7N-25-CR
77698
P.56

SURFACE SCIENCE LABORATORIES

The University of Alabama in Huntsville

XPS Analysis

Dec 19, 1991

For: Dr. Roger Linton
Mail Code EH53
NASA -MSFC
Huntsville, AL

Samples:
Sample : Au film, [Region X : Mo/Au/Pyrex]
Sample : Au film, [Region Y : Au/Pyrex]
Sample # cm-01-45, SiO/ Al /Pyrex
Sample # 2, SiO/ Al /Pyrex, Control
Sample # 5, SiO/ Al /Pyrex, Control

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(NASA-CR-190092) XPS ANALYSIS (Alabama Univ.) 56 p
N92-70546
Unclas
Z9/25 0077698

Technical Report

The following samples were received from Dr. Roger Linton on Dec 14, 1991, for ESCA analysis. The requested area of interest is in the center of the SiO/Al/Pyrex specimens and the X [Mo/ Au/ pyrex] and Y [Au/pyrex] regions of the Au thin film sample. The information sought is the identification of foreign contaminants.

1. Au thin film: X region [Mo/Au/ pyrex]

2. Au thin film: Y region [Au/ pyrex]

3. SiO/ Al/ pyrex mirror
Specimen # cm-01-45

3. SiO/ Al/ pyrex mirror, Control
Specimen # 2

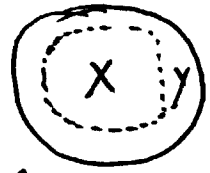
5. SiO/ Al/ pyrex mirror, Control
Specimen # 5

This report contains the results of the samples described above. Each analysis is divided by a GREEN colored separation sheet. For each sample, the first page shows a wide survey scan. The next pages present the quantitative chemical analysis in atomic percent followed by high resolution scans on each of the major component which shows the area used for the quantitative determination of atomic concentrations.

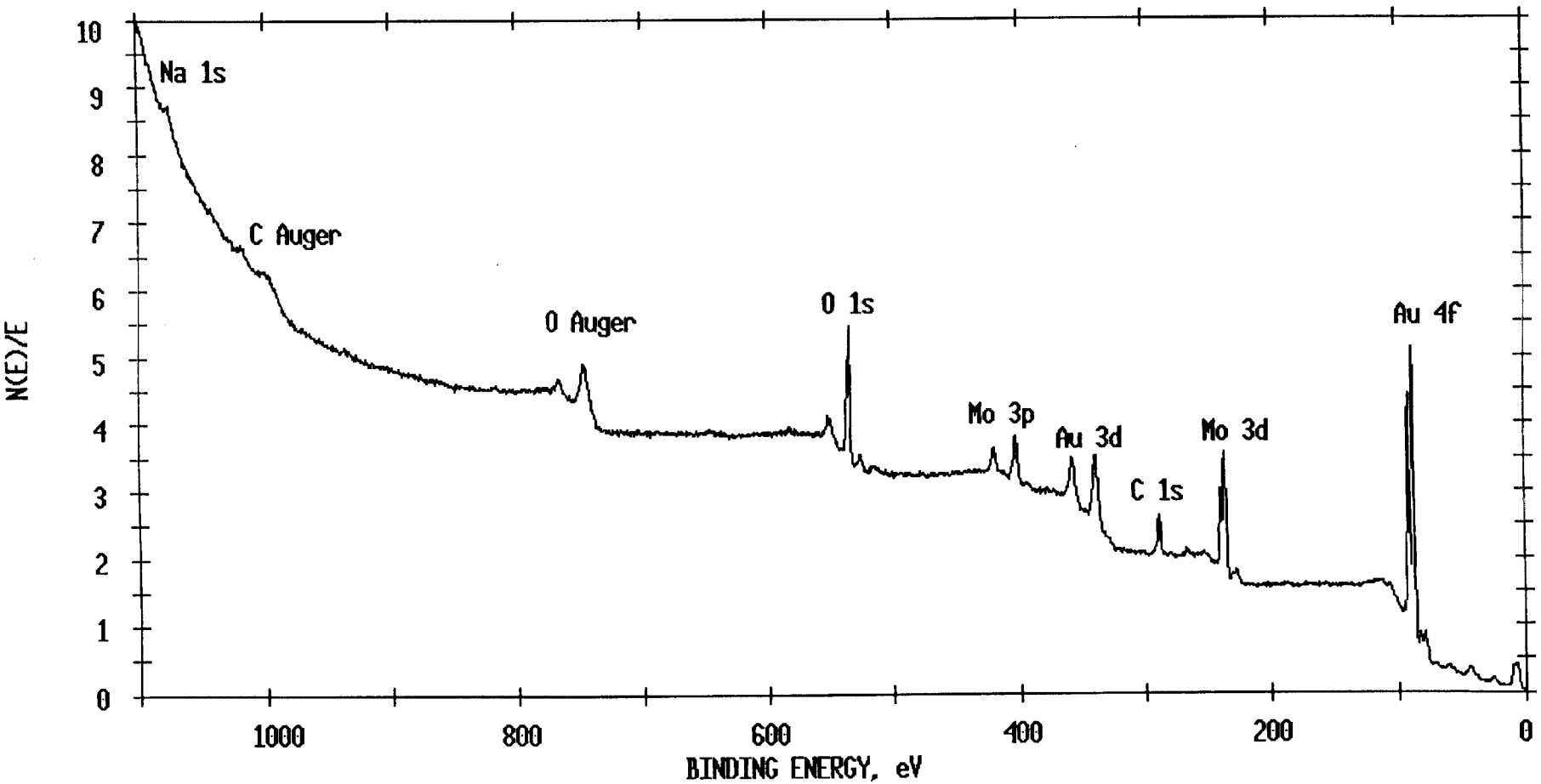
The Au sample has been thoroughly investigated in the two regions, called X [Mo/Au/ Pyrex] and Y [Au/ Pyrex]. It shows that there is more Au and Mo in the region Y than in X, contrary to the information I got through Dr. Gregory regarding this sample.

Ganesh Raikar, (205) 895-6916

ESCA SURVEY 12/17/91 ANGLE= 45 deg ACQ TIME=4.59 min
FILE: Au_x_6 NASA, Mo/Au/Pyrex region
SCALE FACTOR= 72.298 k c/s, OFFSET= 21.376 k c/s PASS ENERGY= 89.450 eV Mg 250 W



Au Sample.



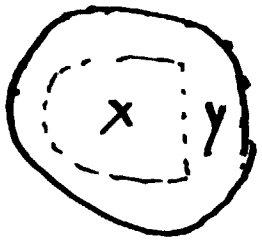
Print AC Table | Exclude Region Atomic Concentration | Display Curve | More Softkeys | AC to AC Summary | Exit

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1



Atomic Concentration Table

File: Au_x_8 NASA, Mo/Au/Pyrex region

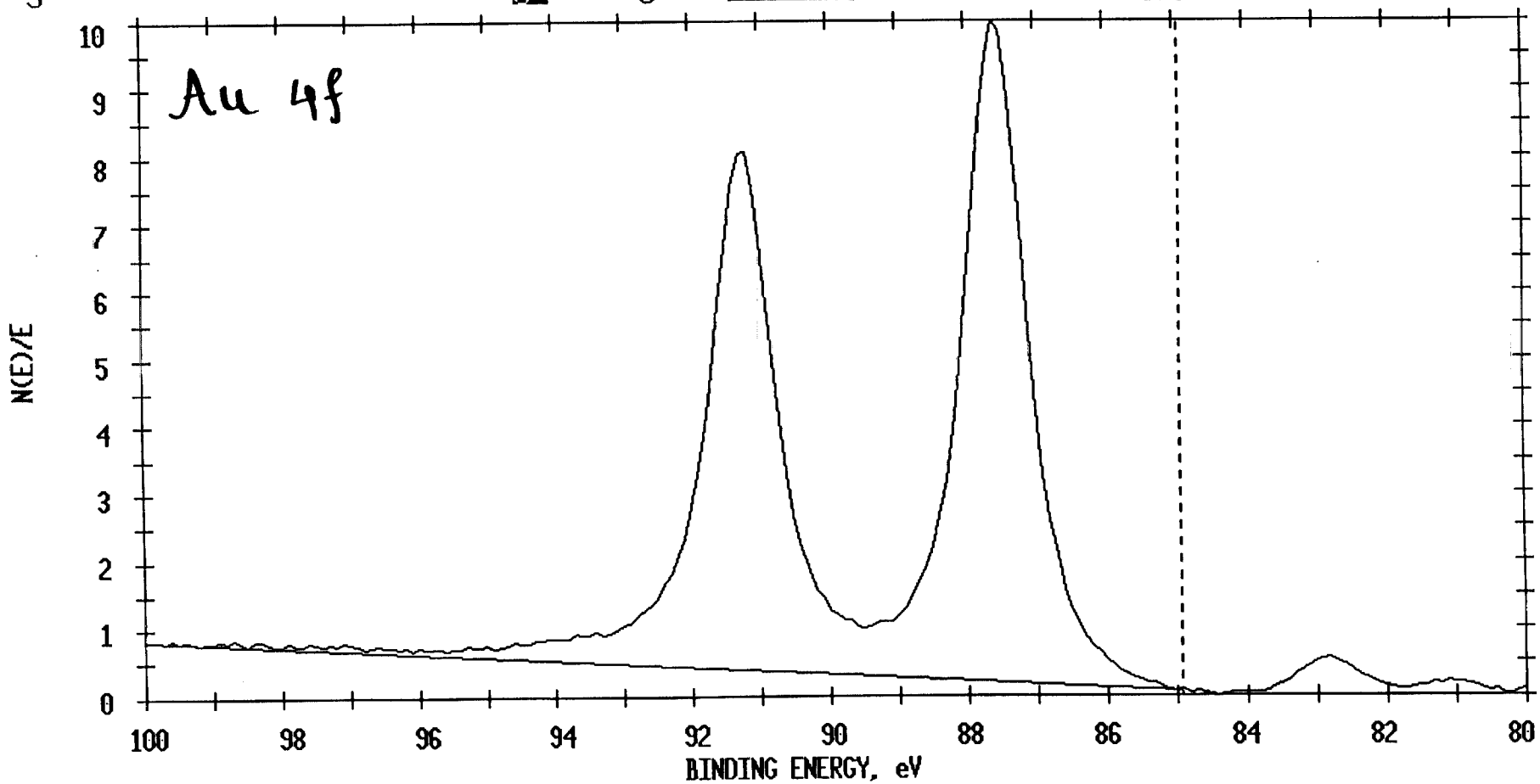
Lens: Large Area Omni-Focus Source: Standard

