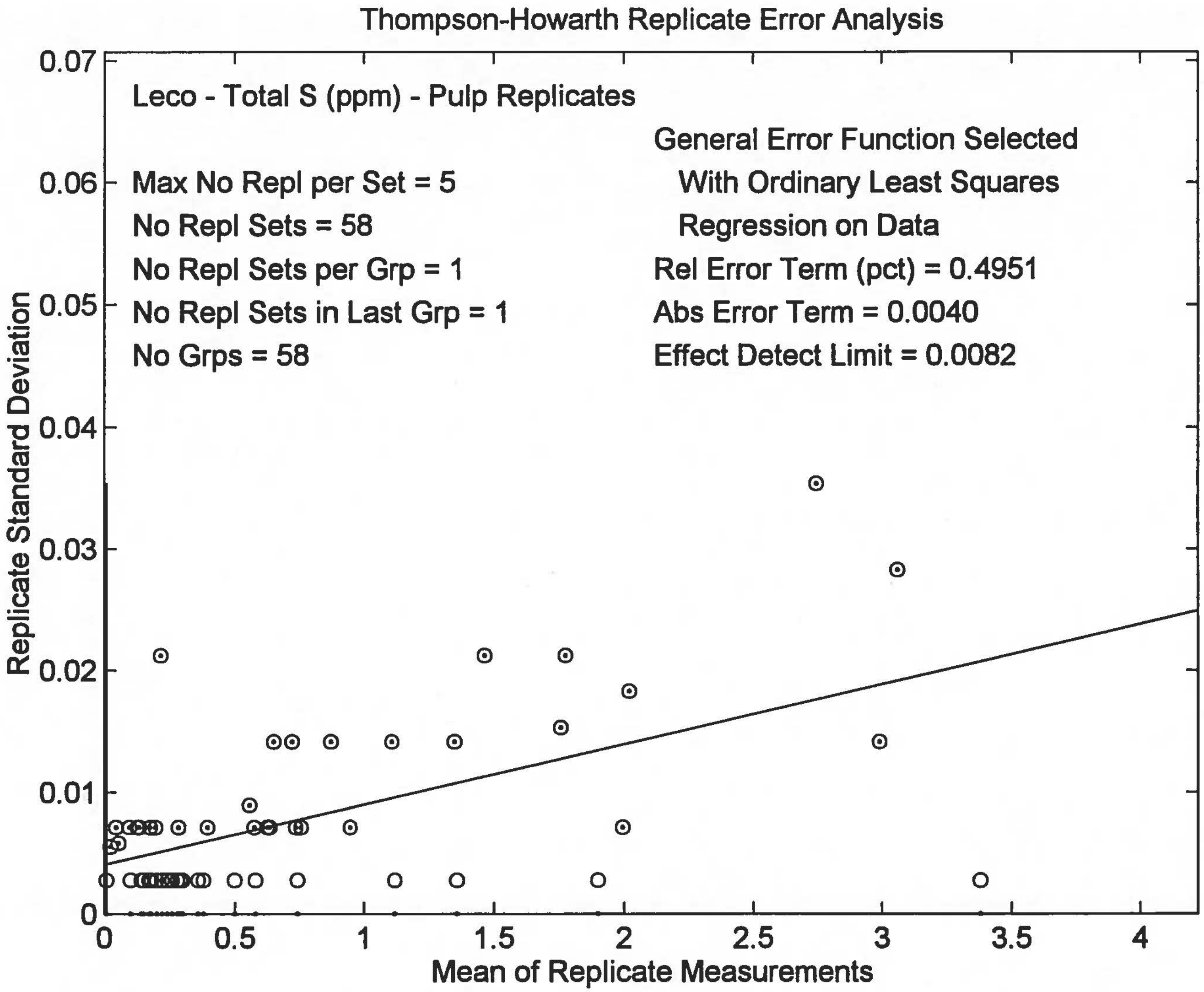

Thompson-Howarth Replicate Error Analysis
Pressed Pellet / XRF - Zr (ppm) - Pulp Replicates
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Max No Repl per Set = 9
No Repl Sets = 21
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 21
Rel Error Term (pct) = 1.3796
Abs Error Term = 0.5564
Effect Detect Limit = 1.1443
Replicate Standard Deviation
0
5
10
15
20
0
100
200
300
400
500
600
700
800
900
Mean of Replicate Measurements

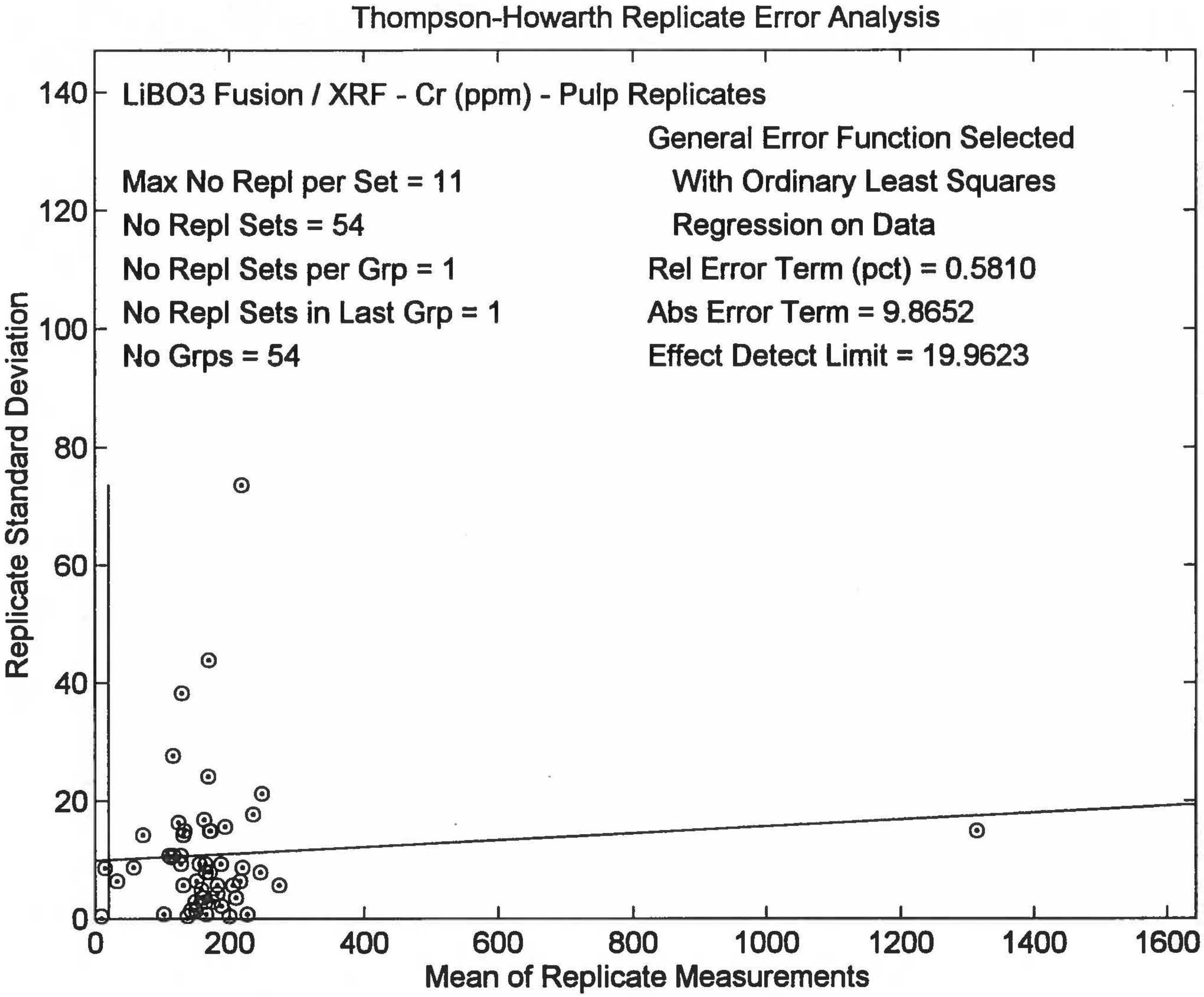

Thompson-Howarth Replicate Error Analysis
Pressed Pellet / XRF - Nb (ppm) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 21
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 21
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 1.3260
Abs Error Term = 0.4676
Effect Detect Limit = 0.9607
Replicate Standard Deviation
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25
30
35
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Pressed Pellet / XRF - Y (ppm) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 21
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 21
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.0000
Abs Error Term = 1.0561
Effect Detect Limit = 2.1122
Replicate Standard Deviation
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25
30
35
40
45
50
Mean of Replicate Measurements


Thompson-Howarth Replicate Error Analysis
Wet Chemistry - CO2 (wt pct) - Pulp Replicates
Max No Repl per Set = 9
No Repl Sets = 56
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 56
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 1.0724
Abs Error Term = 0.0180
Effect Detect Limit = 0.0368
Replicate Standard Deviation
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Mean of Replicate Measurements
0
5
10
15
20
25
30
35
40

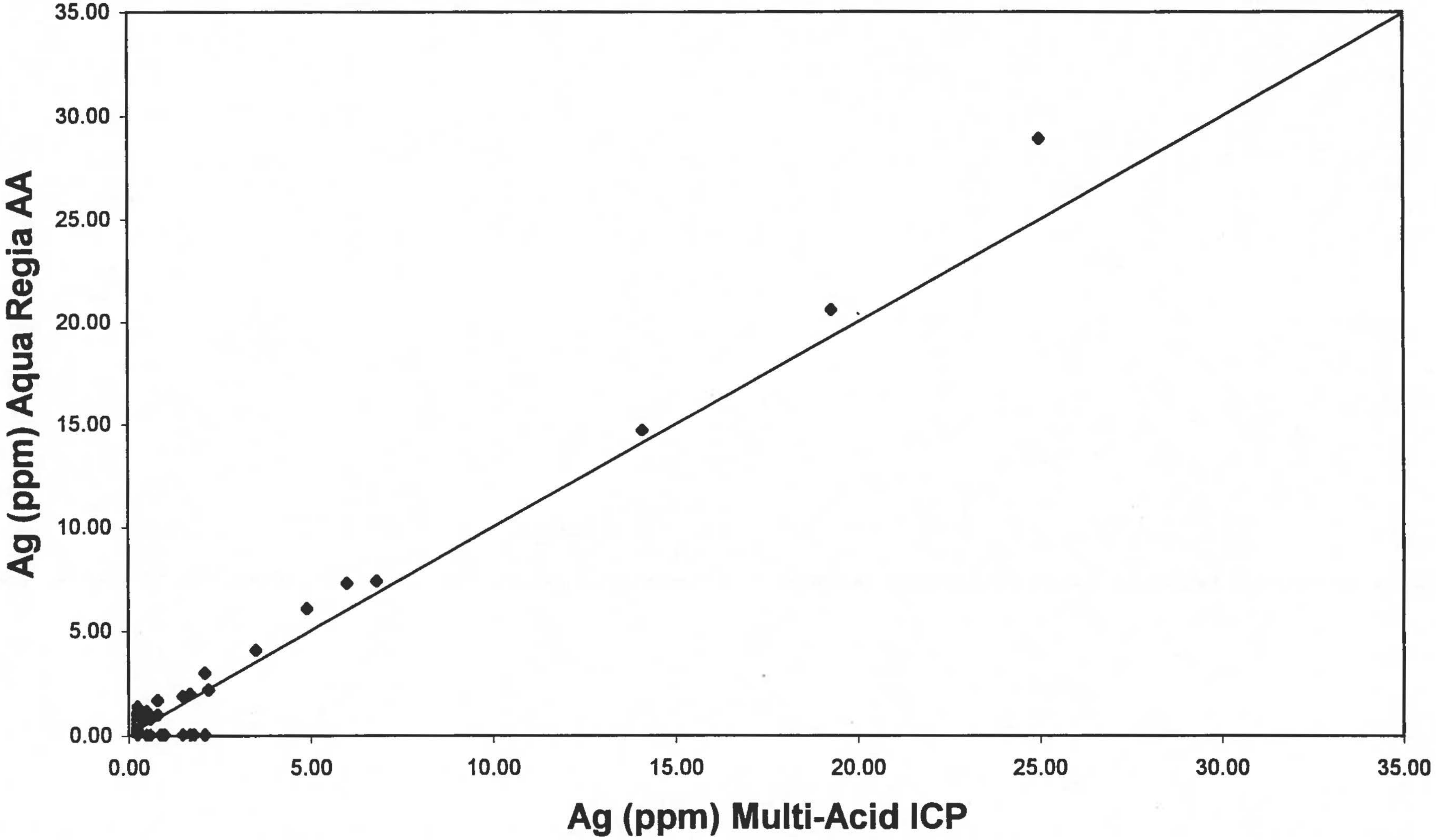

Thompson-Howarth Replicate Error Analysis
Leco - Total C (ppm) - Pulp Replicates
Max No Repl per Set = 8
No Repl Sets = 56
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 56
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.6001
Abs Error Term = 0.0014
Effect Detect Limit = 0.0027
Replicate Standard Deviation
0.15
0.1
0.05
0
Mean of Replicate Measurements
0
2
4
6
8
10


