005040

C U R R A G H   R E S O U R C E S   I N C

INTER-OFFICE MEMORANDUM

FARO OFFICE

DATE: December 7, 1990

TO: BRAD PISONY
GRADE CONTROL GEOLOGIST

FROM: DAVE TENNEY
CHIEF GEOLOGIST

SUBJECT: MAP 3 XRF UNIT

Please make certain that all blast holes which are sampled are also checked with the XRF unit in the field. Any changes in the lithology of the chippings piles should be treated separately, and readings and spectra downloaded into files for further study. Notes should be kept in the technicians notebooks showing readings (BHPb, BHZn, GCZn, Tracker) with comments on the spectrum. In the event that assays are not available this information can be used to outline dig packages.

D. Tenney

Dave Tenney
Chief Geologist

DT:cc

cc: W. Dunn
M. Wasel
P. Ledwidge
H. MacIssac
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A. MacLelland
S. Horte
G. Godberson
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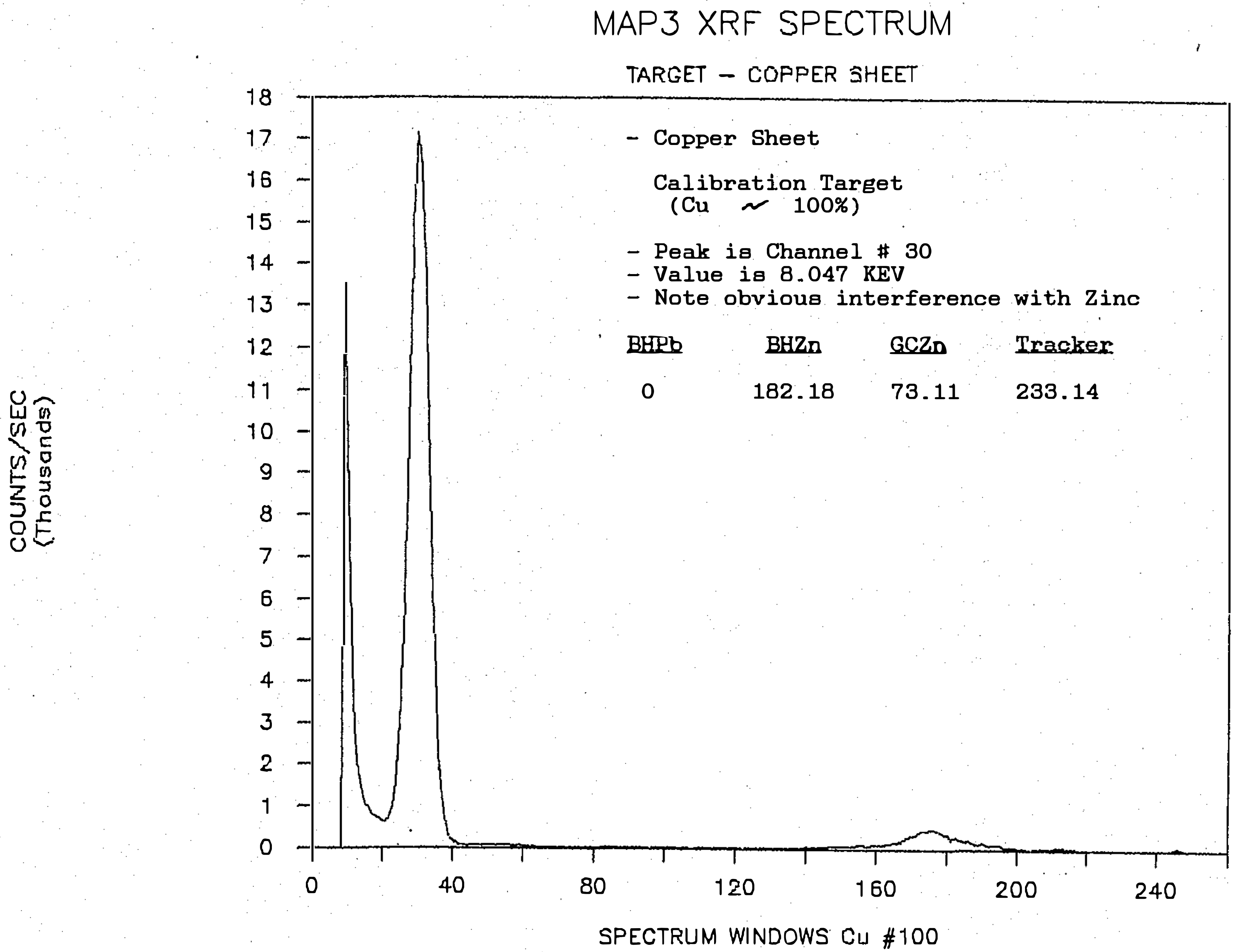
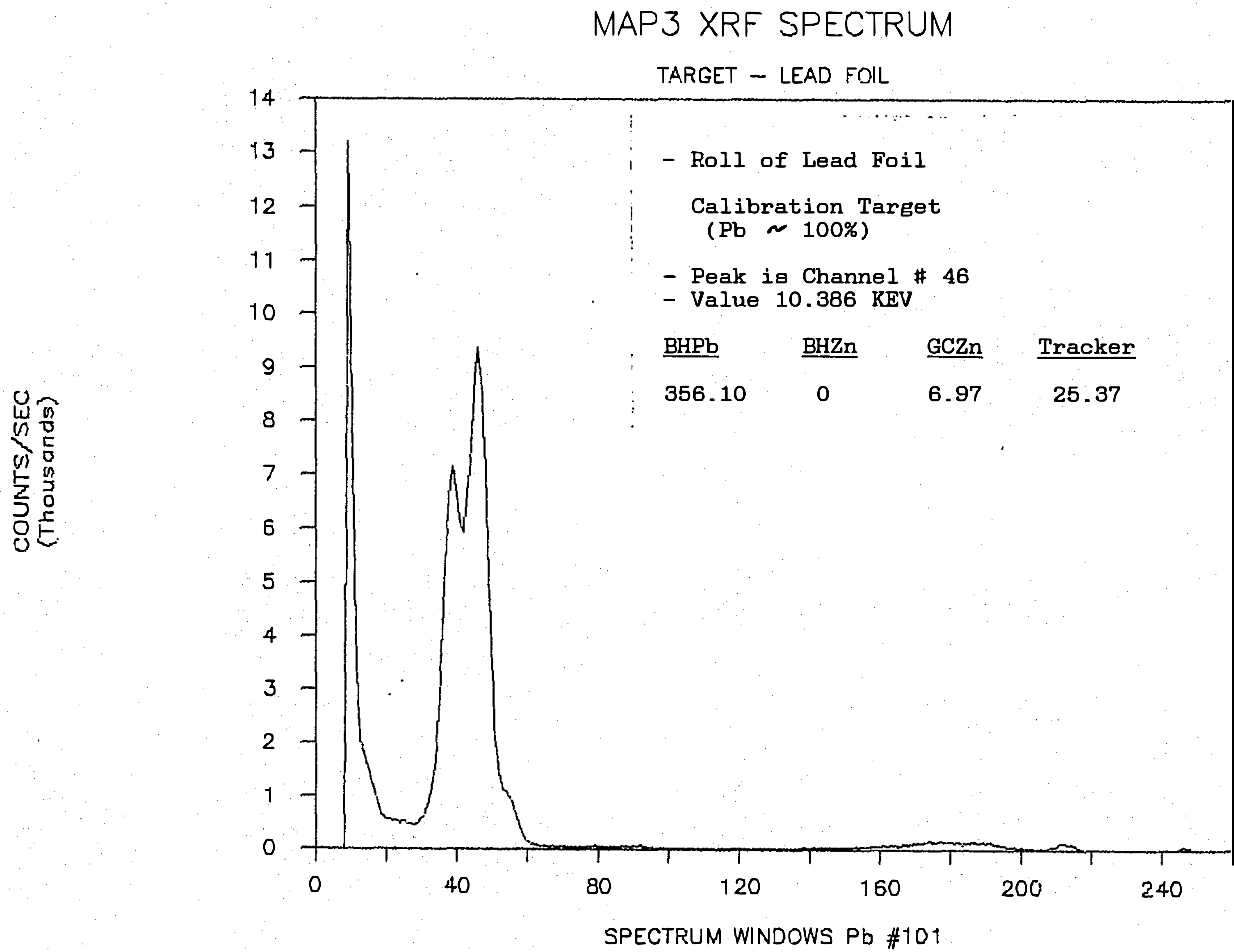
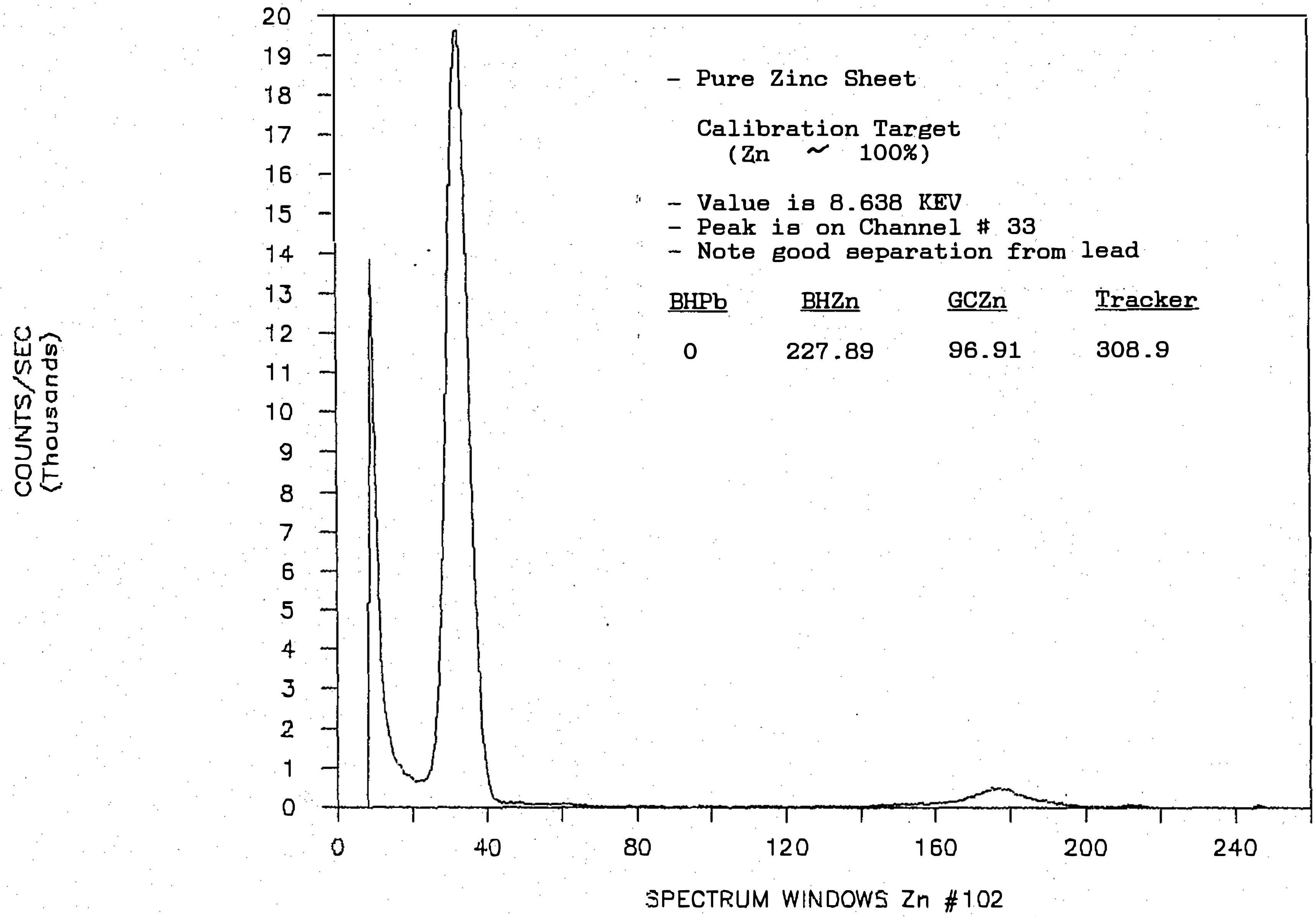
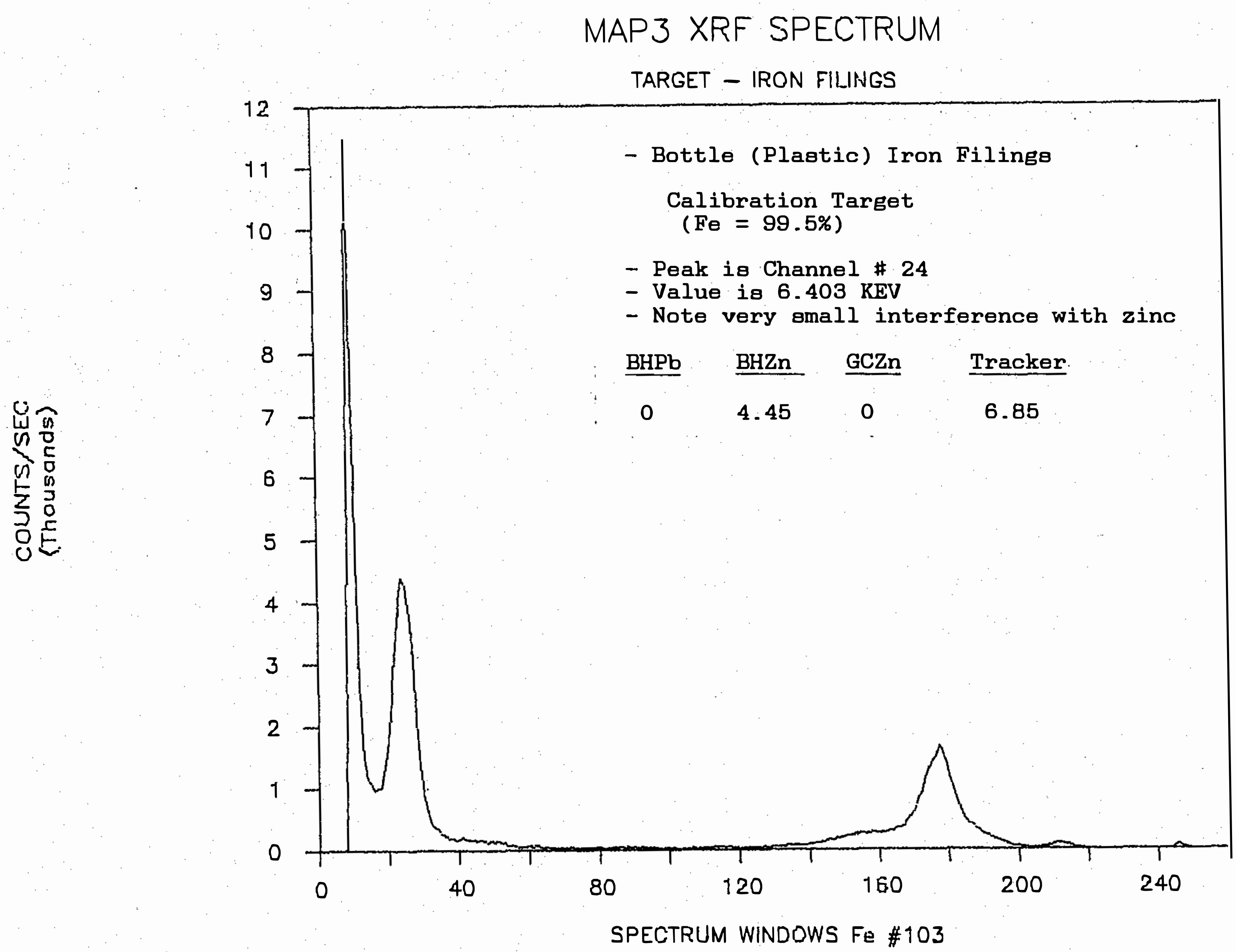