Element	Area (cts-eV/s)	Sensitivity Factor	Concentration (%)
Au4f	192554	6.250	13.76
Mo3d	81742	3.321	10.99
Si2p	2628	0.339	3.46
O1s	61264	0.711	38.48
C1s	20188	0.296	30.46
Na1s	5938	1.685	1.57
Cl2p	118	0.891	0.06
F1s	2724	1.000	1.22

Ion Gun: OFF 0.5mPa X-ray: ON Mg Acquiring Technique: ESCA 12/17/91 15:10

Atomic Concentration

a User Settings Previous New
b Element Name
c Mode Area Height d Baseline Linear Integrated
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1
f Left
i Right
g Analysis 100.00 Counts 8550
j Analysis 84.90 Counts 5500
h Entered Counts 856
k Entered Counts 5428



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

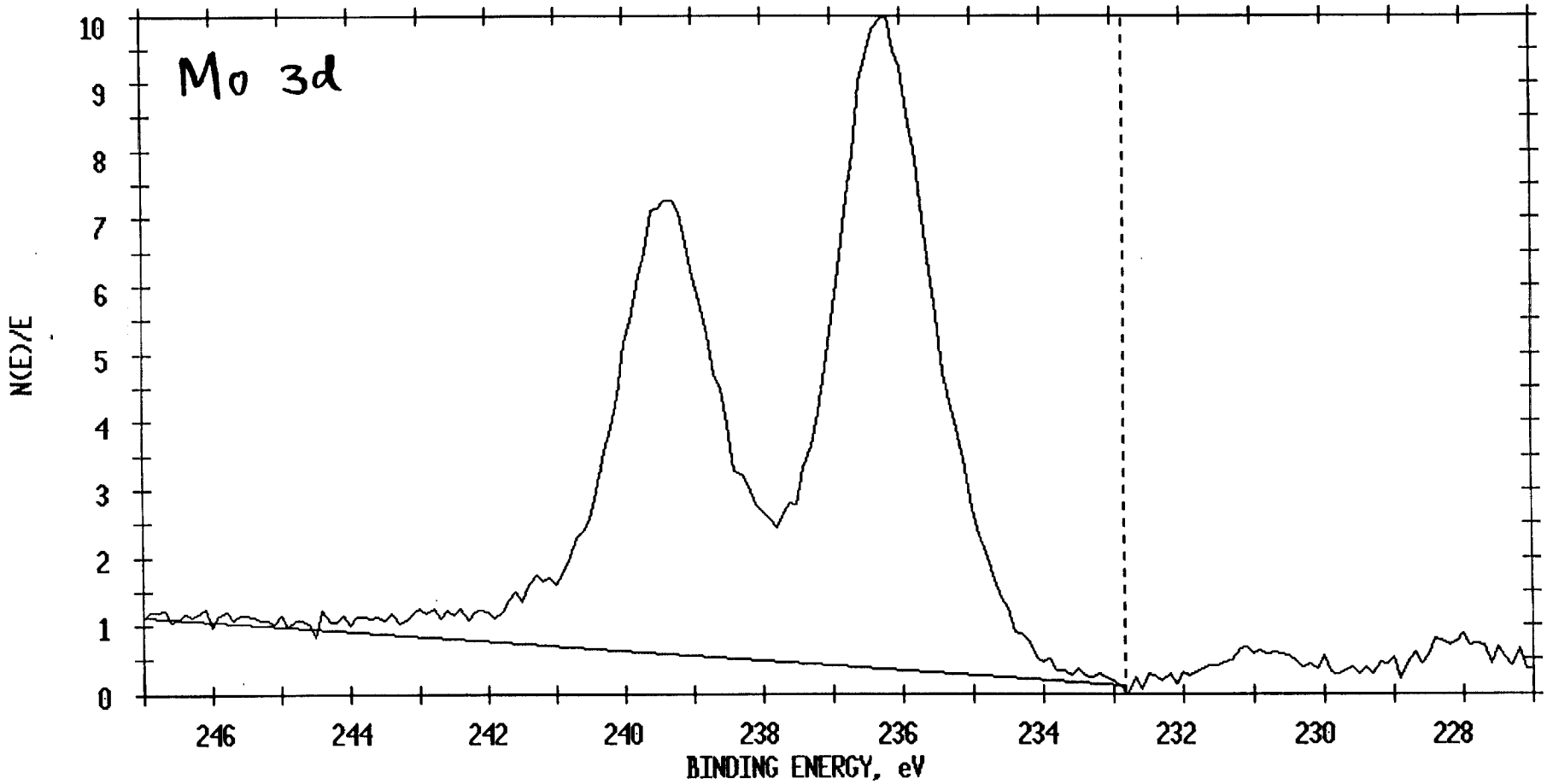
i Right

g Analysis 247.00 Counts 11680