Thompson-Howarth Replicate Error Analysis
Leco - Total S (ppm) - Pulp Replicates
Max No Repl per Set = 5
No Repl Sets = 58
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 58
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.4951
Abs Error Term = 0.0040
Effect Detect Limit = 0.0082
Replicate Standard Deviation
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Mean of Replicate Measurements
0
0.5
1
1.5
2
2.5
3
3.5
4

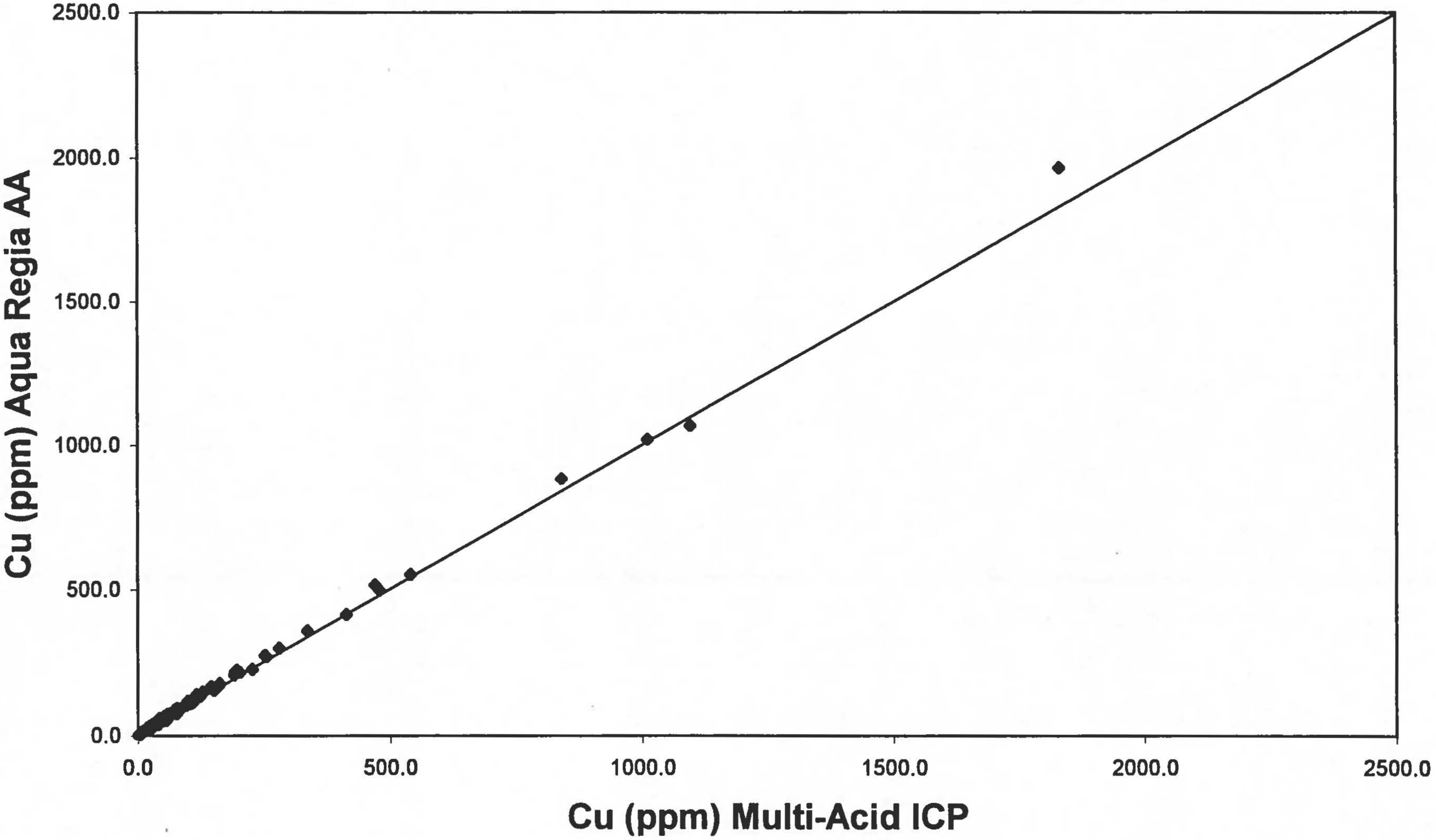

Thompson-Howarth Replicate Error Analysis
LiBO3 Fusion / XRF - Cr (ppm) - Pulp Replicates
Max No Repl per Set = 11
No Repl Sets = 54
No Repl Sets per Grp = 1
No Repl Sets in Last Grp = 1
No Grps = 54
General Error Function Selected
With Ordinary Least Squares
Regression on Data
Rel Error Term (pct) = 0.5810
Abs Error Term = 9.8652
Effect Detect Limit = 19.9623
Replicate Standard Deviation
0
20
40
60
80
100
120
140
0
200
400
600
800
1000
1200
1400
1600
Mean of Replicate Measurements