MAP3 XRF SPECTRUM
TARGET – COPPER SHEET
- Copper Sheet
Calibration Target
(Cu ~ 100%)
- Peak is Channel # 30
- Value is 8.047 KEV
- Note obvious interference with Zinc
BHPb BHZn GCZn Tracker
0 182.18 73.11 233.14
COUNTS/SEC
(Thousands)
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0
40
80
120
160
200
240
SPECTRUM WINDOWS Cu #100


MAP3 XRF SPECTRUM
TARGET – LEAD FOIL
- Roll of Lead Foil
Calibration Target
(Pb ~ 100%)
- Peak is Channel # 46
- Value 10.386 KEV
BHPb BHZn GCZn Tracker
356.10 0 6.97 25.37
COUNTS/SEC
(Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
40
80
120
160
200
240
SPECTRUM WINDOWS Pb #101

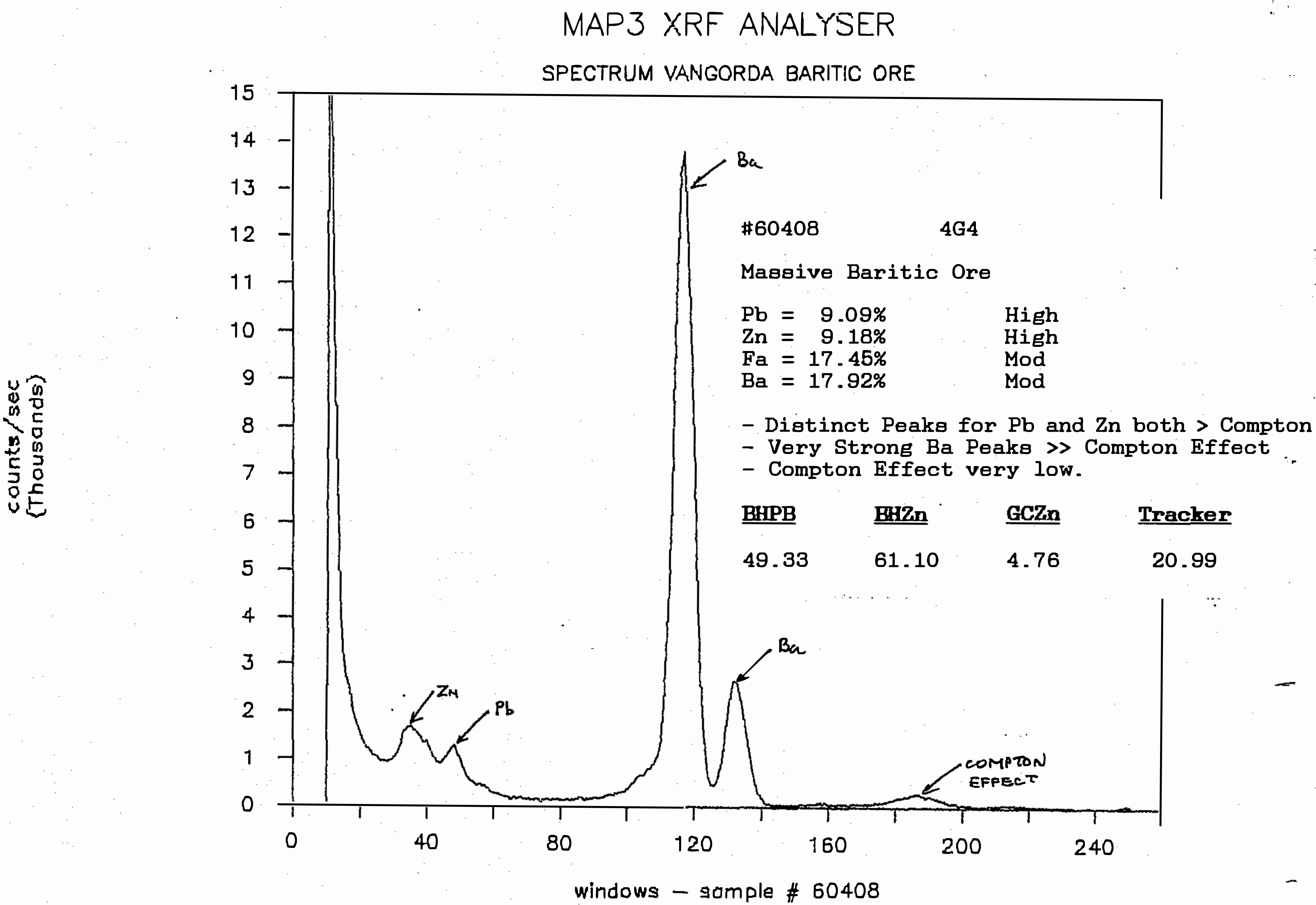