j Analysis 232.80 Counts 10234

h Entered Counts 11725

k Entered Counts 10374



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

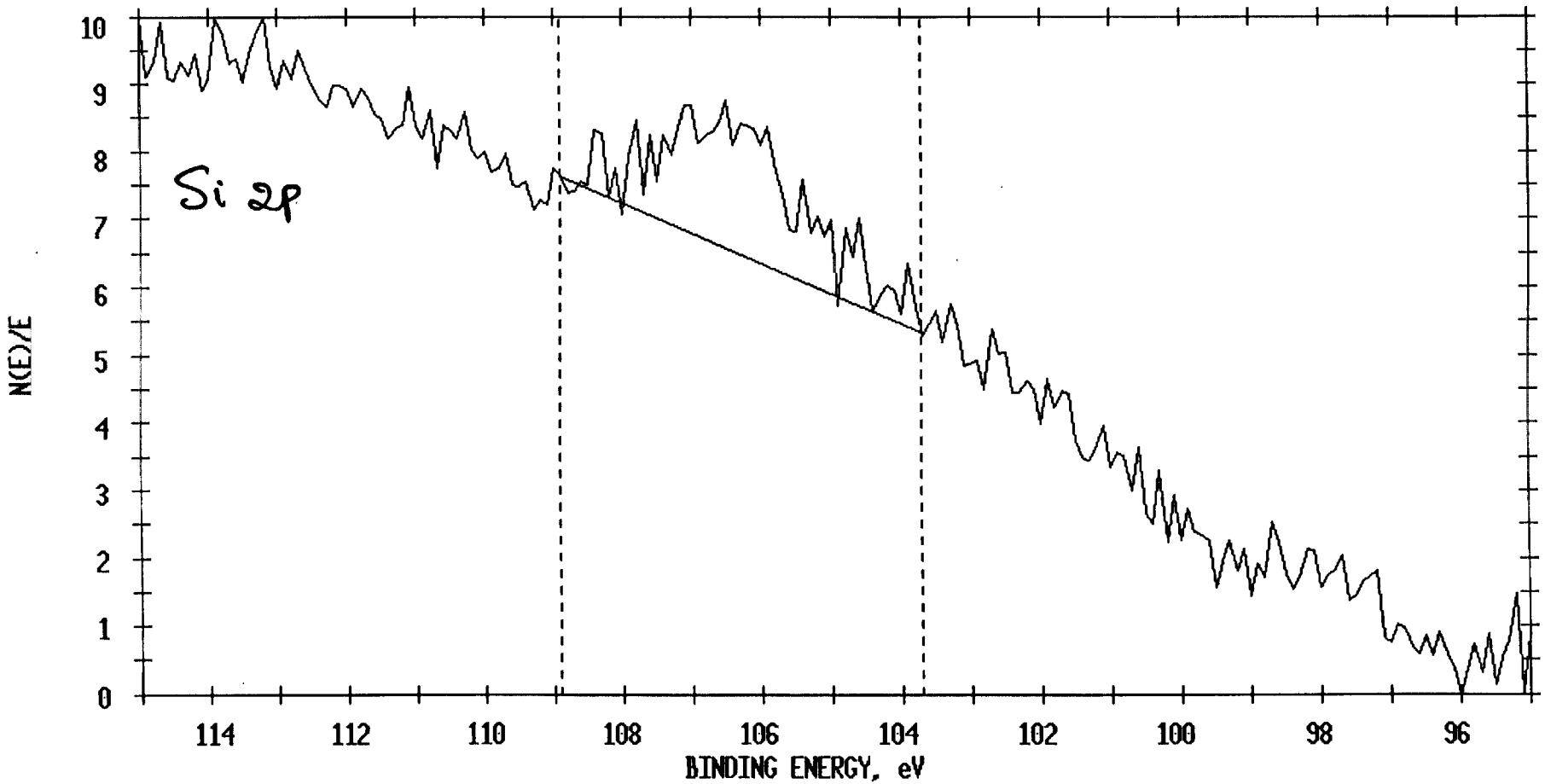
i Right

g Analysis 108.90 Counts 10046

j Analysis 103.70 Counts 9402

h Entered Counts 1004

k Entered Counts 942



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

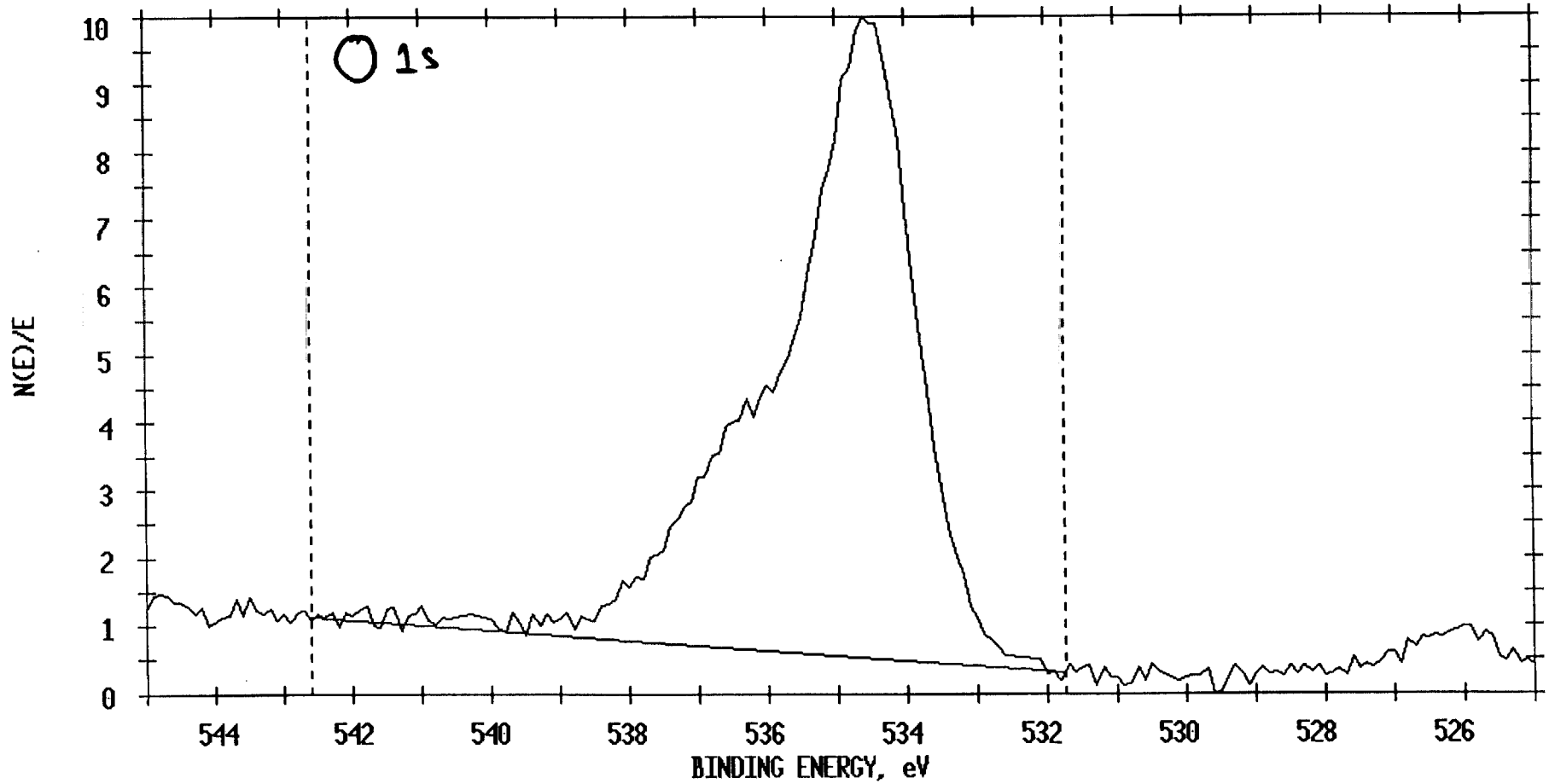
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

i Right

g Analysis 542.60 Counts 19474 h Entered Counts 1957

j Analysis 531.70 Counts 18610 k Entered Counts 1846



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

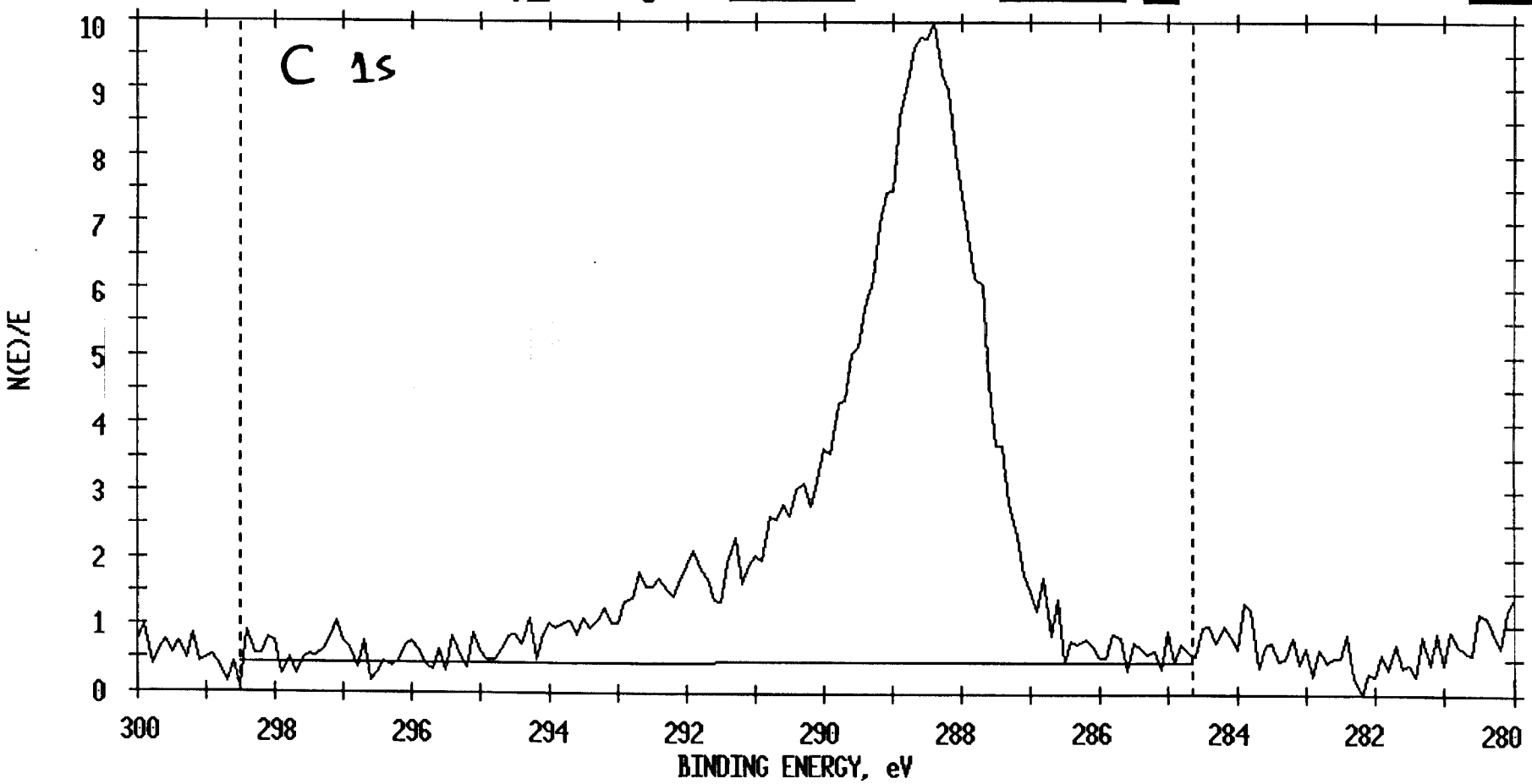
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