APPENDIX 2

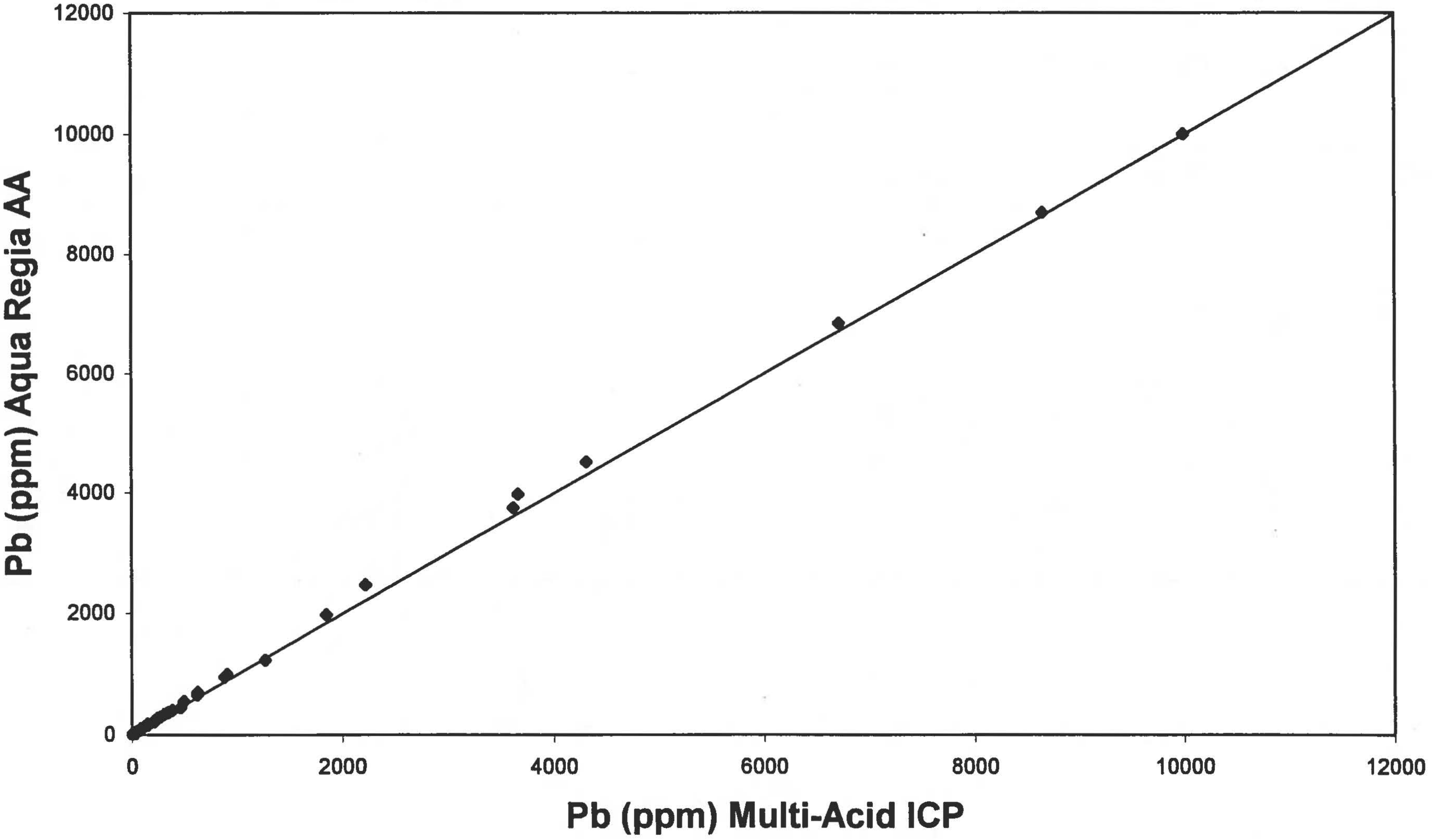
Ag Analytical Technique Comparison



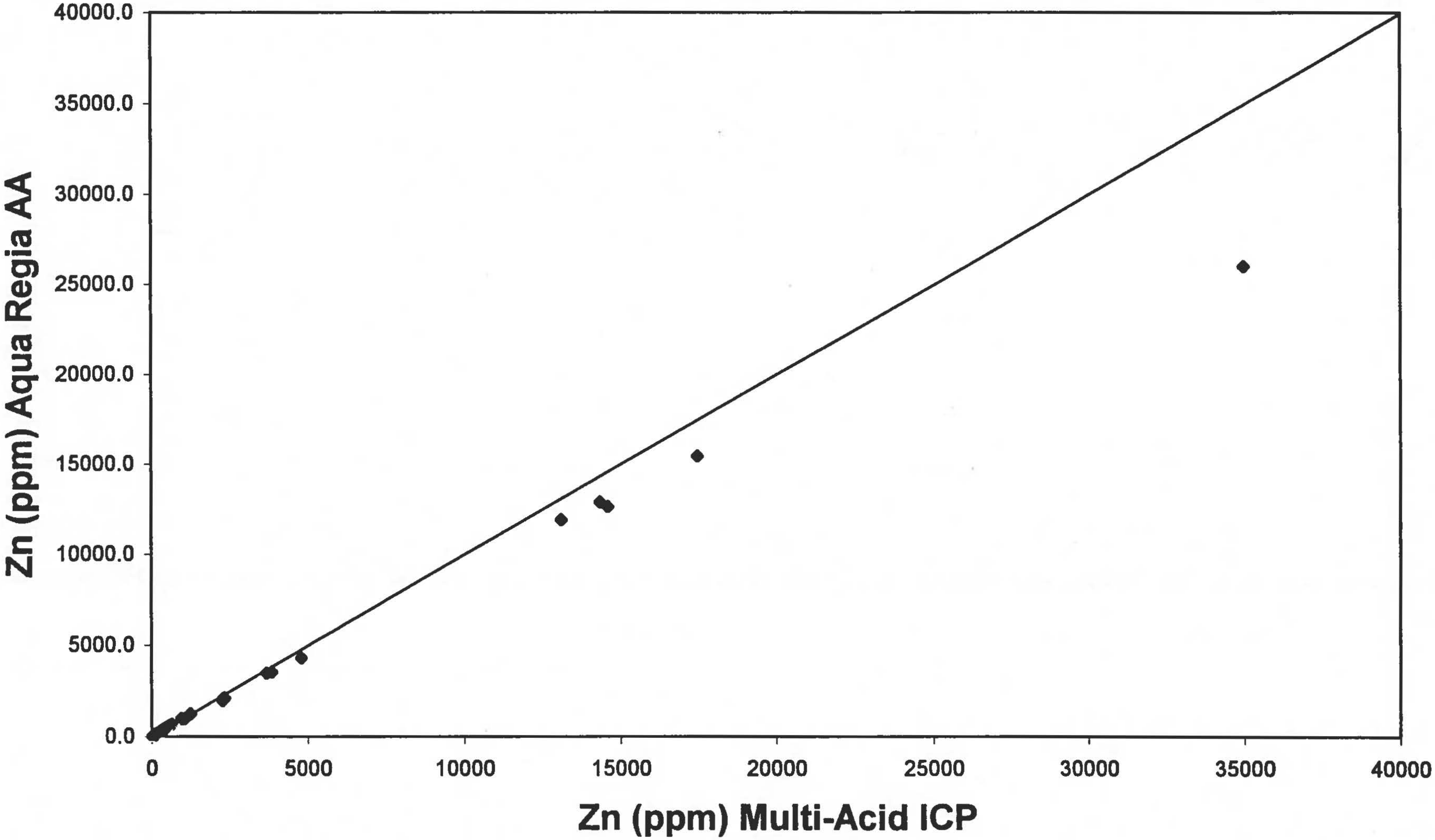
Cu Analytical Technique Comparison



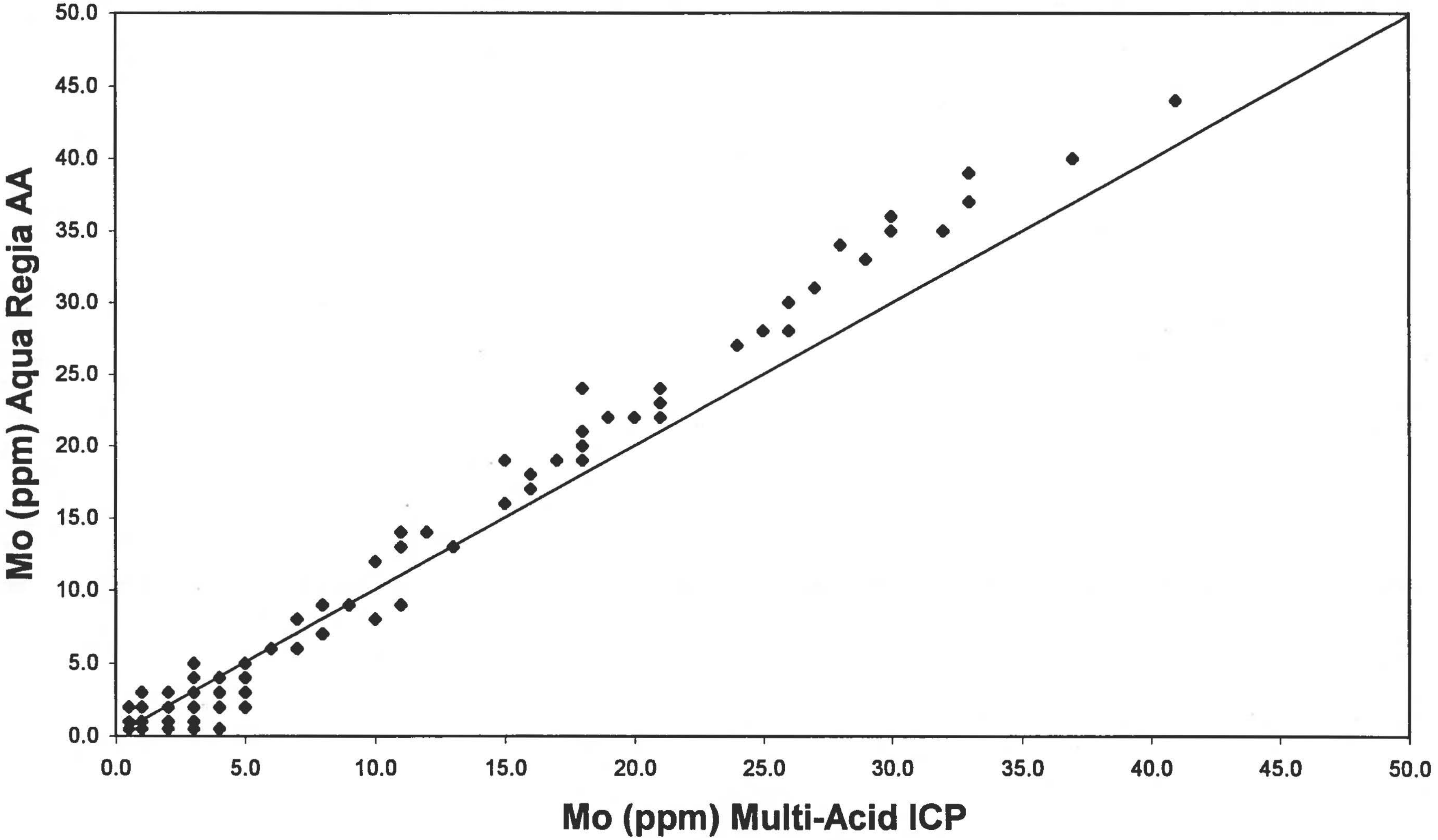
Pb Analytical Technique Comparison



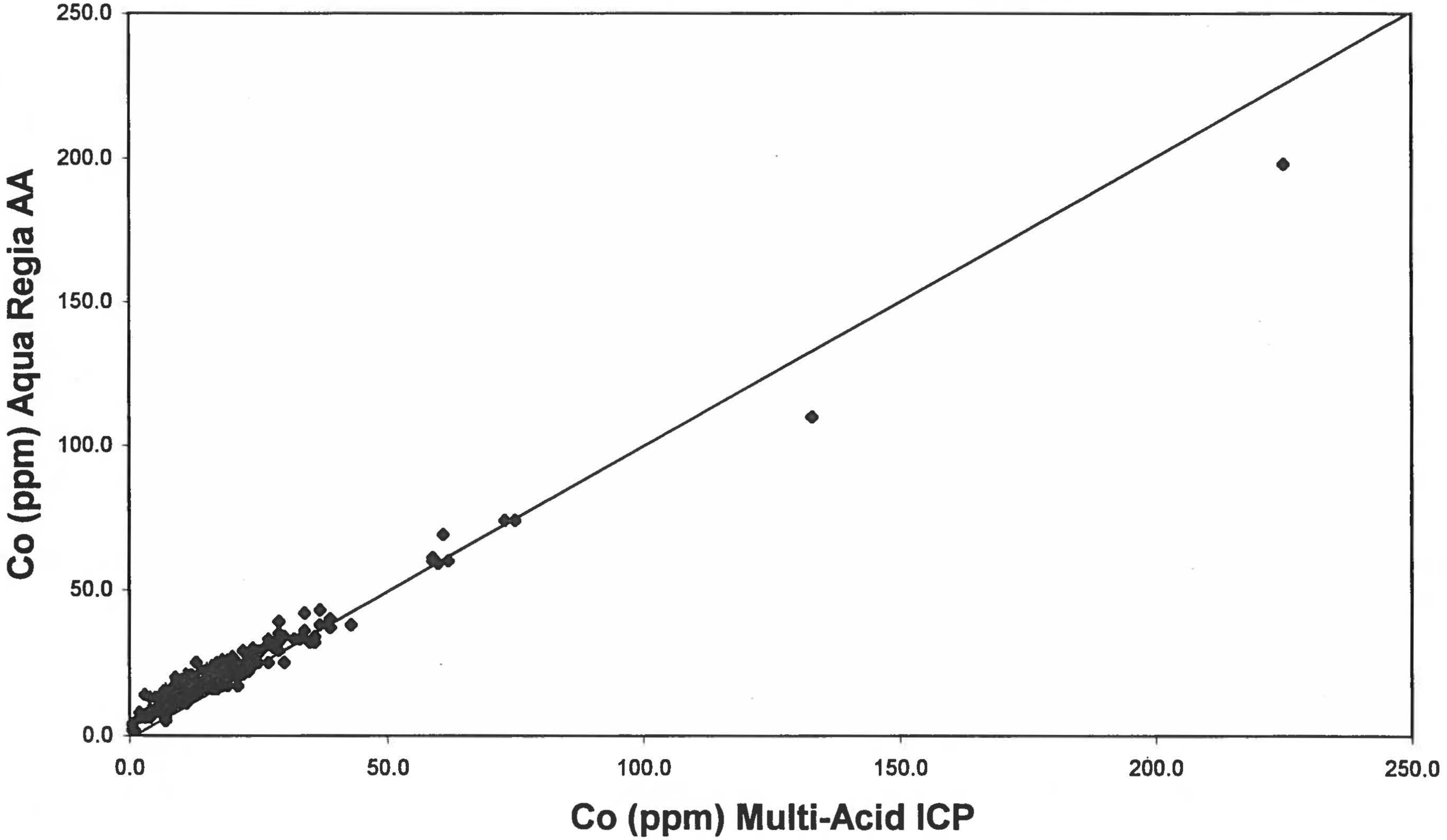
Zn Analytical Technique Comparison



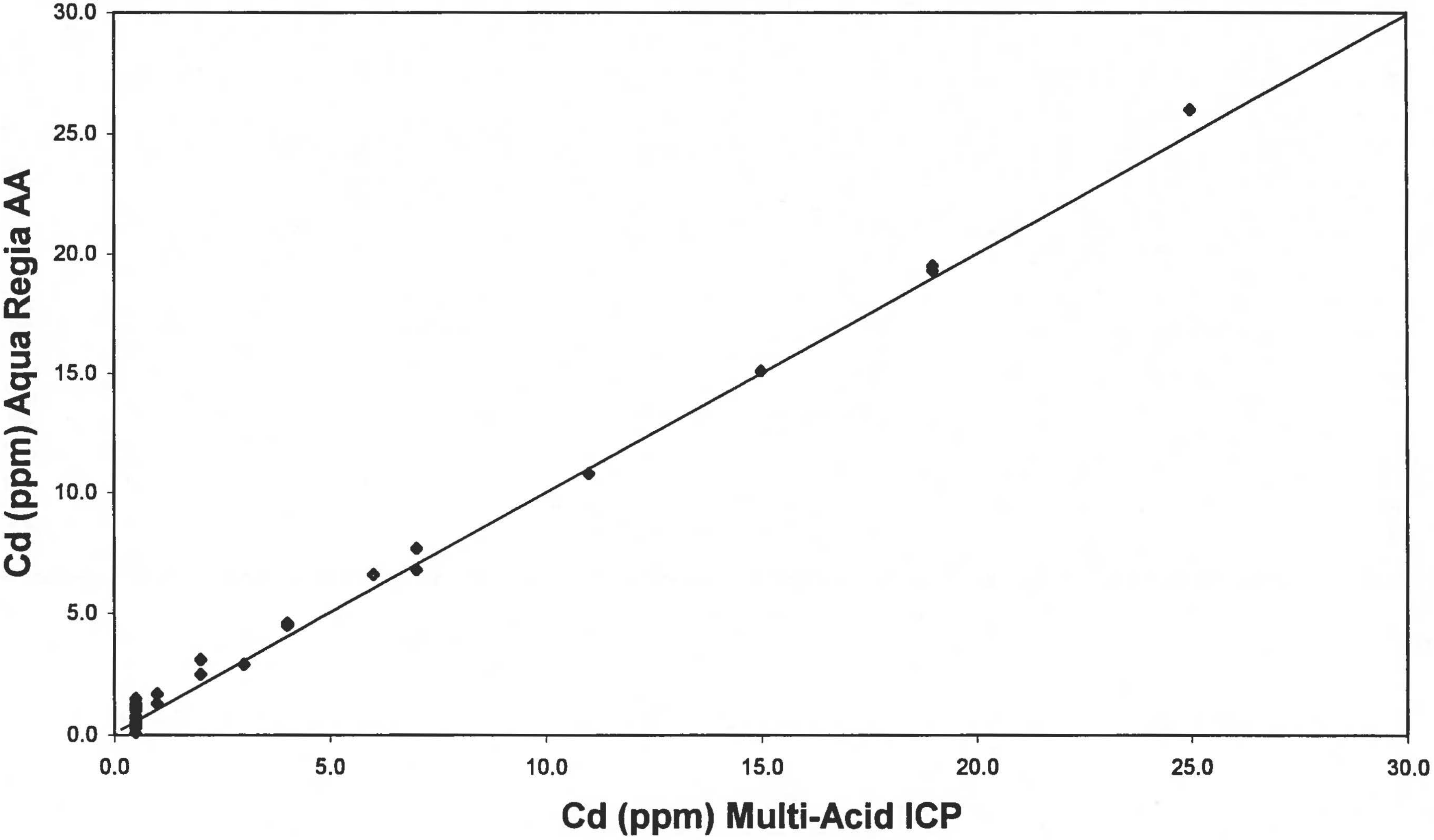
Mo Analytical Technique Comparison