MAP3 XRF SPECTRUM

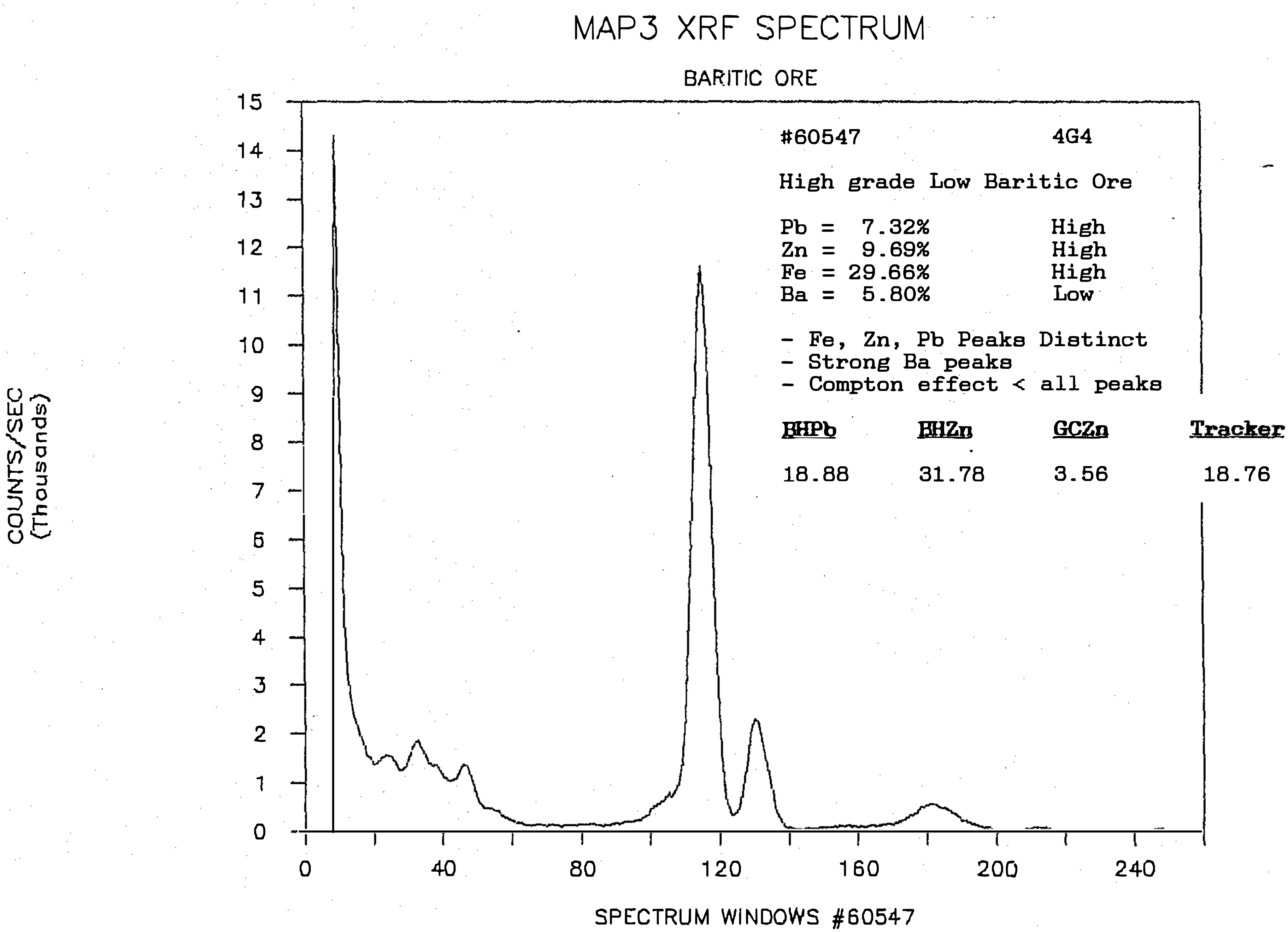
TARGET — ZINC SHEET

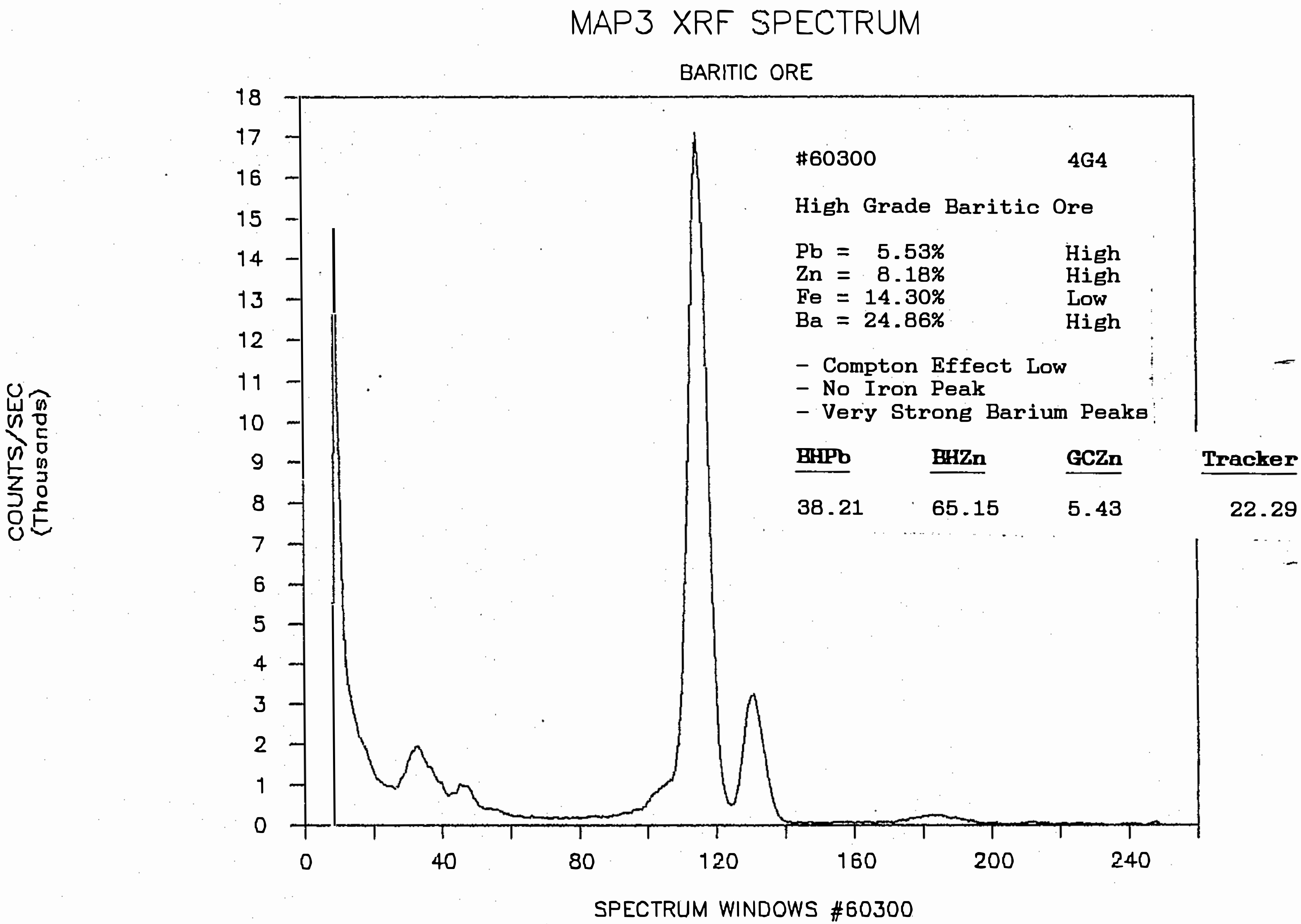


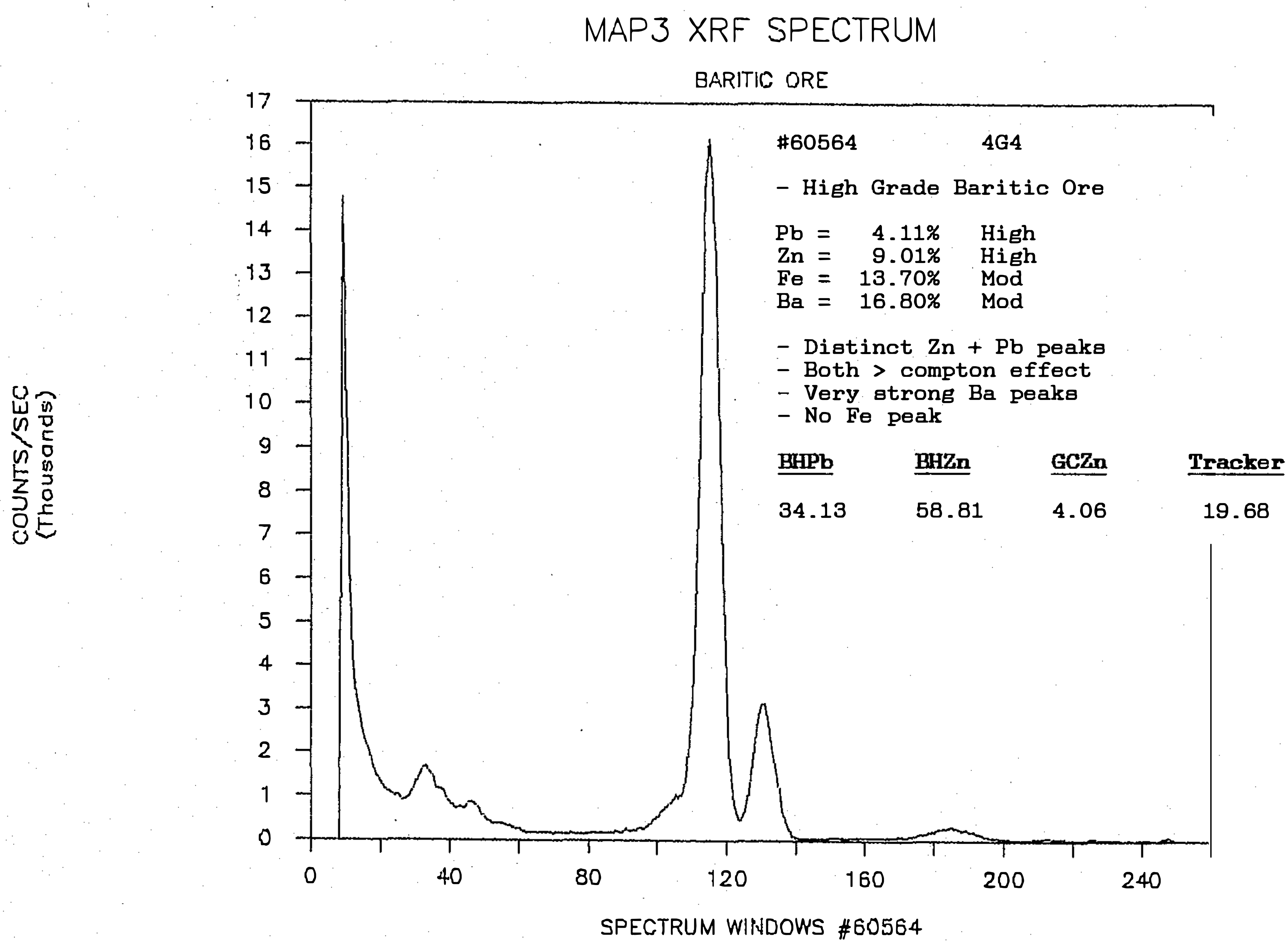


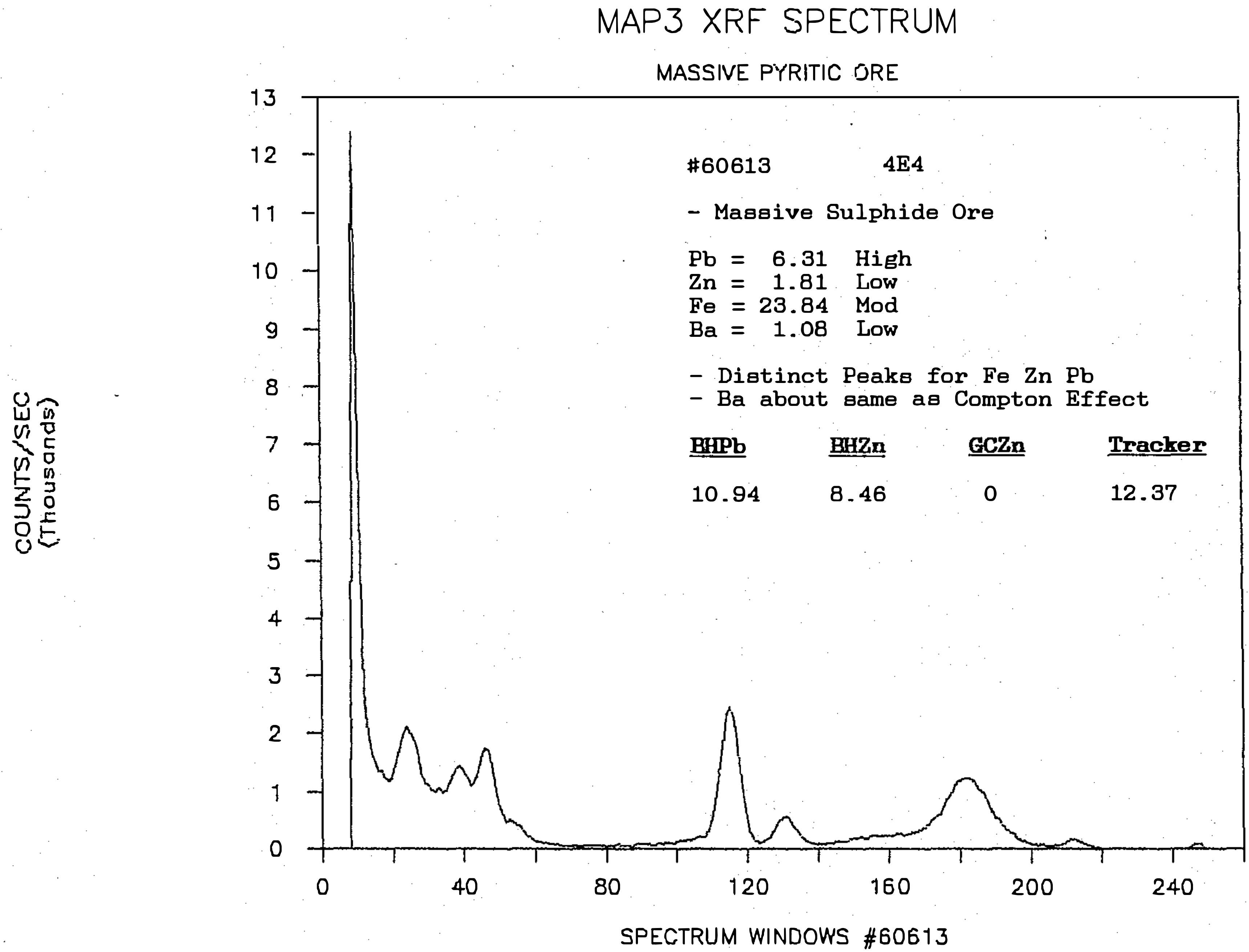
MAP3 XRF SPECTRUM
TARGET — IRON FILINGS
- Bottle (Plastic) Iron Filings
Calibration Target
(Fe = 99.5%)
- Peak is Channel # 24
- Value is 6.403 KEV
- Note very small interference with zinc
BHPb
BHZn
GCZn
Tracker
0
4.45
0
6.85
COUNTS/SEC
(Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
SPECTRUM WINDOWS Fe #103


MAP3 XRF ANALYSER
SPECTRUM VANGORDA BARITIC ORE
counts/sec (Thousands)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Ba
Ba
ZN
Pb
COMPTON EFFECT
#60408 4G4
Massive Baritic Ore
Pb = 9.09% High
Zn = 9.18% High
Fa = 17.45% Mod
Ba = 17.92% Mod
- Distinct Peaks for Pb and Zn both > Compton
- Very Strong Ba Peaks >> Compton Effect
- Compton Effect very low.
BHPB BHZn GCZn Tracker
49.33 61.10 4.76 20.99
0
40
80
120
160
200
240
windows — sample # 60408


MAP3 XRF SPECTRUM
BARITIC ORE
#60547 4G4
High grade Low Baritic Ore
Pb = 7.32% High
Zn = 9.69% High
Fe = 29.66% High
Ba = 5.80% Low
- Fe, Zn, Pb Peaks Distinct
- Strong Ba peaks
- Compton effect < all peaks
BHPb BHZn GCZn Tracker
18.88 31.78 3.56 18.76
COUNTS/SEC (Thousands)
SPECTRUM WINDOWS #60547