i Right

g Analysis 298.50 Counts 11944 h Entered Counts 12098

j Analysis 284.60 Counts 12148 k Entered Counts 12112



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

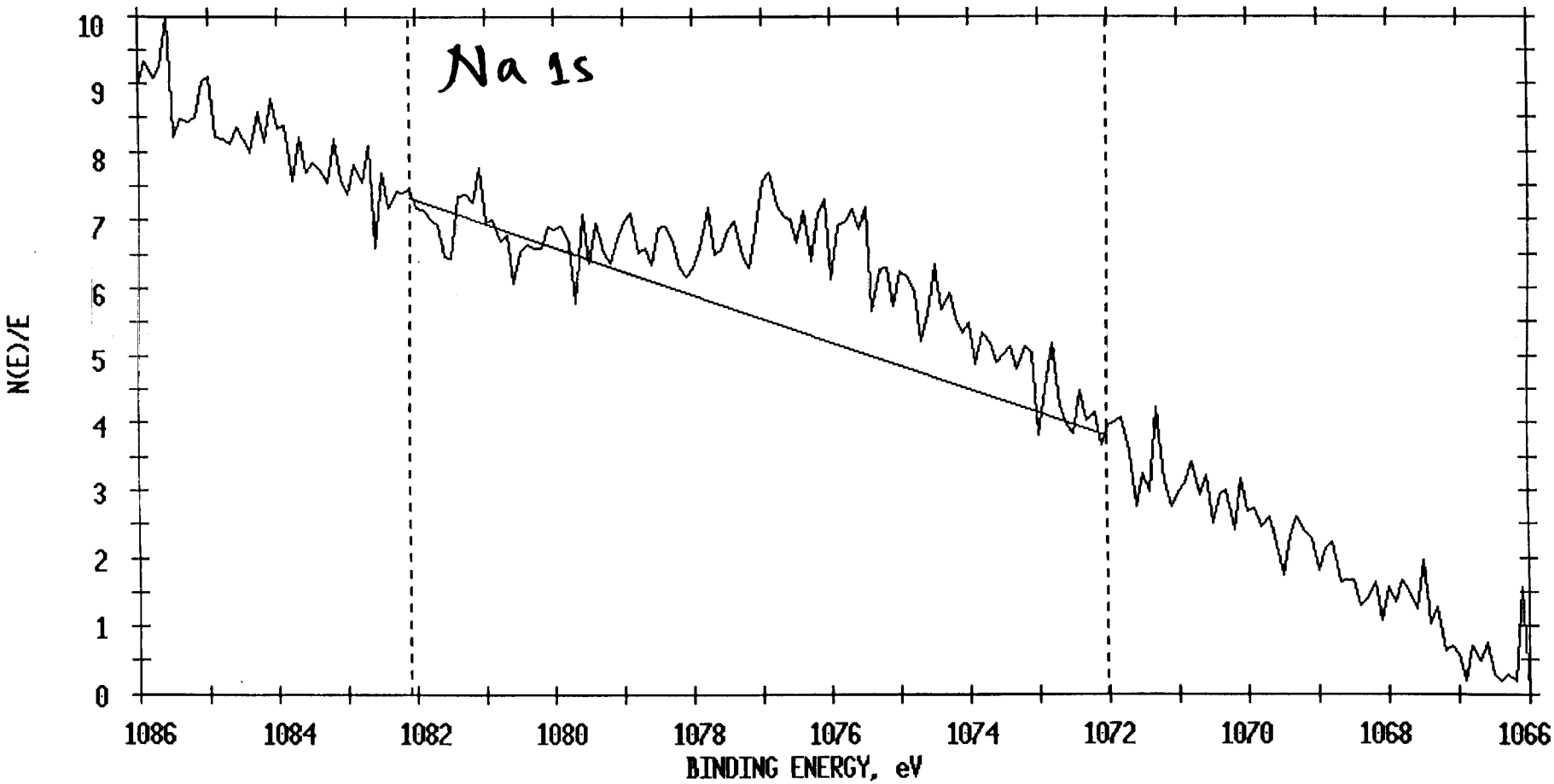
i Right

g Analysis 1082.10 Counts 36364

j Analysis 1072.00 Counts 34730

h Entered Counts 36323

k Entered Counts 34680



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

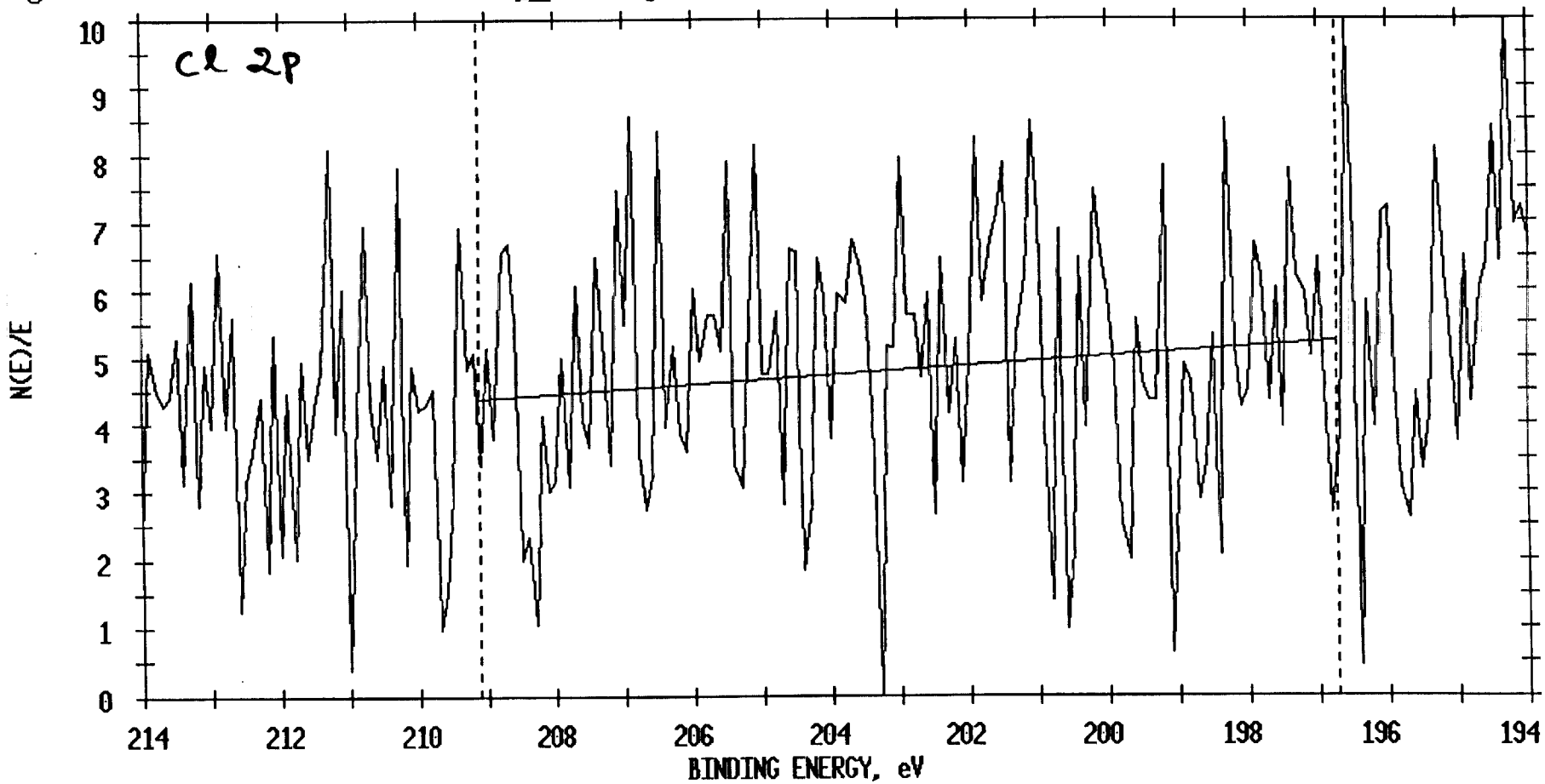
i Right

g Analysis 209.10 Counts 9866

j Analysis 196.70 Counts 9890

h Entered Counts 9918

k Entered Counts 9963



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

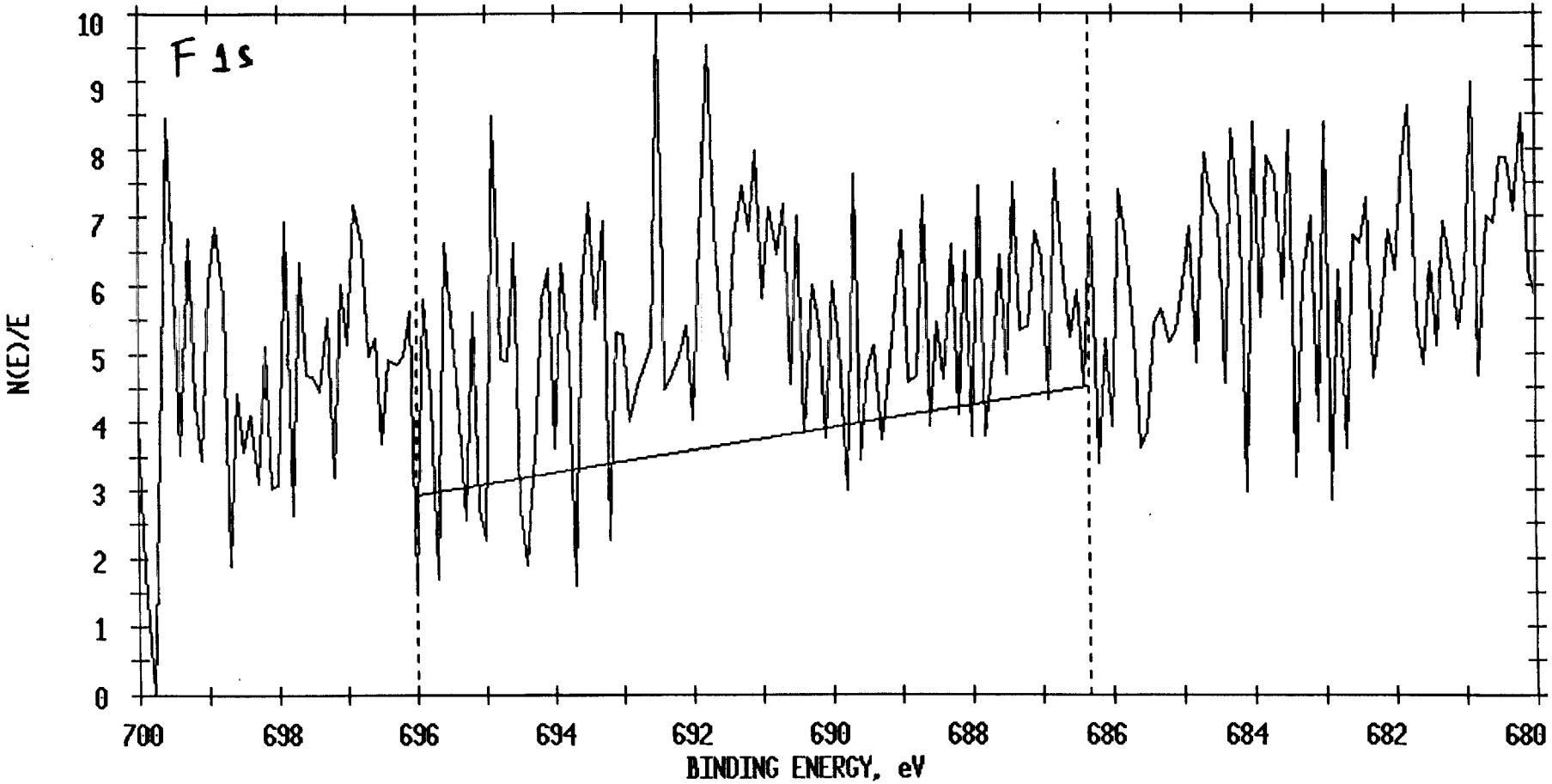
g Analysis 696.00 Counts 19370

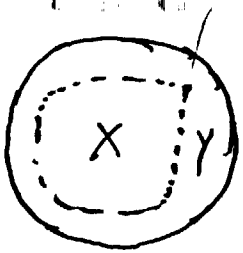
h Entered Counts 1949

i Right

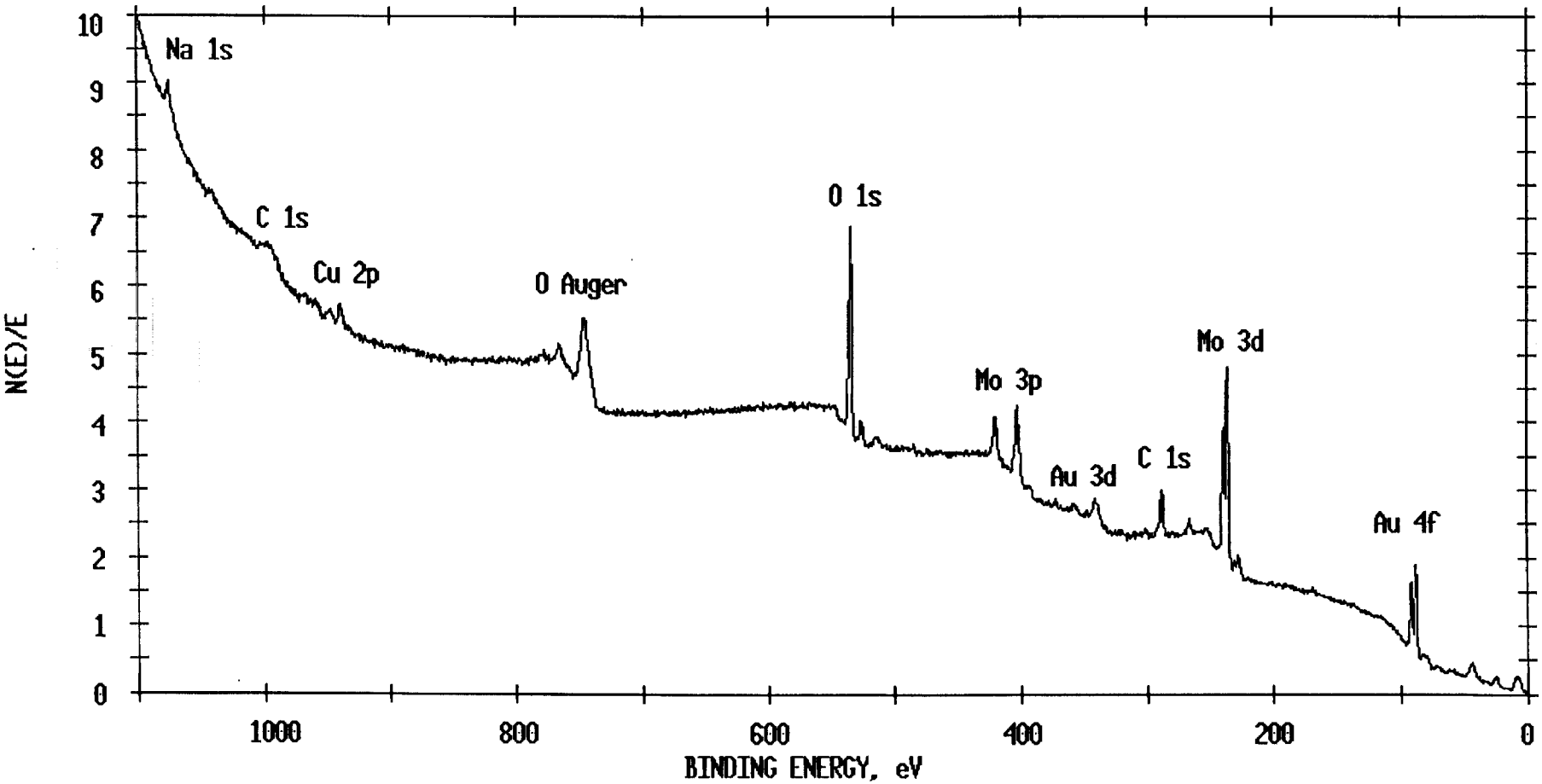