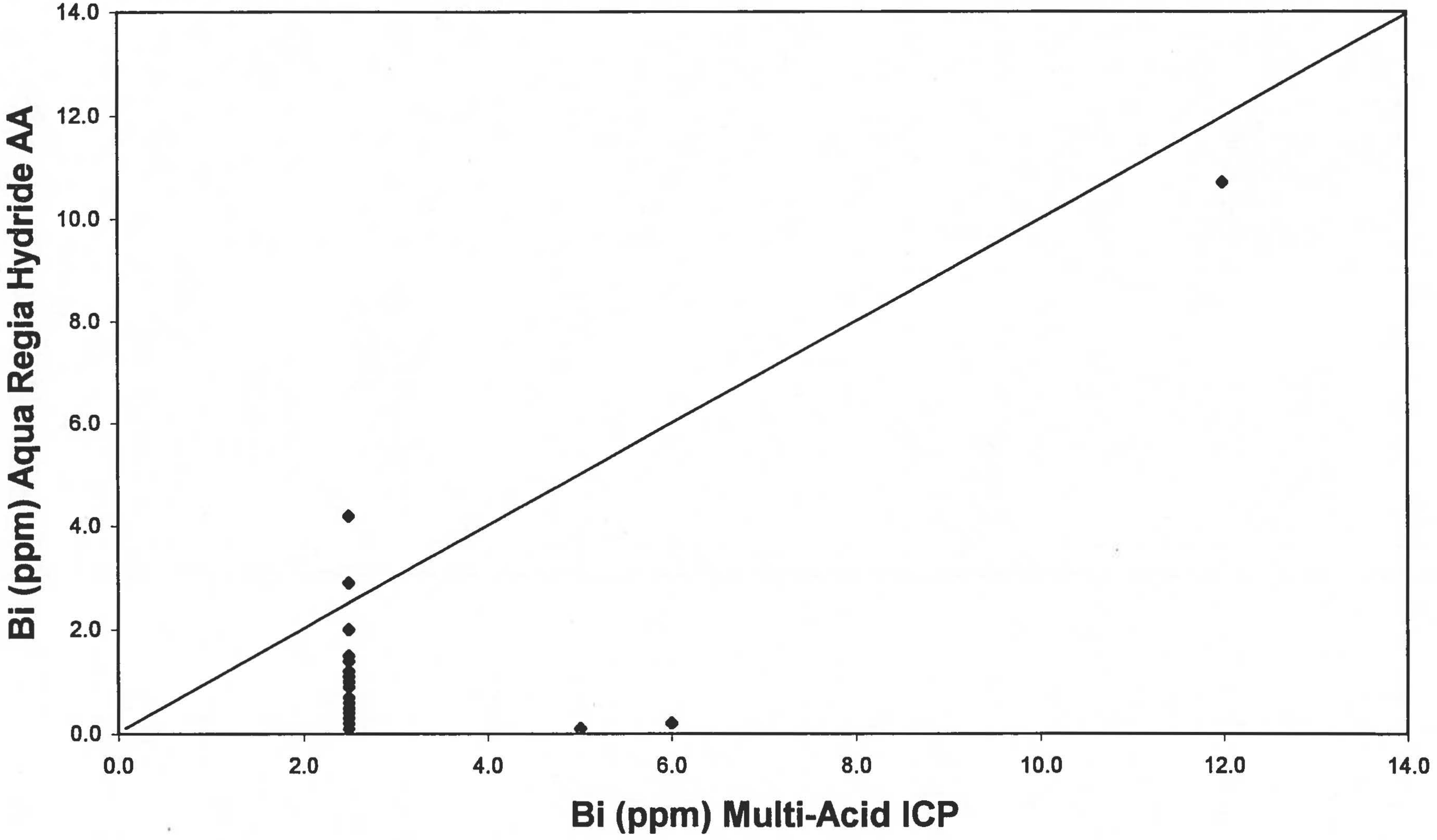
Co Analytical Technique Comparison

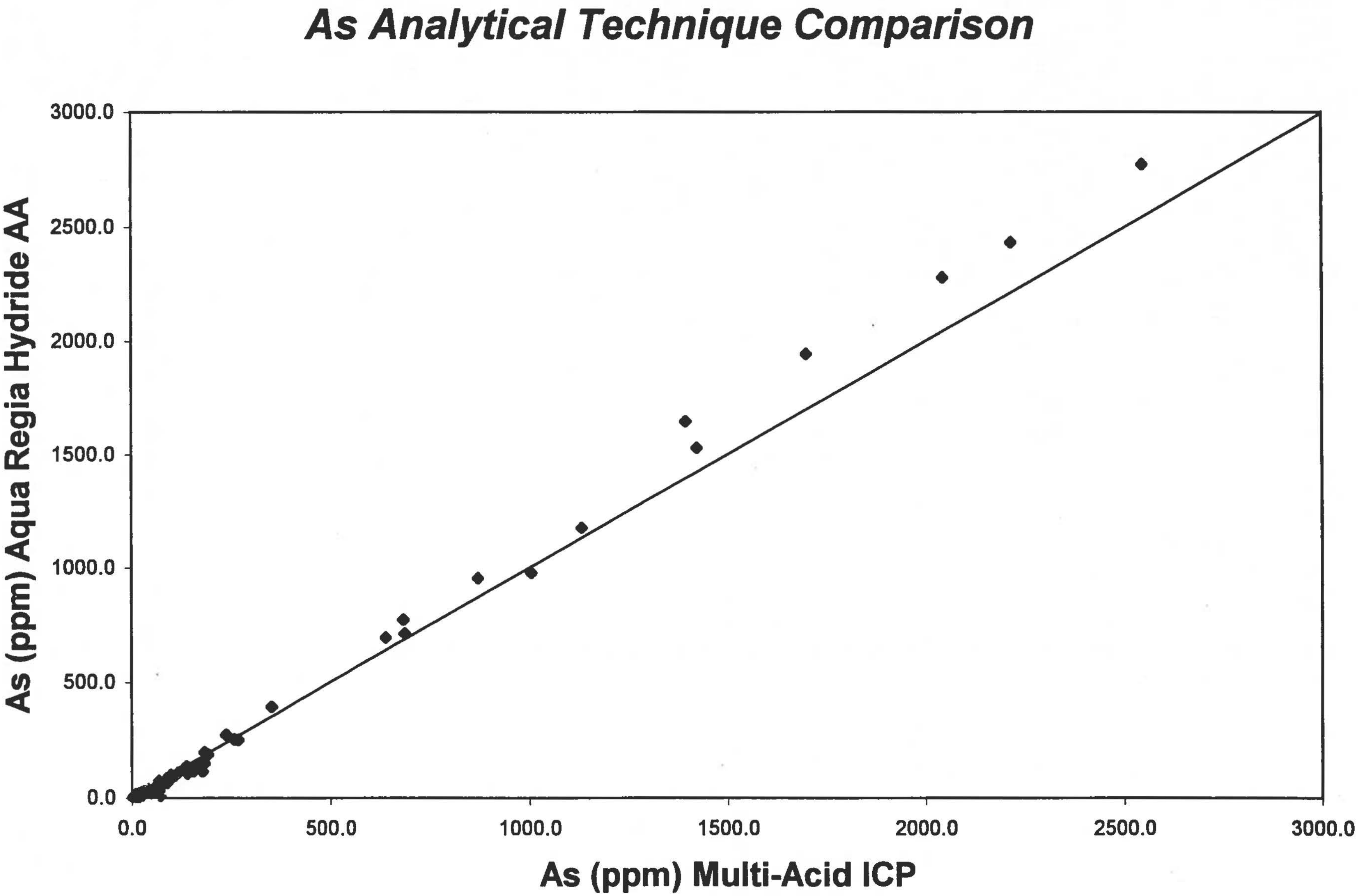


Cd Analytical Technique Comparison

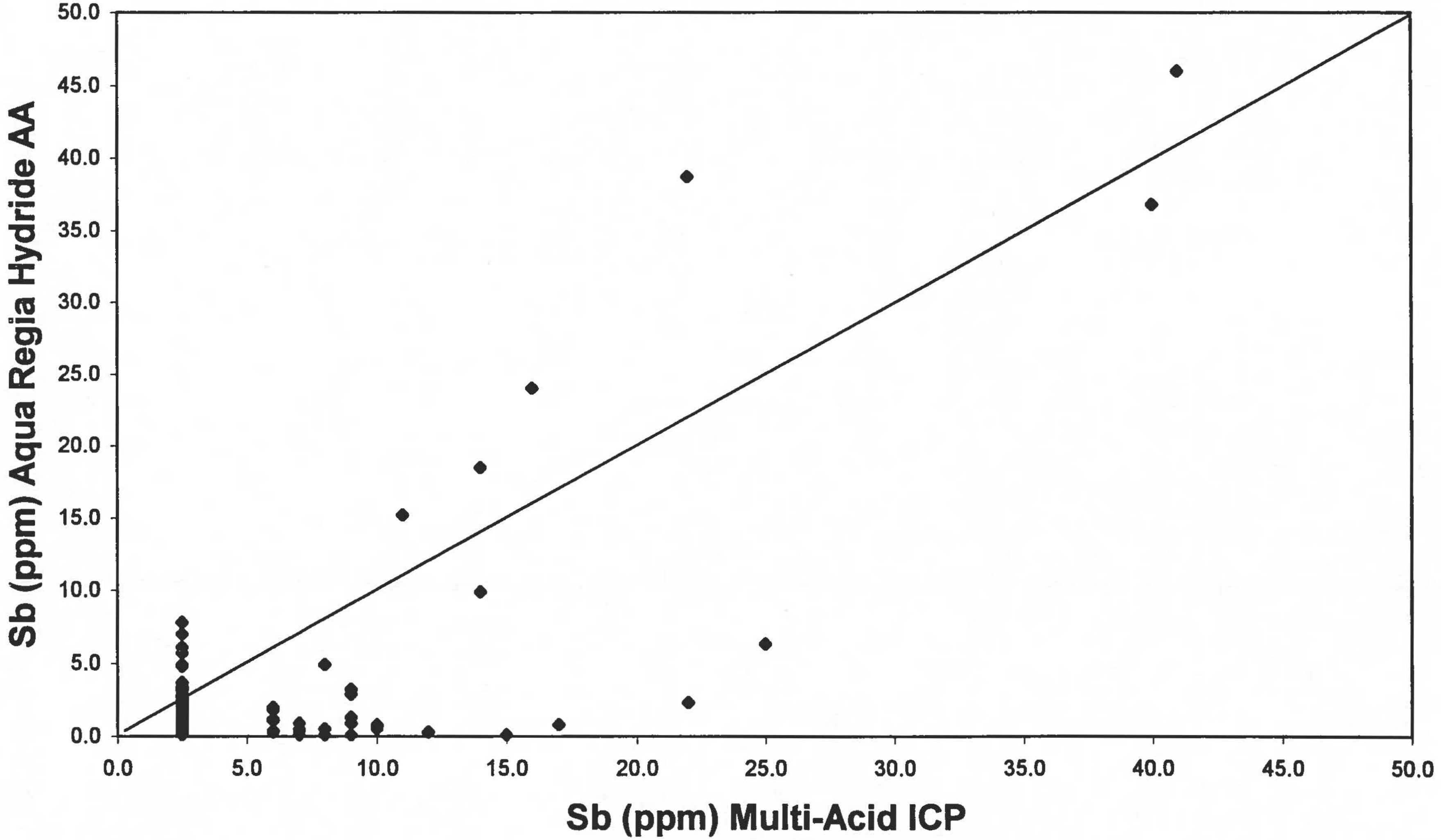


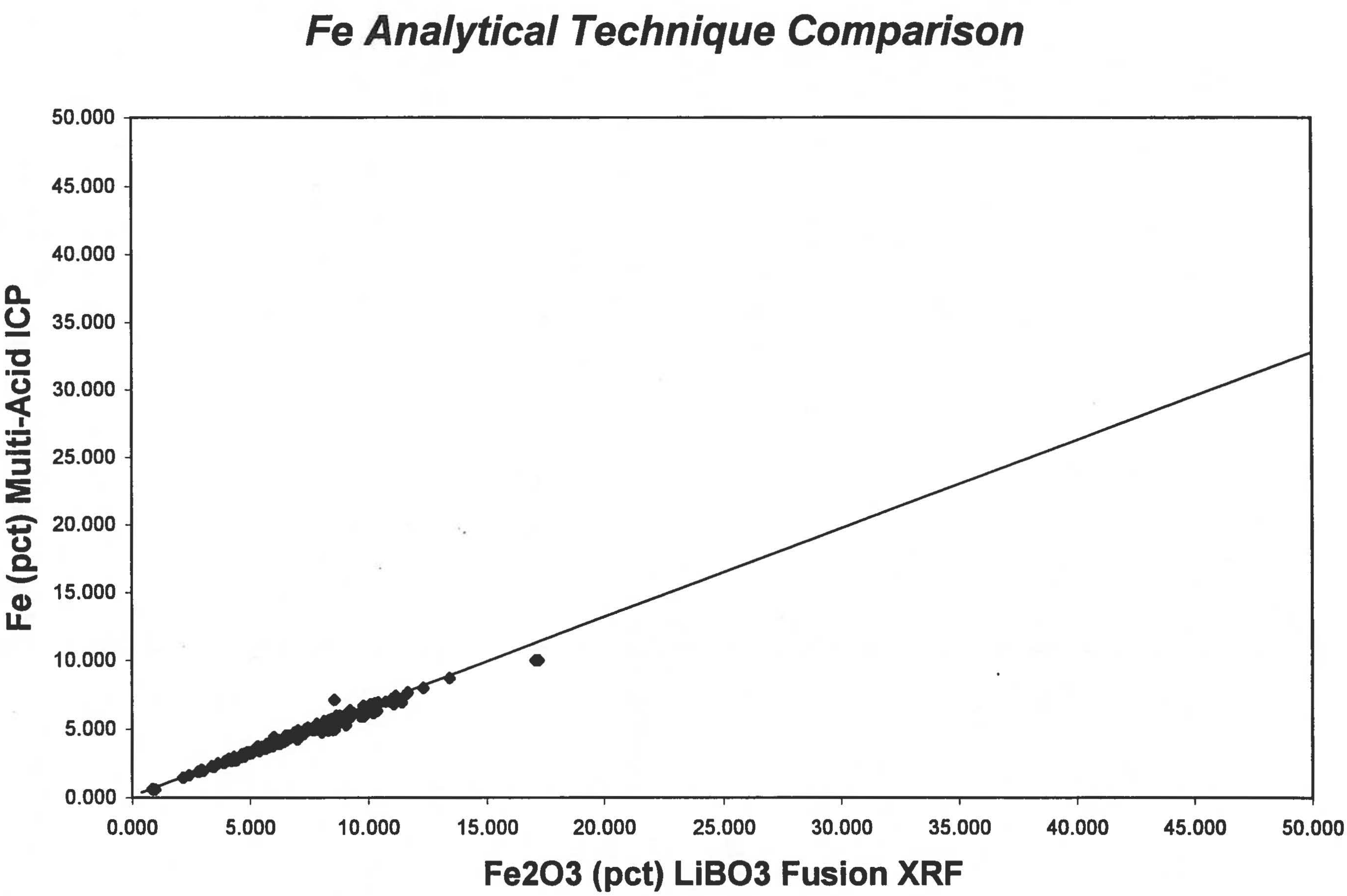
Bi Analytical Technique Comparison



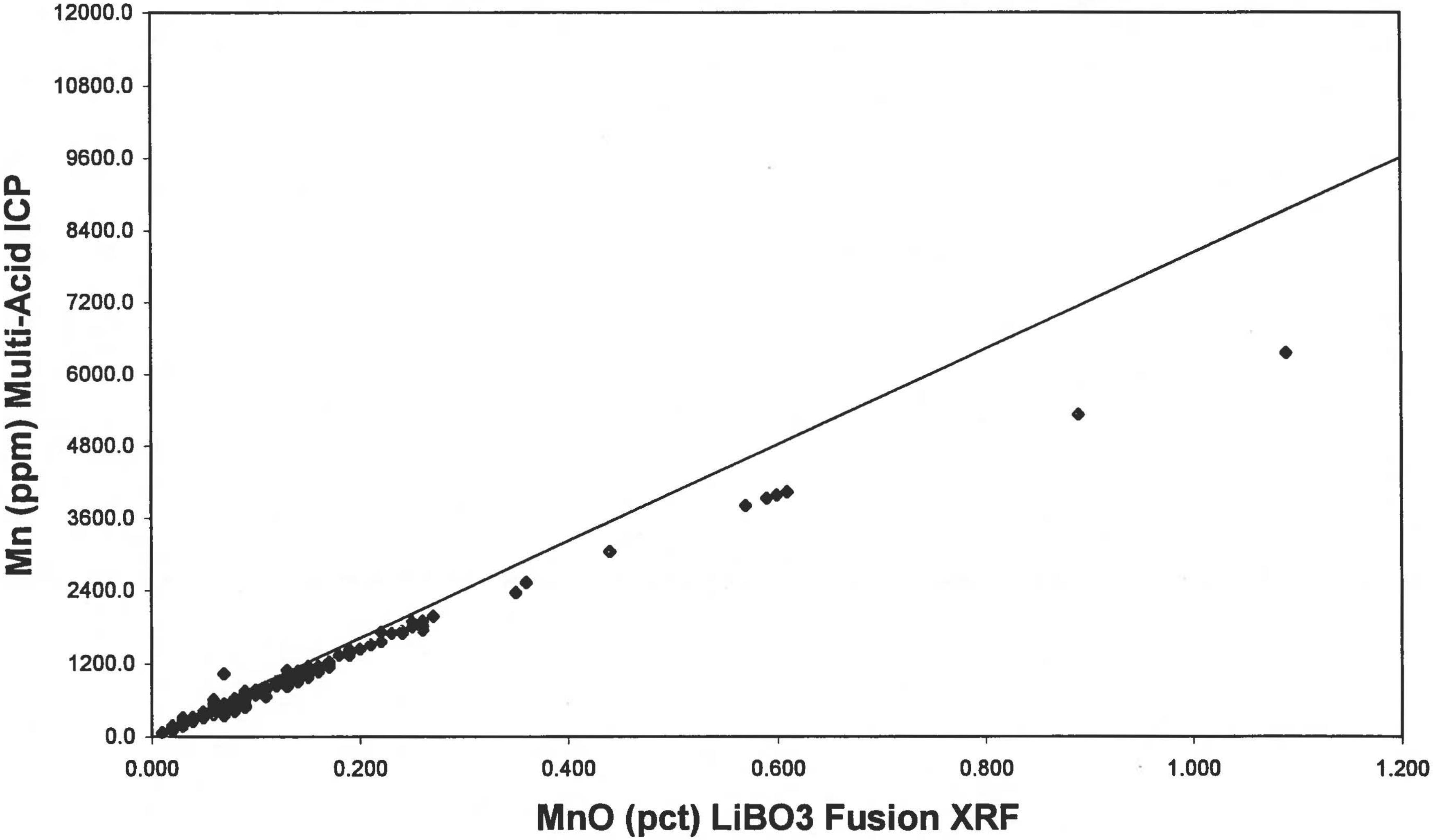

As Analytical Technique Comparison
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