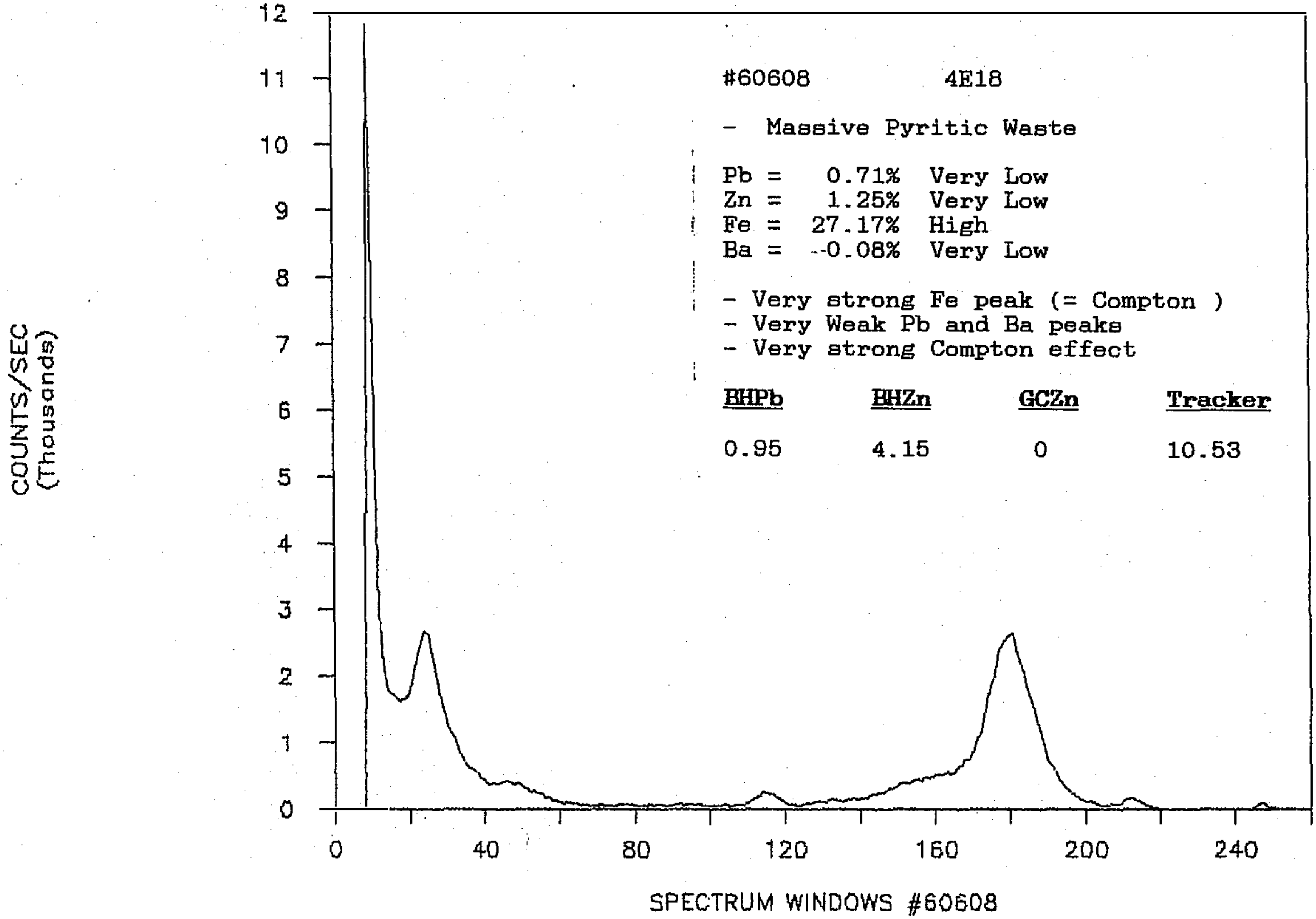

MAP3 XRF SPECTRUM
BARITIC ORE
COUNTS/SEC (Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
#60300
4G4
High Grade Baritic Ore
Pb = 5.53% High
Zn = 8.18% High
Fe = 14.30% Low
Ba = 24.86% High
- Compton Effect Low
- No Iron Peak
- Very Strong Barium Peaks
BHPb BHZn GCZn Tracker
38.21 65.15 5.43 22.29
0
40
80
120
160
200
240
SPECTRUM WINDOWS #60300