j Analysis 686.30 Counts 19860

k Entered Counts 1963





ESCA SURVEY 12/16/91 ANGLE= 45 deg ACQ TIME=3.67 min
FILE: Au_y_1 NASA, Au/Pyrex region
SCALE FACTOR= 65.242 k c/s, OFFSET= 18.740 k c/s PASS ENERGY= 89.450 eV Mg 250 W



Print AC Table | Print AC Table | Exclude Region | Display Curve | More Softkeys | AC to AC Summary | Exit

Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

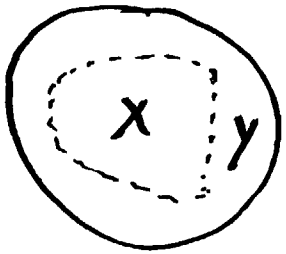
Atomic Concentration Table

File: Au_y_5

NASA, Au/Pyrex region

Lens: Large Area Omni-Focus

Source: Standard



Element	Area (cts-eV/s)	Sensitivity Factor	Concentration (%)
Au4f	50622	6.250	3.67
Mo3d	118588	3.321	16.17
Si2p	486	0.339	0.65
O1s	78334	0.711	49.88
C1s	17130	0.296	26.20
Na1s	10622	1.685	2.85
Cl2p	1138	0.891	0.58
F1s	0	1.000	0.00