As (ppm) Aqua Regia Hydride AA
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
As (ppm) Multi-Acid ICP

Sb Analytical Technique Comparison

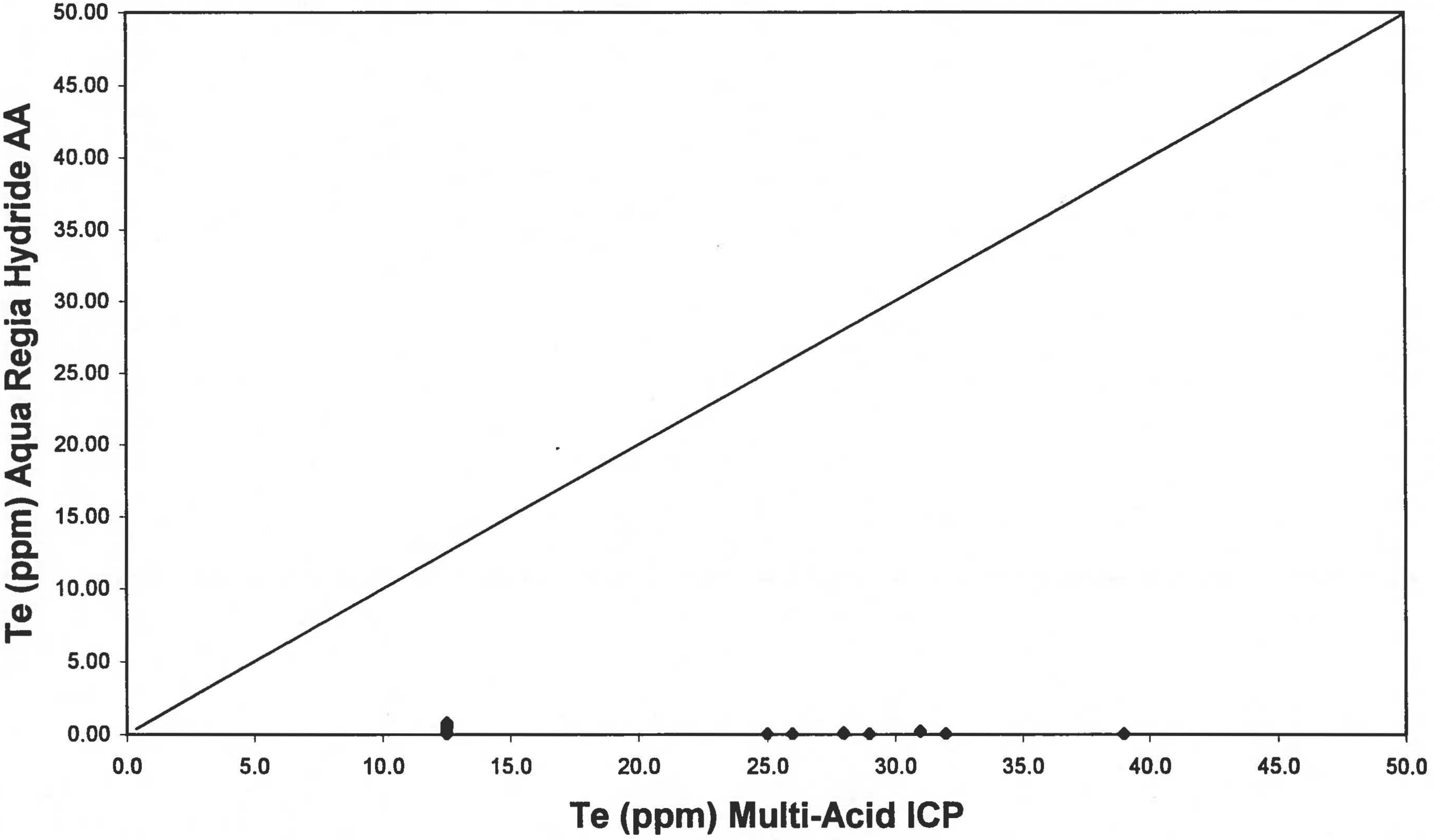



Fe Analytical Technique Comparison
Fe (pct) Multi-Acid ICP
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
0.000
5.000
10.000
15.000
20.000
25.000
30.000
35.000
40.000
45.000
50.000
Fe2O3 (pct) LiBO3 Fusion XRF