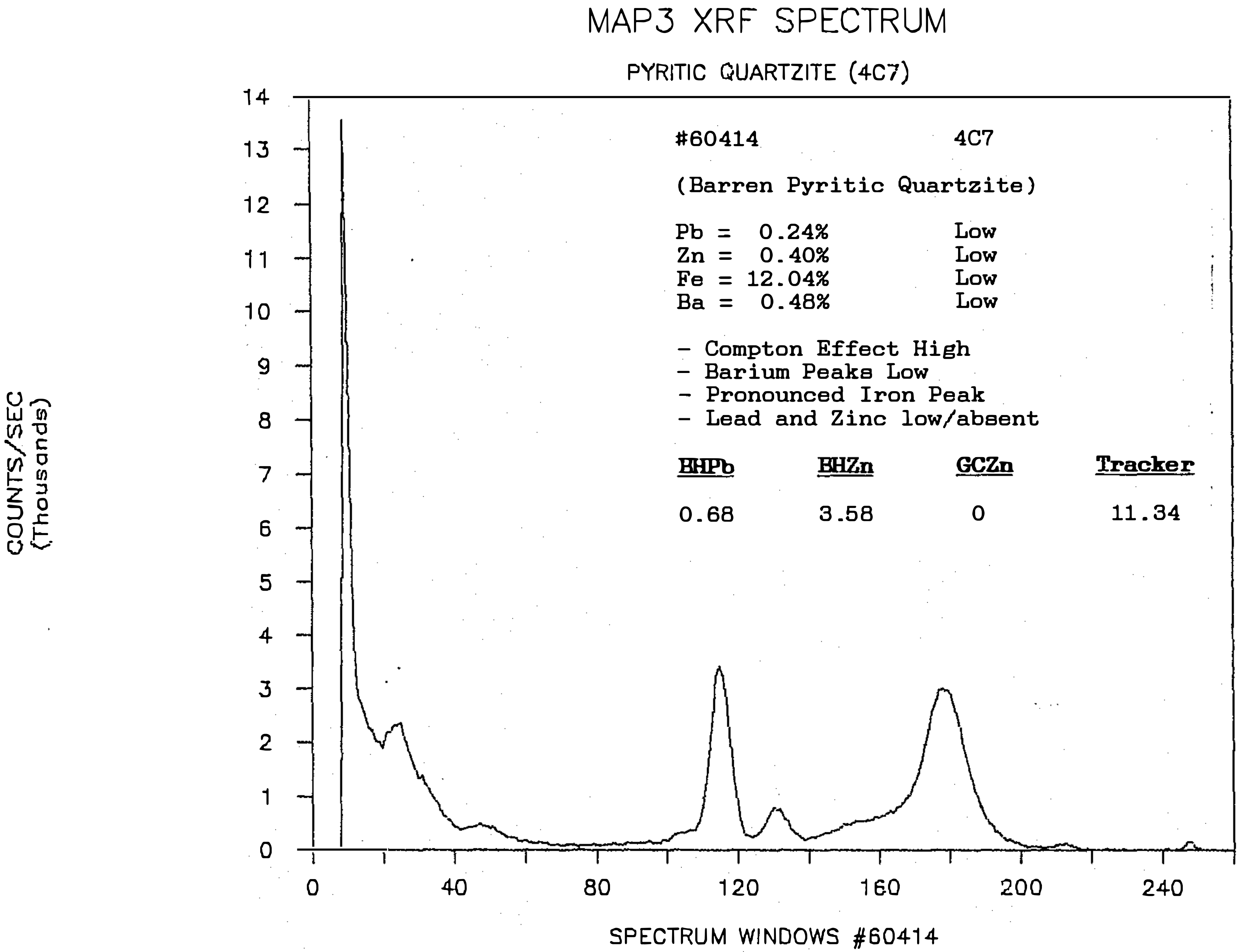

MAP3 XRF SPECTRUM
BARITIC ORE
#60564 4G4
- High Grade Baritic Ore
Pb = 4.11% High
Zn = 9.01% High
Fe = 13.70% Mod
Ba = 16.80% Mod
- Distinct Zn + Pb peaks
- Both > compton effect
- Very strong Ba peaks
- No Fe peak
BHPb BHZn GCZn Tracker
34.13 58.81 4.06 19.68
COUNTS/SEC (Thousands)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
0 40 80 120 160 200 240
SPECTRUM WINDOWS #60564


MAP3 XRF SPECTRUM
MASSIVE PYRITIC ORE
#60613 4E4
- Massive Sulphide Ore
Pb = 6.31 High
Zn = 1.81 Low
Fe = 23.84 Mod
Ba = 1.08 Low
- Distinct Peaks for Fe Zn Pb
- Ba about same as Compton Effect
BHPb BHZn GCZn Tracker
10.94 8.46 0 12.37
COUNTS/SEC (Thousands)
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 40 80 120 160 200 240
SPECTRUM WINDOWS #60613

MAP3 XRF SPECTRUM

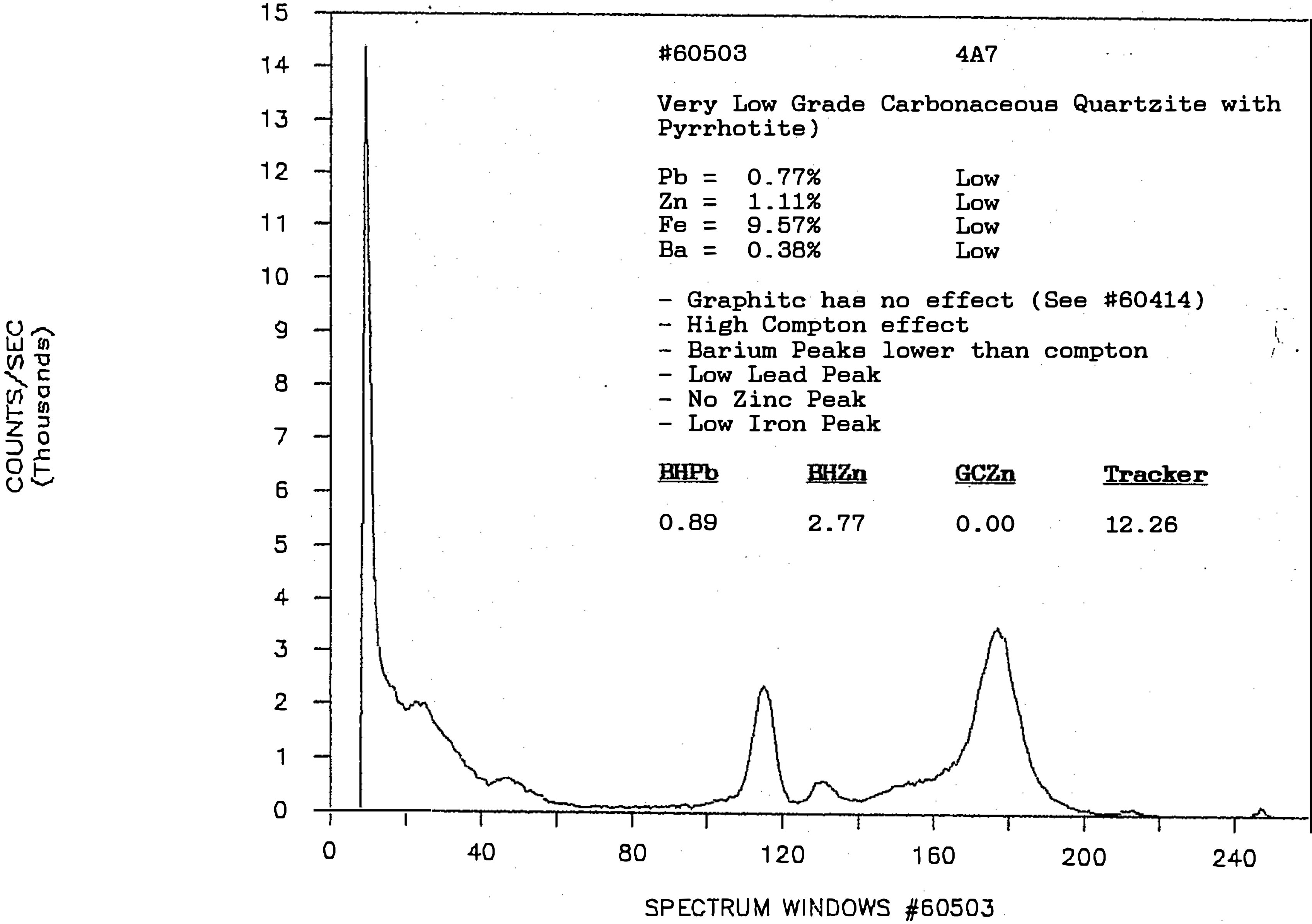
MASSIVE PYRITIC WASTE




MAP3 XRF SPECTRUM
PYRITIC QUARTZITE (4C7)
#60414
4C7
(Barren Pyritic Quartzite)
Pb = 0.24% Low
Zn = 0.40% Low
Fe = 12.04% Low
Ba = 0.48% Low
- Compton Effect High
- Barium Peaks Low
- Pronounced Iron Peak
- Lead and Zinc low/absent
BHPb BHZn GCZn Tracker
0.68 3.58 0 11.34
COUNTS/SEC (Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
40
80
120
160
200
240
SPECTRUM WINDOWS #60414