Ion Gun: OFF 0.5mPa

X-ray: ON Mg

Acquiring

Technique: ESCA

12/17/91 15:13

Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

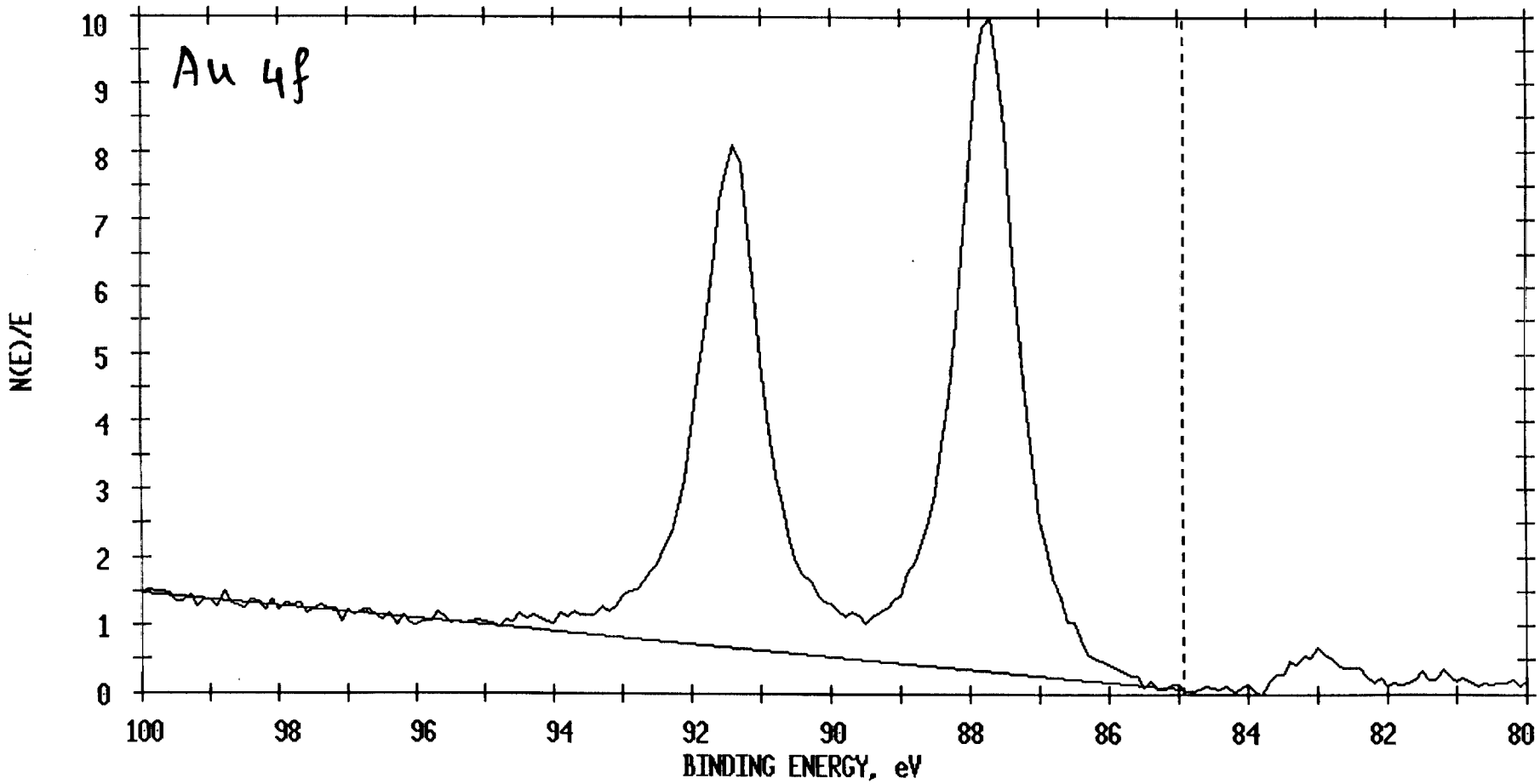
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

i Right

g Analysis 100.00 Counts 5550 h Entered Counts 5575

j Analysis 84.90 Counts 3852 k Entered Counts 3878



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

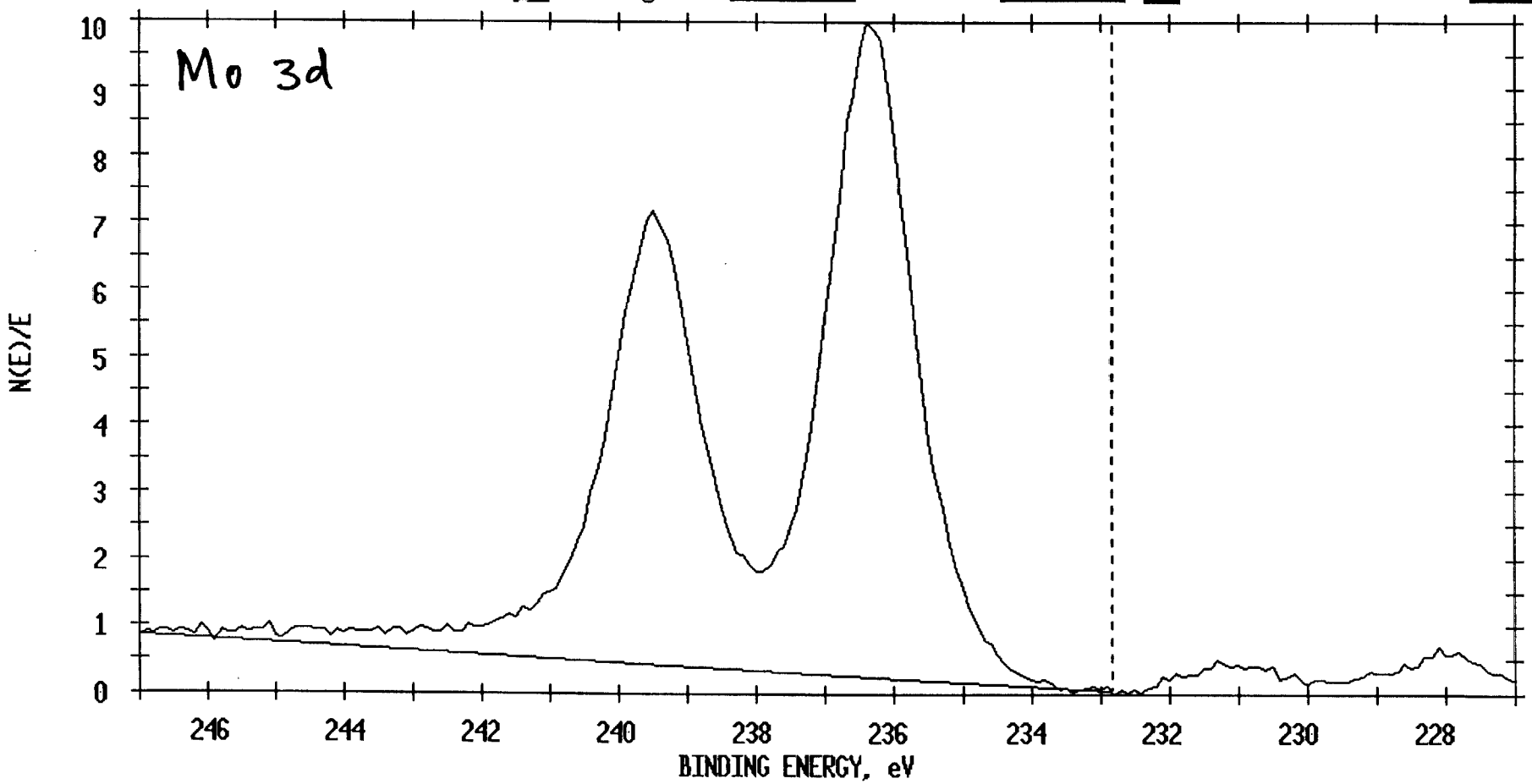
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

i Right

g Analysis 247.00 Counts 11610 h Entered Counts 1167

j Analysis 232.80 Counts 9882 k Entered Counts 999



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

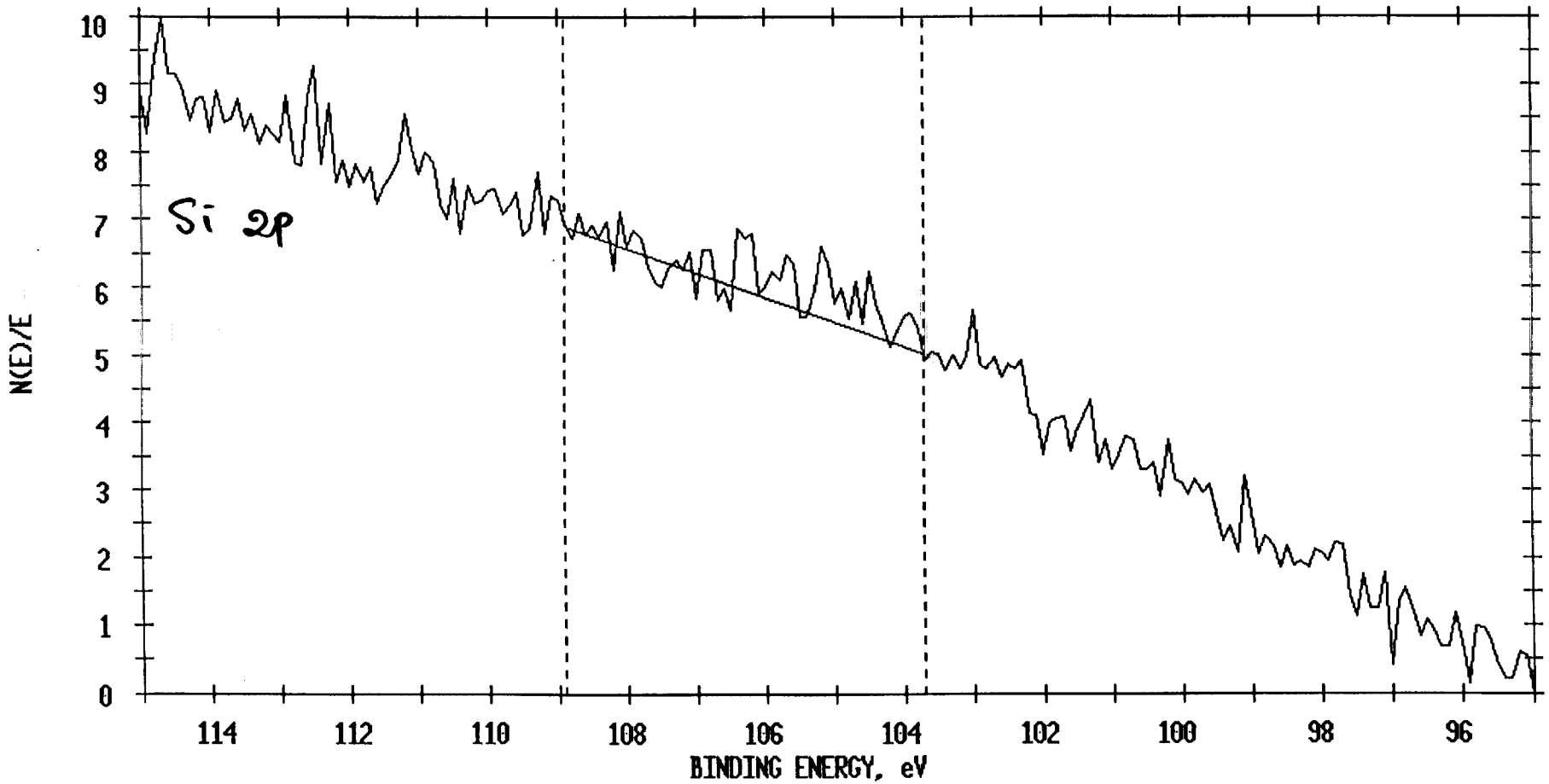
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