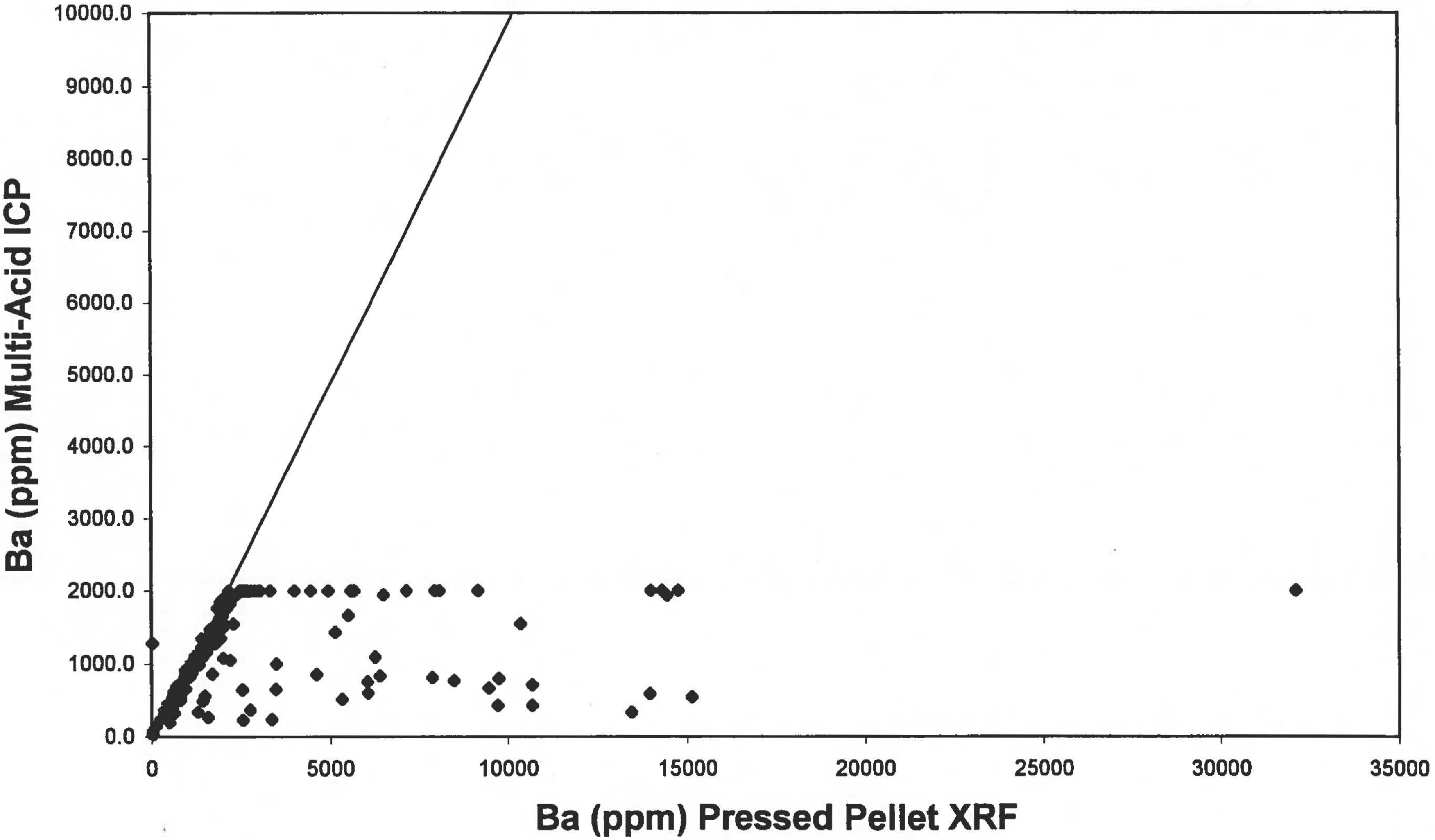
Mn Analytical Technique Comparison



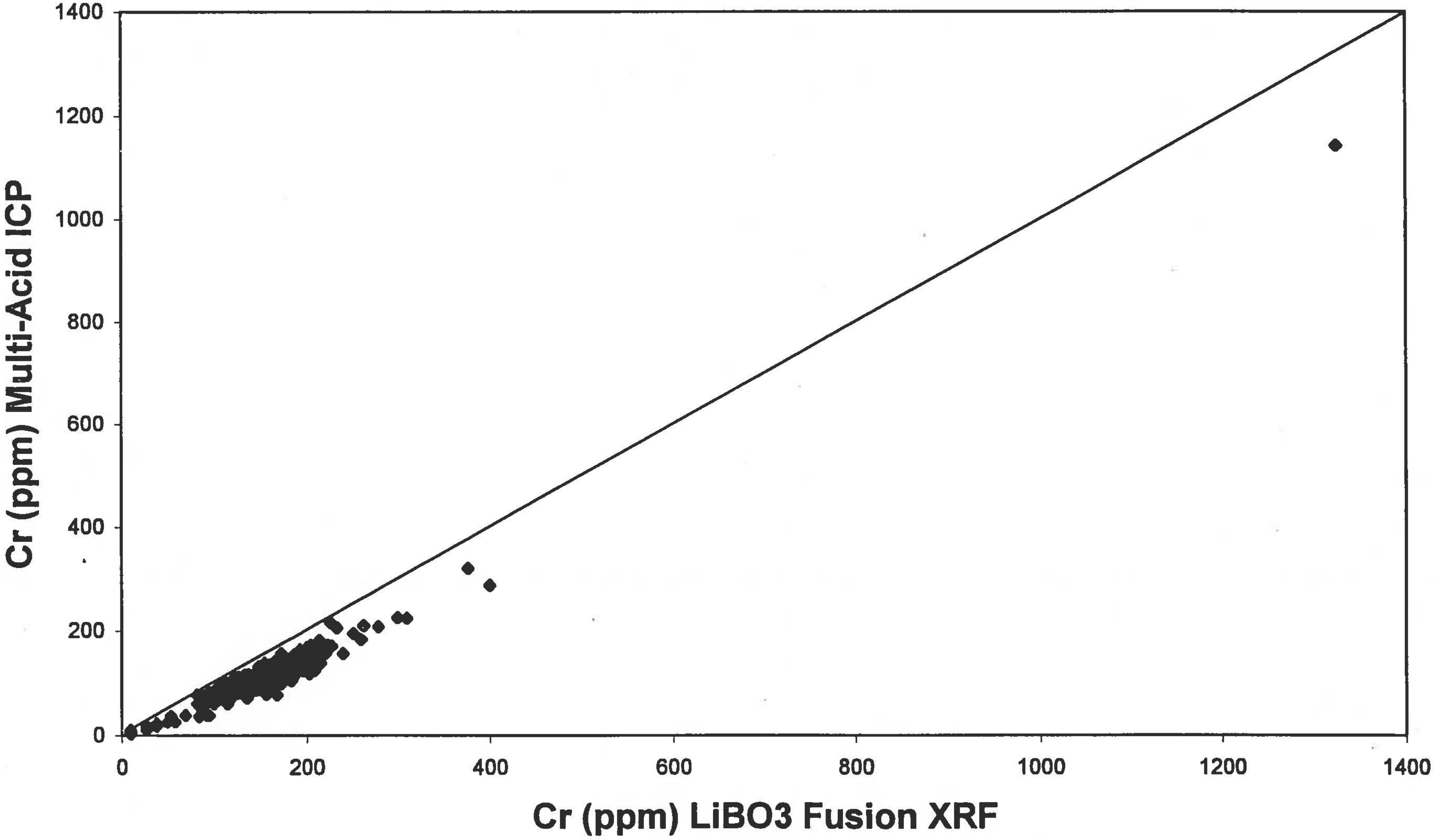
Te Analytical Technique Comparison



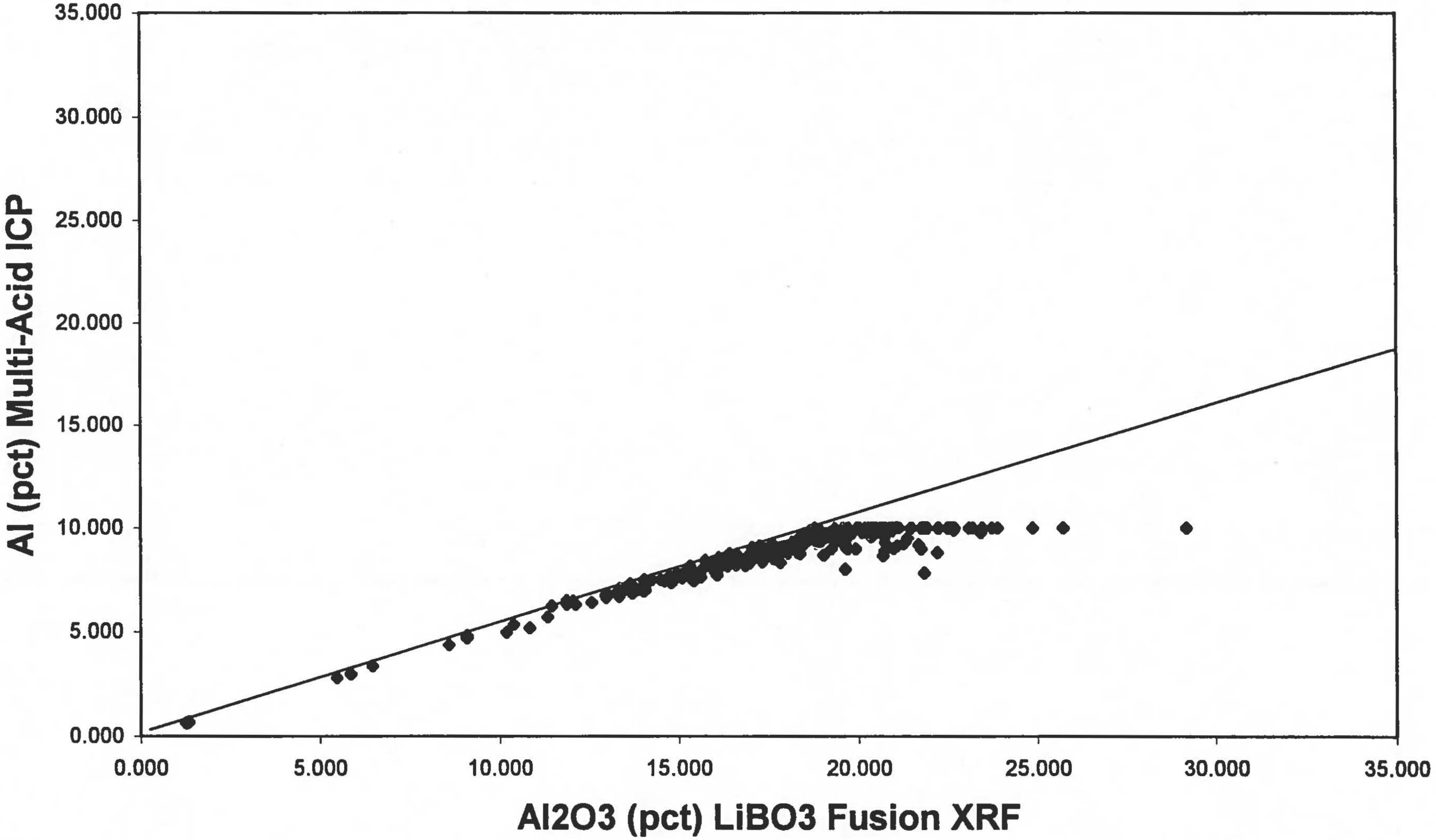
Ba Analytical Technique Comparison

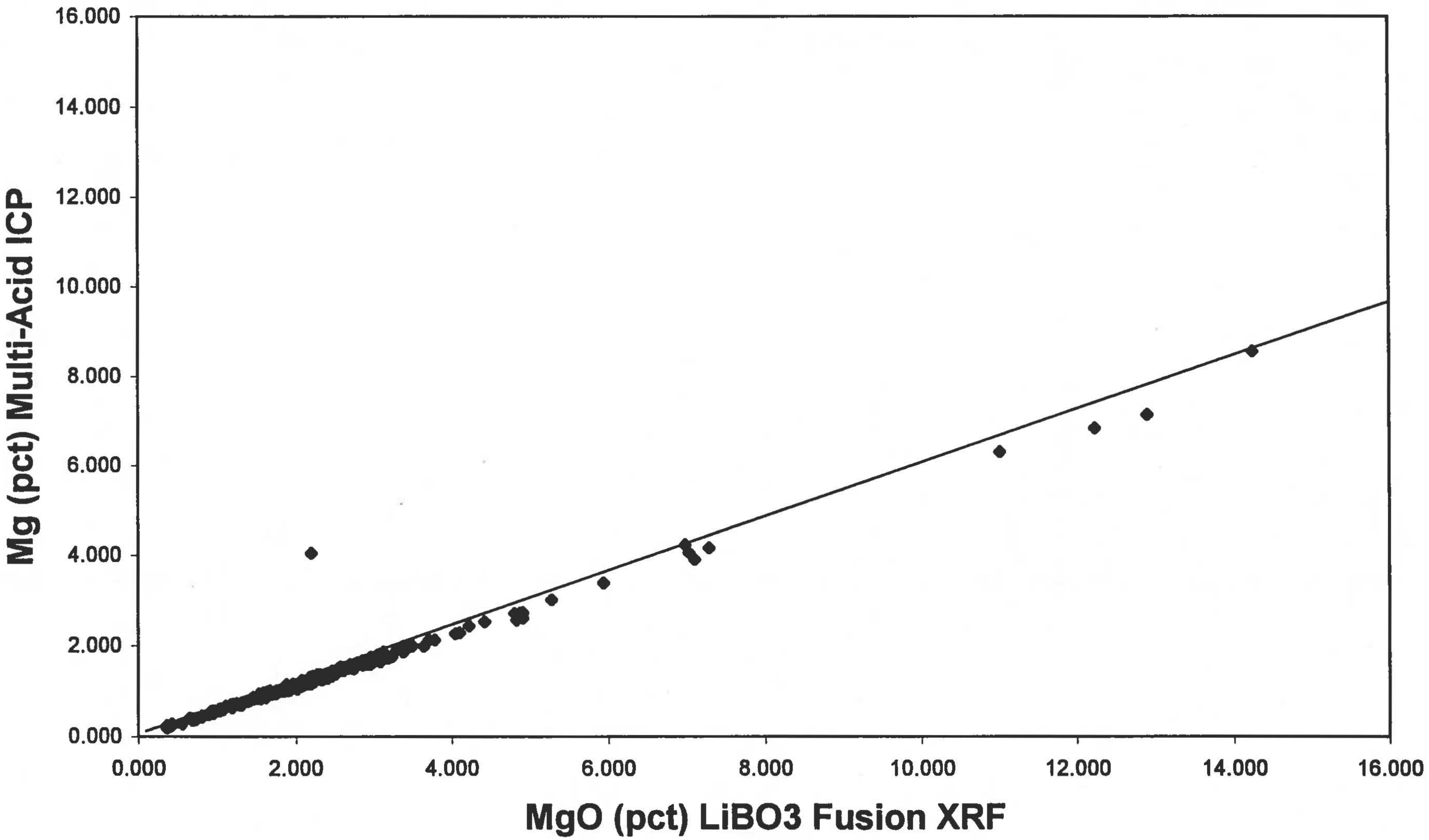


Cr Analytical Technique Comparison



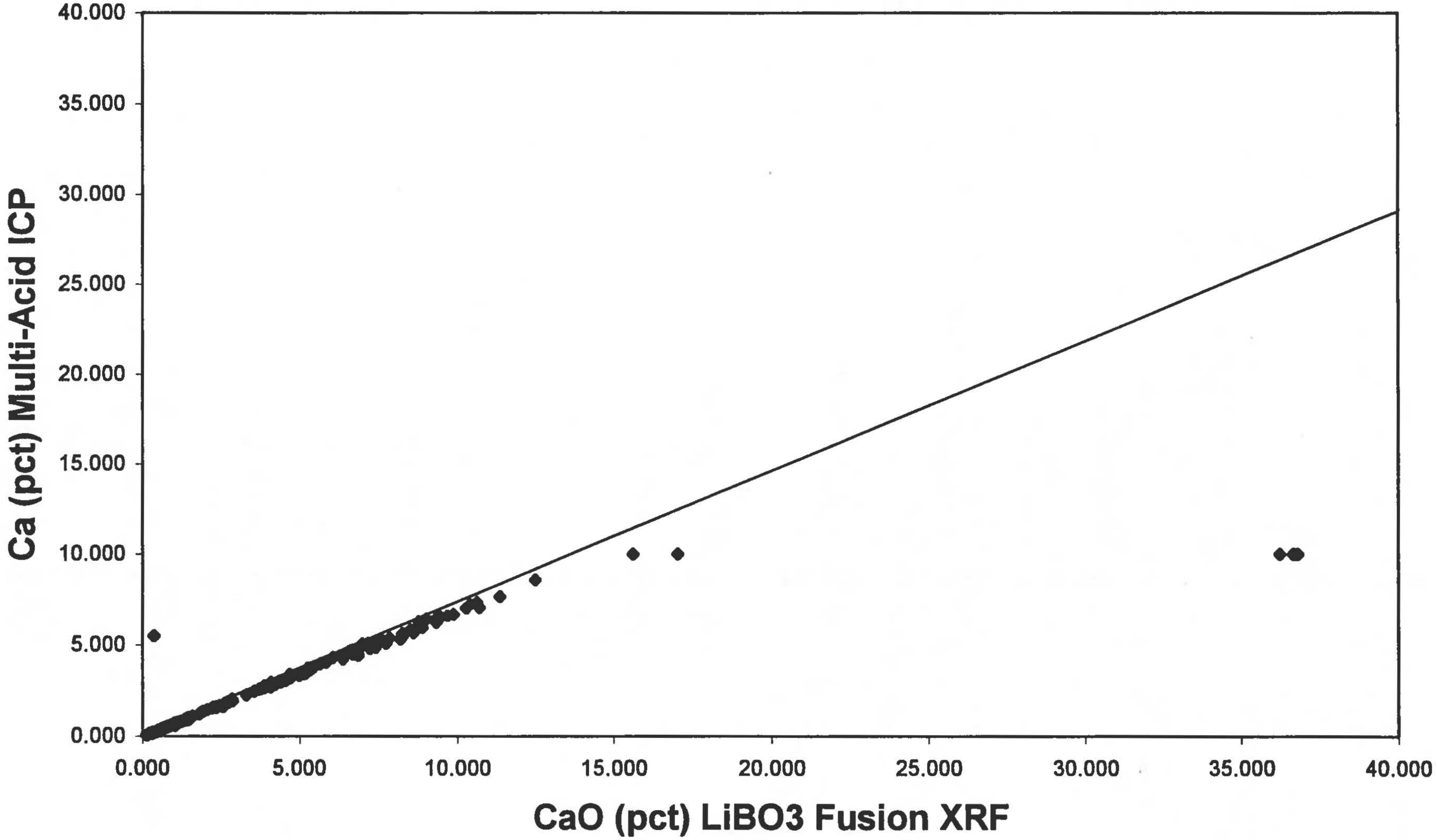
Al Analytical Technique Comparison