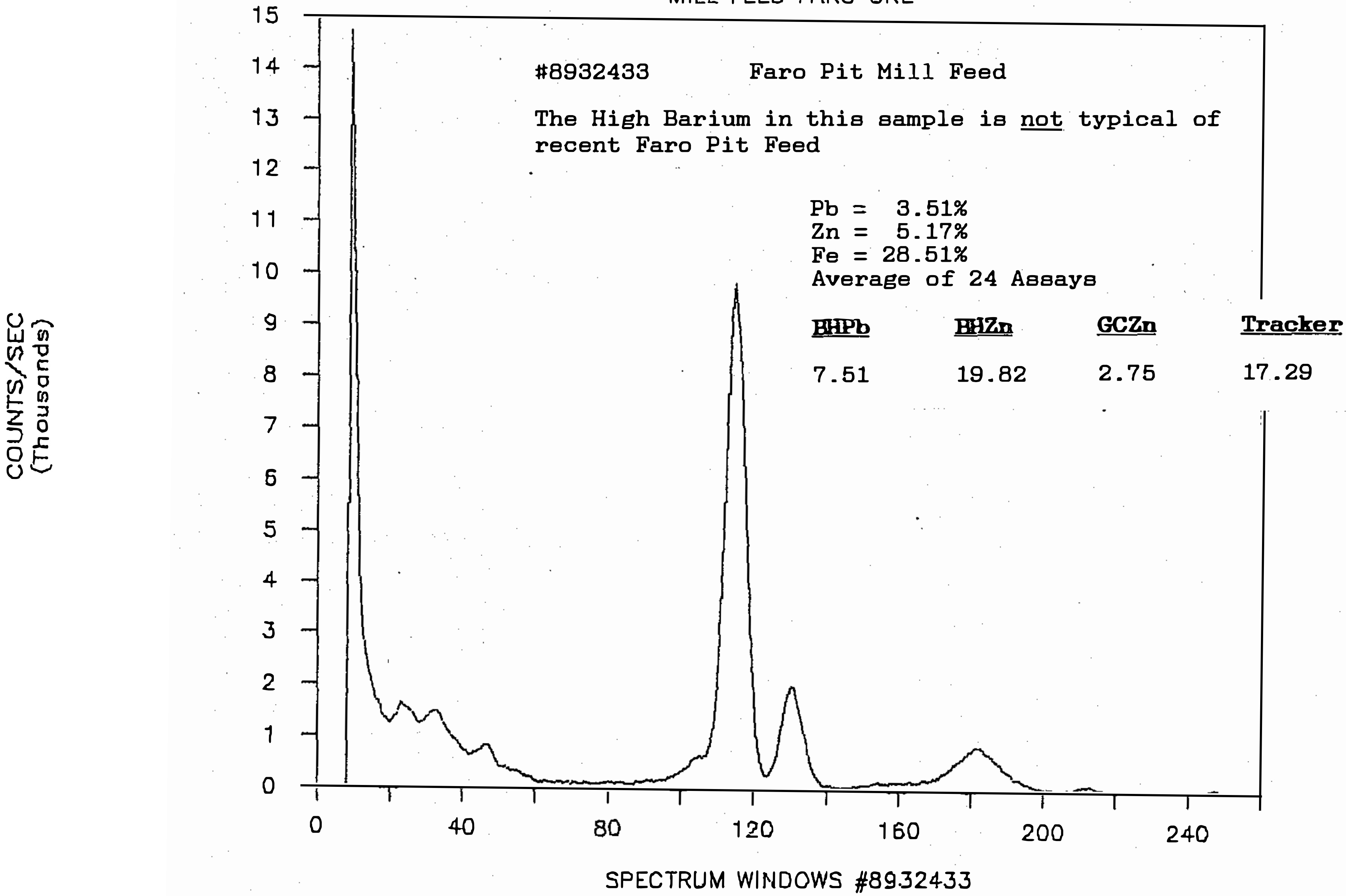
MAP3 XRF SPECTRUM

GRAPHITIC QUARTZITE



MAP3 XRF SPECTRUM

MILL FEED FARO ORE



bD

C U R R A G H   R E S O U R C E S   I N C

INTER-OFFICE MEMORANDUM

FARO OFFICE

DATE: November 19, 1990

TO: GEOLOGY STAFF

FROM: DAVE TENNEY
CHIEF GEOLOGIST

SUBJECT: USE OF XRF ANALYSER IN PIT AND CONTINUING INVESTIGATION

Preliminary calibrations of the Map 3 XRF Analyser have been done using diamond drill core pulps from Vangorda 1990 Drill programme. The following preliminary results may be used at Vangorda for grade control purpose.

1) **Baritic Ore:**

The presence of barium is obvious from the spectrum on channels 116 and 130. When the magnitude of channel 130 is of the same size as the Compton Effect, barium grade is in the range 3-5%.

Grades for lead and zinc using the Bunker Hill calibration (i.e. the only lead reading and the first zinc reading) are extremely high for baritic ore of even moderate grade.

Multiple regression formulae for baritic ores are not as reliable as for the other rock types tested (graphitic quartzite and massive pyritic rocks) but nevertheless may still be used to give a grade estimate. (See Appendix 1)

PB% = 1.80 + 0.13*BHPb - 0.11*BHZn +0.34*GCZn
+ 0.20*ZnTracker (corr.coeff. 0.793)

Zn = -0.18 - 0.046*BHPb + 0.031*BHZn + 0.52*GCZn
+0.27*ZnTracker (corr.coeff. 0.59)

The detection and estimation of grade in baritic ore (4G) should be straight forward using the above parameters.

BHPb =	Bunker Hill - Pb%	(instrument reading)
BHZn =	Bunker Hill - Zn%	(instrument reading)
GCZn =	Greens Creek - Zn%	(instrument reading)
ZnTracker =	Greens Creek -Zn Tracker	(instrument reading)

note the last reading, Greens Creek Zn Tracker indicates relative change in Zinc Grade and is not intended to be a percentage measurement.

2) **Massive Sulphides - Waste and Ore**

Linear Regression lines for lead and zinc in massive sulphides have been calculated as follows:

% Pb = BH%Pb * .37 + 0.61 (corr. 66)

% Zn = Zn (Tracker) * .889 -8.235 (corr. .62)

Higher correlation coefficients were obtained with multiple regression (See Appendix 1)

Pb% = -6.84+0.22*BHPb-0.18*BHZn-0.29*GCZn+0.80*Zn Tracker
(correl.coeff 0.808)

Zn% = -6.27+0.17*BHPb-0.076*BHZn-0.65*GCZn+0.73*Zn Tracker
(correl.coeff. 0.740)

The zinc regression formula looks suspicious as two of the zinc coefficients are negative (!) and the lead coefficient is positive (!). Also, the correlation coefficient for "Tracker" on zinc is 0.68 which is very little less than the 0.74 for multiple regression noted above.

It may turn out that the zinc tracker alone using simple linear regression is a better indicator of grade than the multiple regression formula and tests of predictive value will be made during the coming weeks.

It is critical at Vangorda (and elsewhere) that we are able to distinguish massive sulphide waste from massive sulphide ore. The reliability of regression formulae designed to give high reliability of grade predictions in the region around cut-off (i.e. 5-6% combined Pb & Zn) will be investigated shortly.

3) **Carbonaceous Quartzite:**

Very good results were obtained using multiple regression on 14 samples of carbonaceous quartzites: multiple correlation coefficients for both lead and zinc were 0.99, although a larger sample population would doubtless reduce these numbers somewhat. From Appendix 1.

Pb% = -1.88+0.46*BHPb-0.18*BHZn+0.015*GCZn+0.21*Zn Tracker
(corr.coeff. 0.989)

Zn% = -2.67-0.086*BHPb+0.035*BHZn+0.39*GCZn+0.27*Zn Tracker
(corr coeff. 0.995)

4) Plan:

a) Treat all baritic rock types according to 1 above using spectrum and regression formulae.

b) Treat all other rock types according to 2 and 3 above using regression formulae.

c) Sample all blastholes that appear to need sampling and compare assay results with XRF results. If sulphide waste can be predicted reliably using XRF readings corrected using regression formulas, then massive sulphide waste blasthole chippings need no longer be assayed. This will save all concerned considerable time and effort.

d) **Objectives**

1) classify ore types using spectra

2) identify relative barium contents using spectra. (low, medium, high, very high)

3) select correlation factors in accordance with 2.

e) **Prepare and Print**

1) spectra for each rock type from symphony

2) collect database of assays for most important rock and ore types

3) correlate for each rock and ore type to find regression line

4) based on test criteria establish cut off readings for instrument

5) test above against assays (do blind test)

6) book of spectra with assay information and XRF readings.

D. Tenney.

Dave Tenney
Chief Geologist

DT:cc
cc: D. Basso
W. Dunn