i Right

g Analysis 108.90 Counts 6414 h Entered Counts 641

j Analysis 103.70 Counts 5984 k Entered Counts 601



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

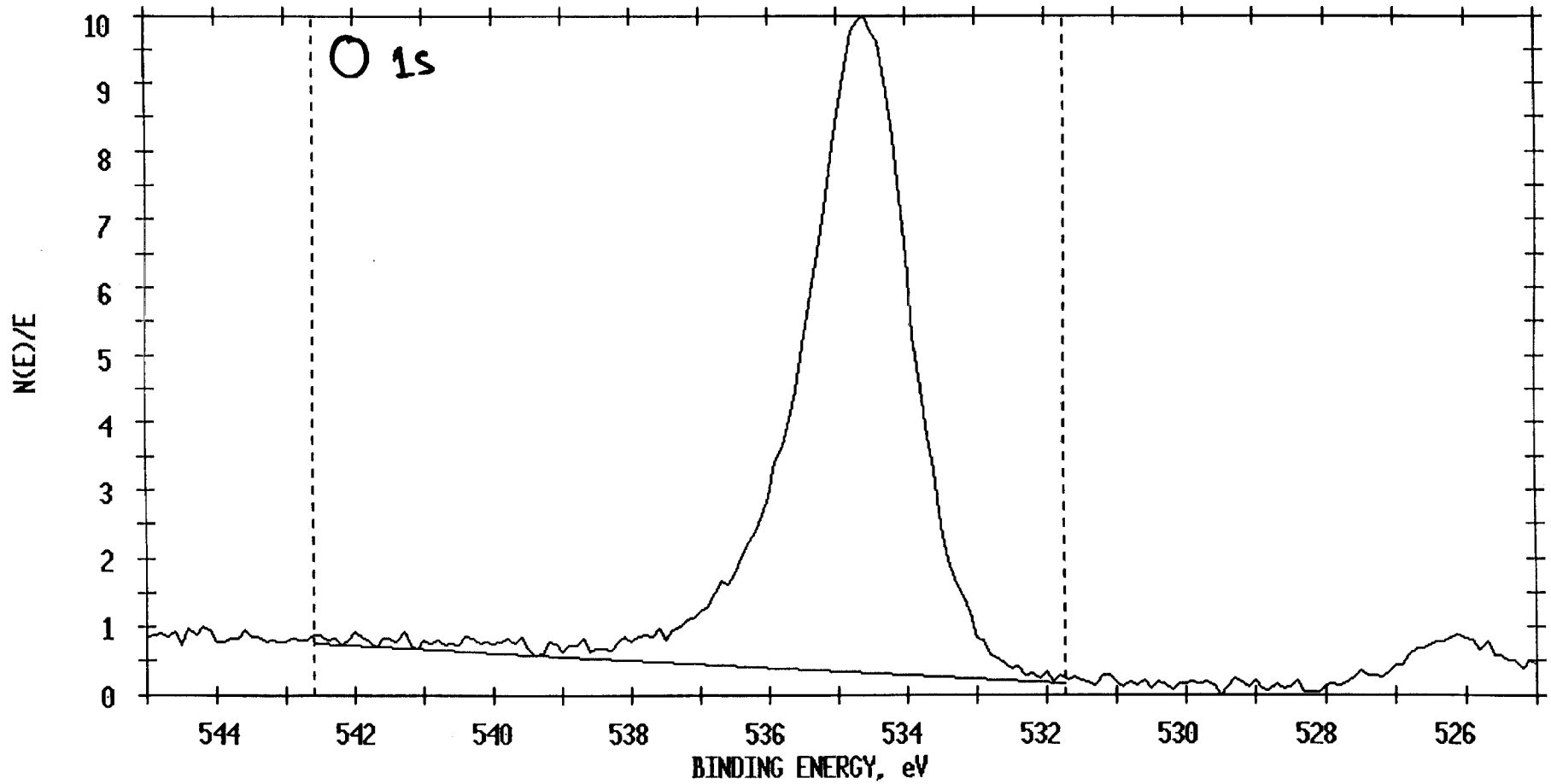
i Right

g Analysis 542.60 Counts 19486

j Analysis 531.70 Counts 18116

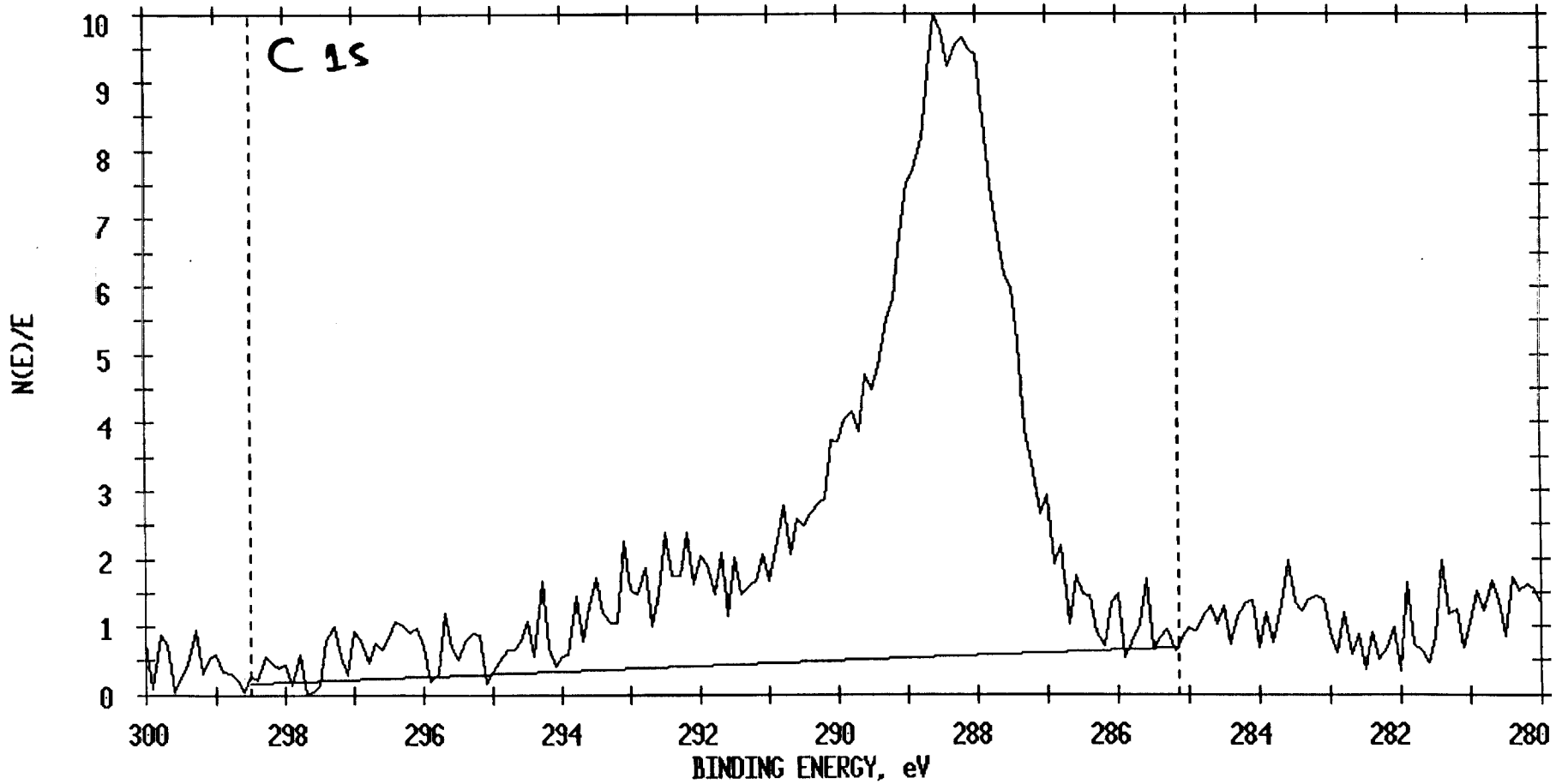
h Entered Counts 19255

k Entered Counts 18000



Atomic Concentration

a User Settings Previous New
b Element Name
c Mode Area Height d Baseline Linear Integrated
e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1
f Left
g Analysis 298.50 Counts 12084
h Entered Counts 12045
i Right
j Analysis 285.10 Counts 12258
k Entered Counts 12215