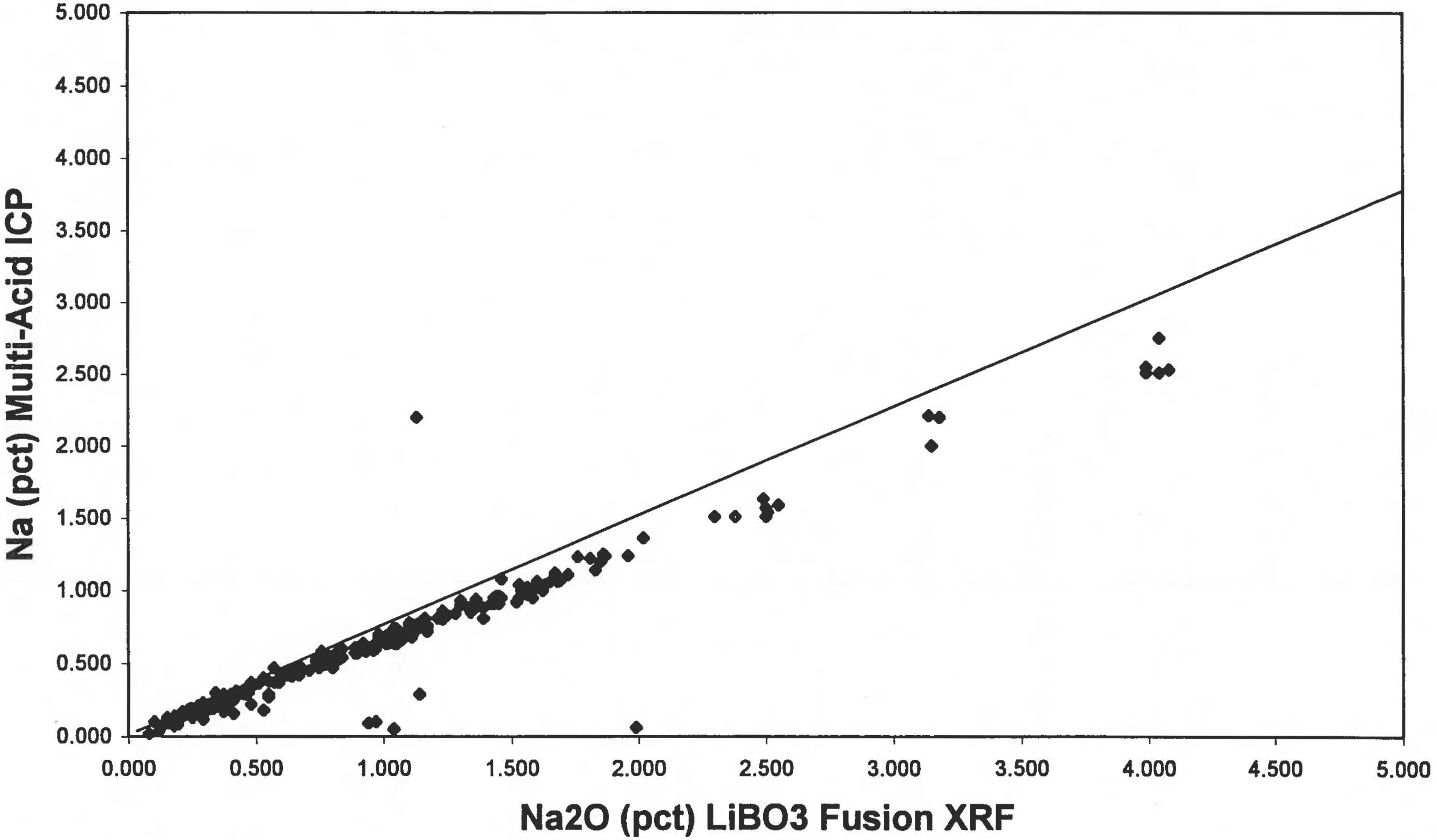


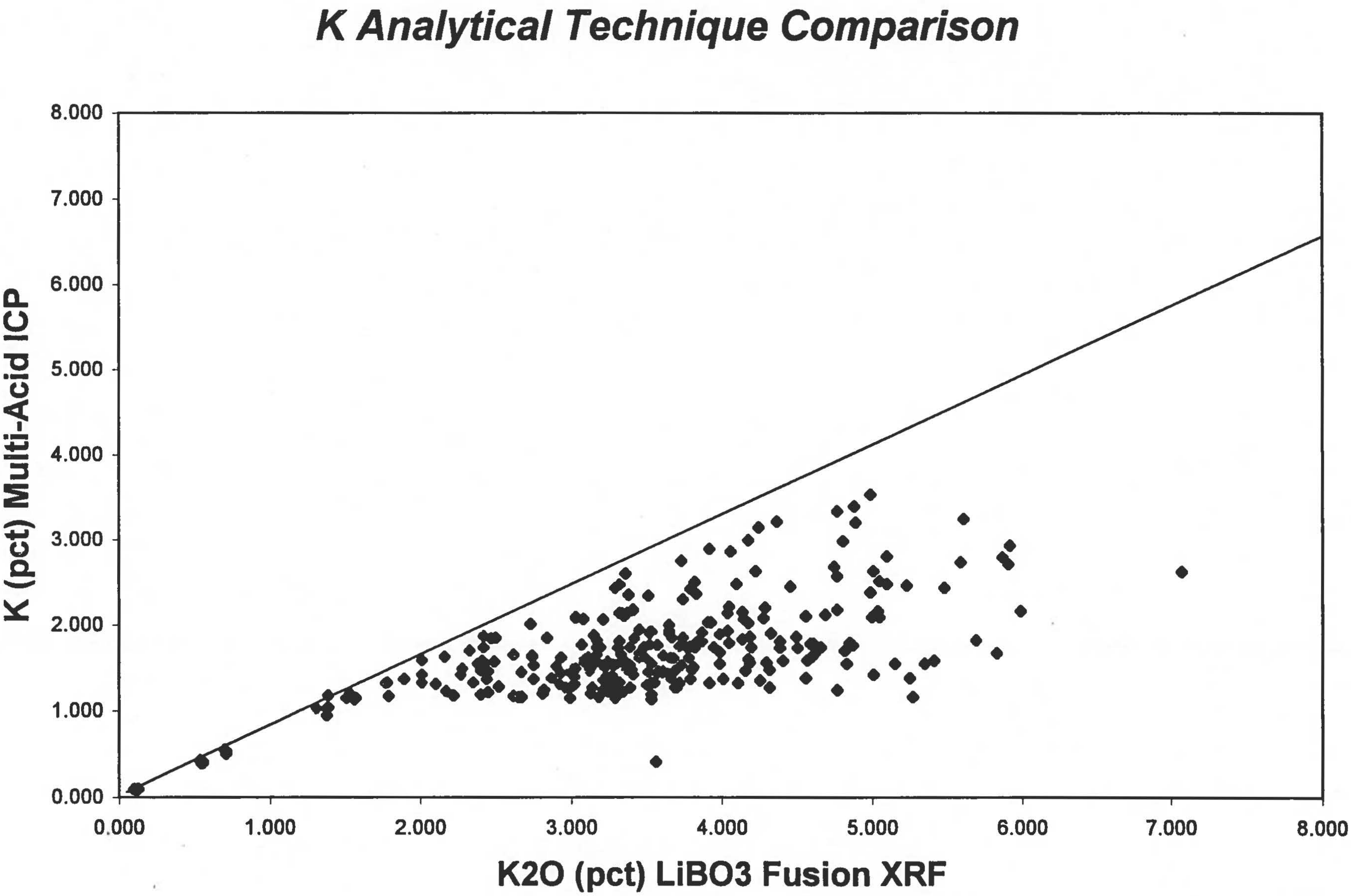
Mg Analytical Technique Comparison

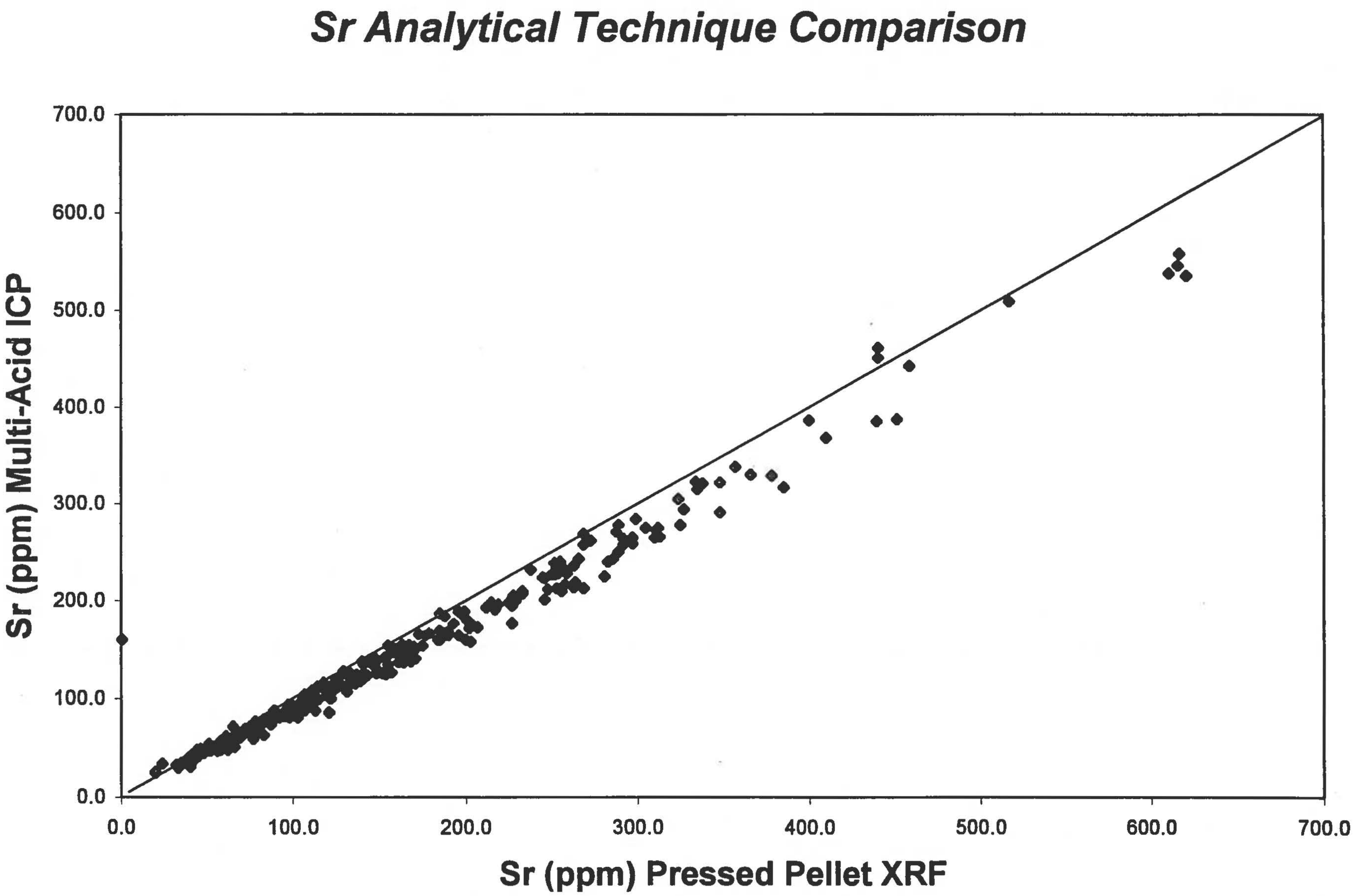
Ca Analytical Technique Comparison



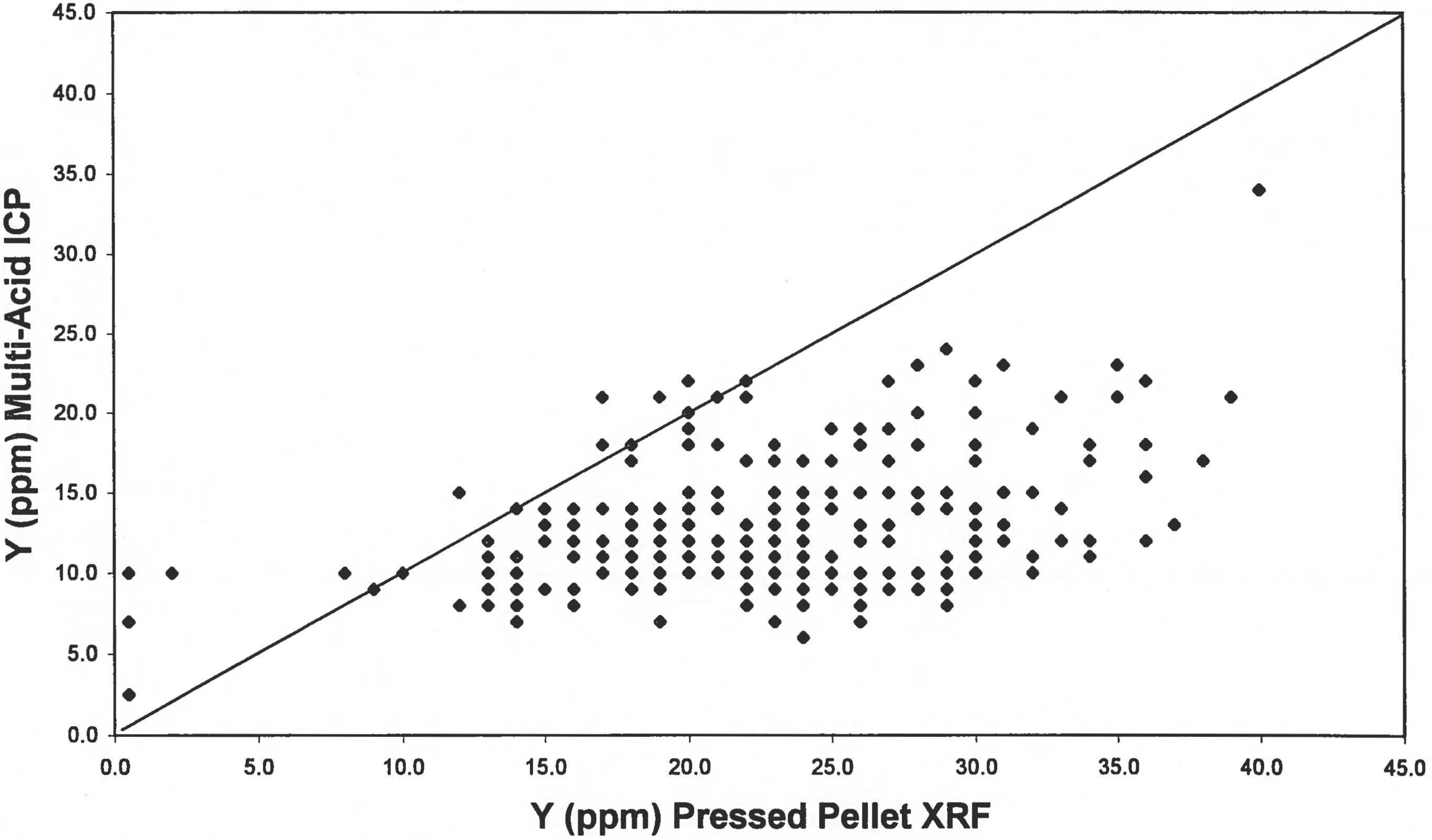
Na Analytical Technique Comparison



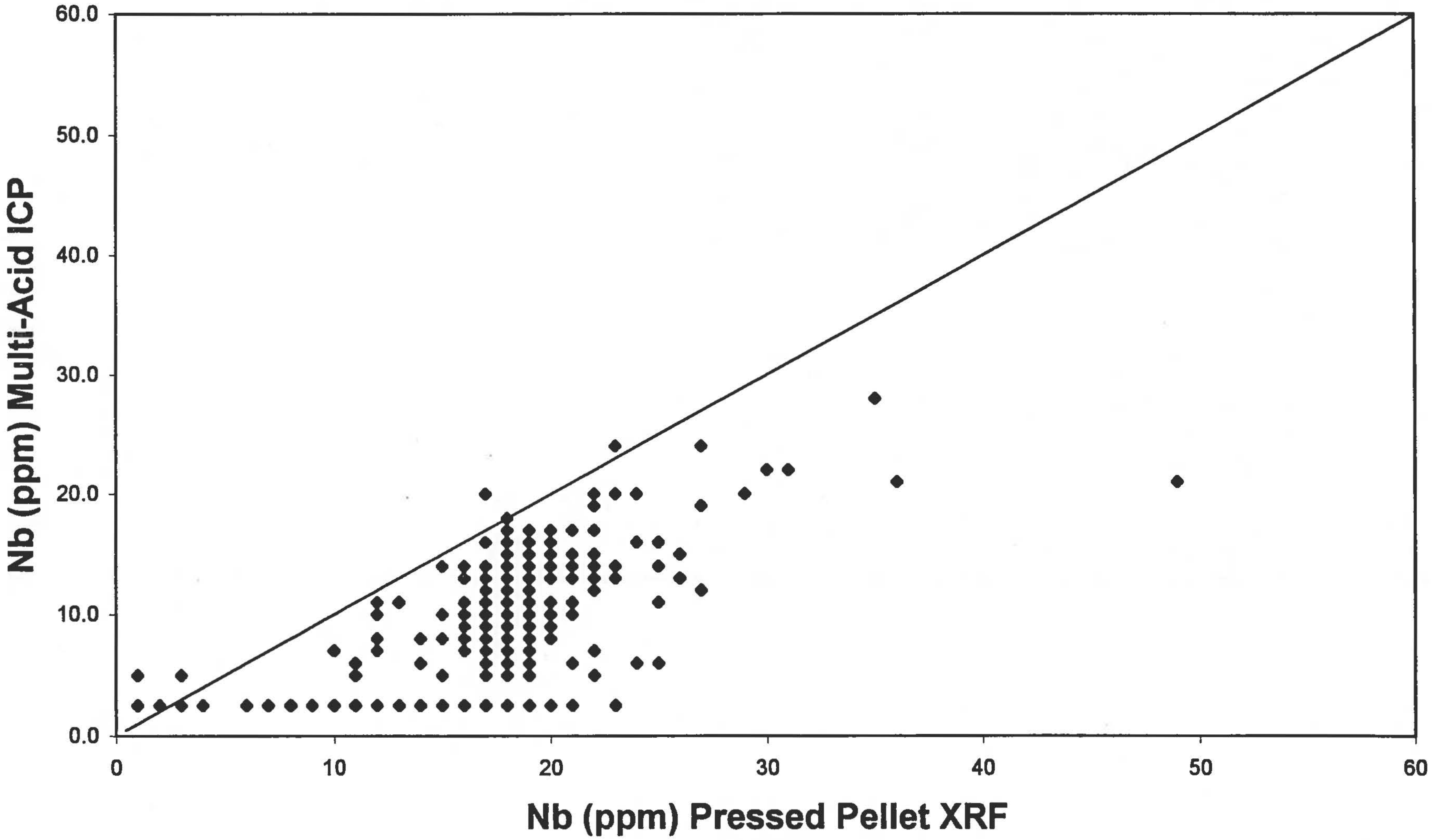

K Analytical Technique Comparison
K (pct) Multi-Acid ICP
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
K2O (pct) LiBO3 Fusion XRF


Sr Analytical Technique Comparison
Sr (ppm) Multi-Acid ICP
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Sr (ppm) Pressed Pellet XRF

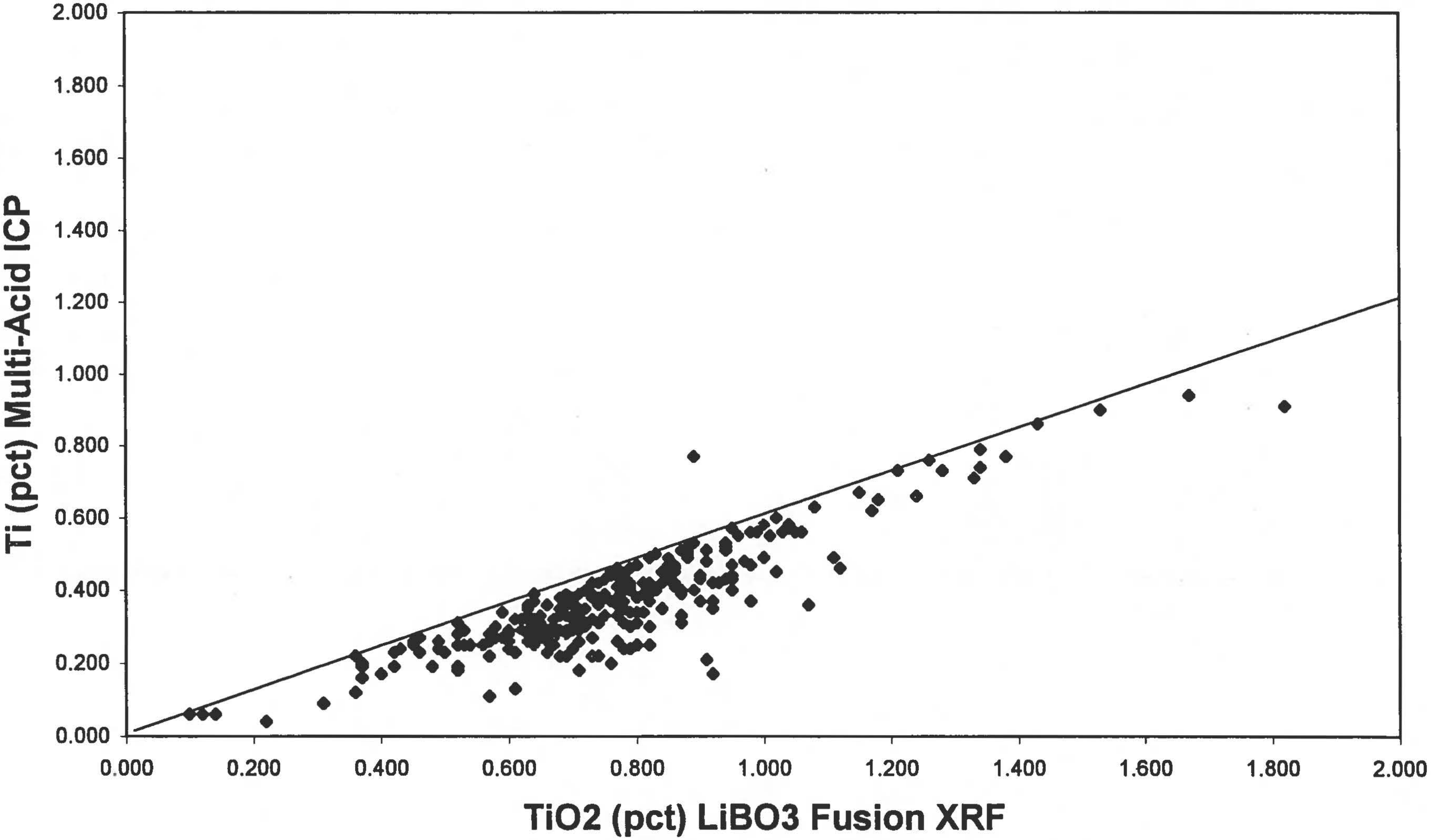
Y Analytical Technique Comparison



Nb Analytical Technique Comparison



Ti Analytical Technique Comparison



Zr Analytical Technique Comparison