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

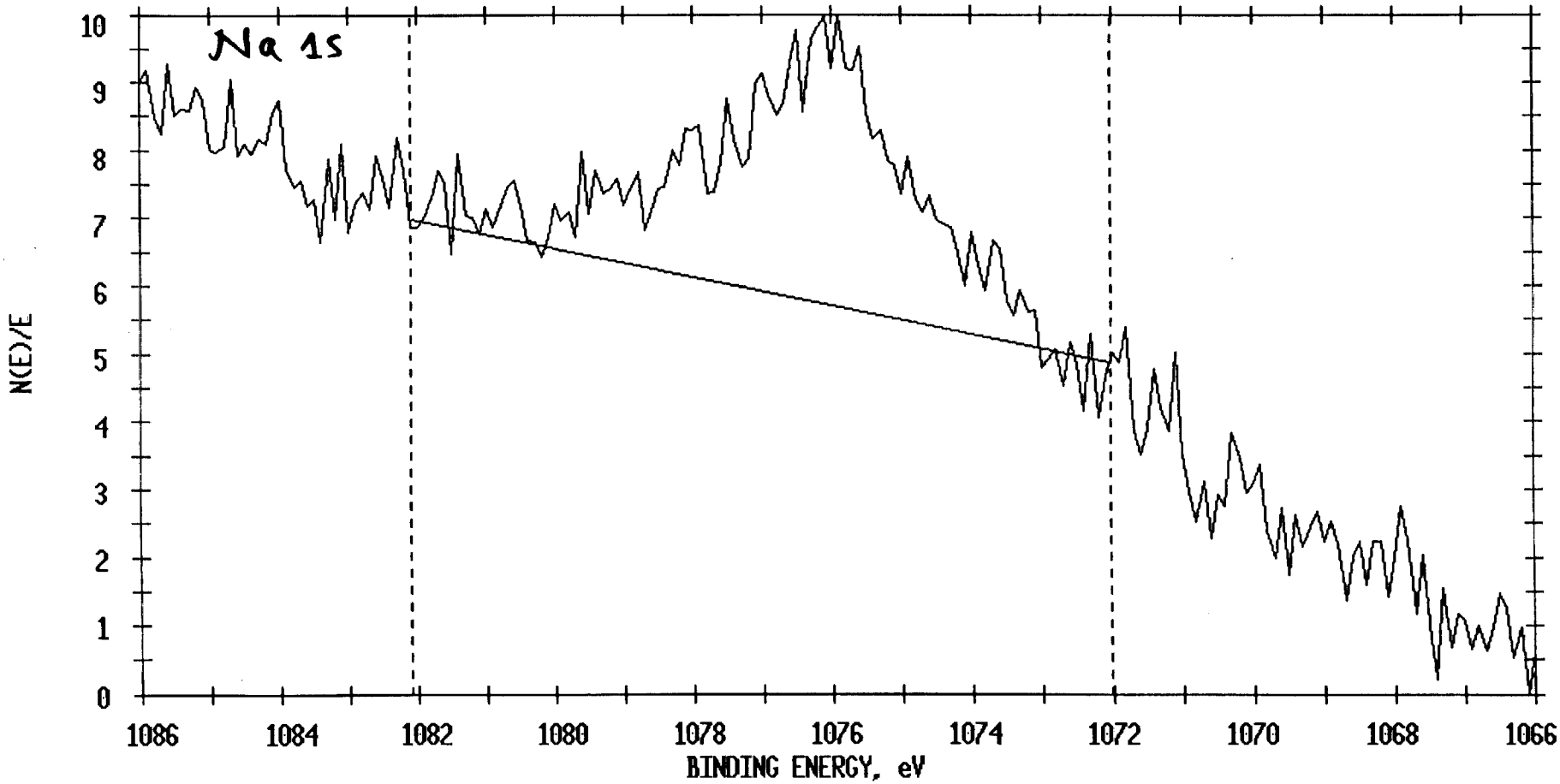
i Right

g Analysis 1082.10 Counts 30340

j Analysis 1072.00 Counts 29602

h Entered Counts 3040

k Entered Counts 2955



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

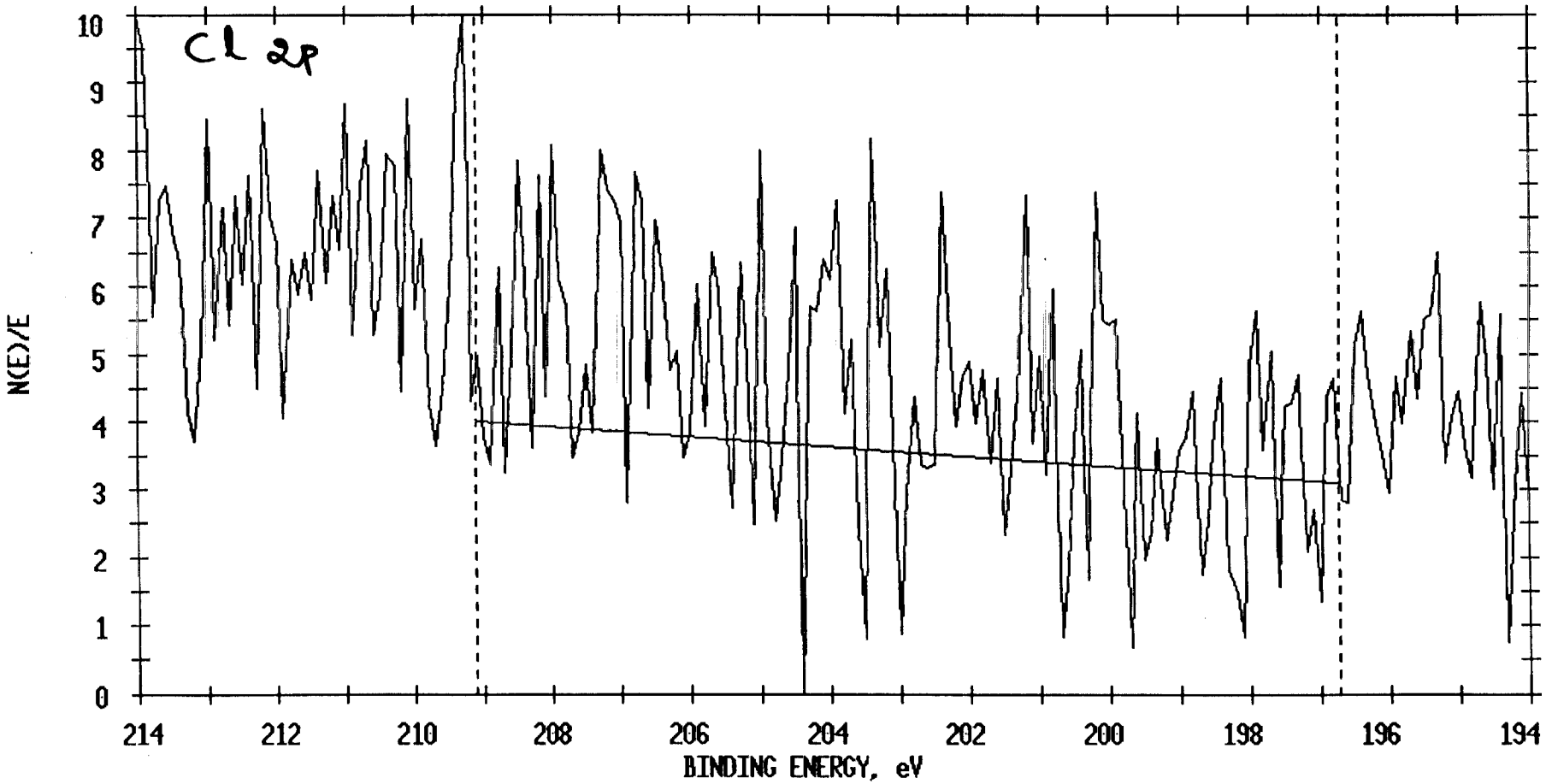
i Right

g Analysis 209.10 Counts 8990

j Analysis 196.70 Counts 8874

h Entered Counts 893

k Entered Counts 888



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Au1 Mo1 Si1 O1 C1 Na1 Cl1 F1

f Left

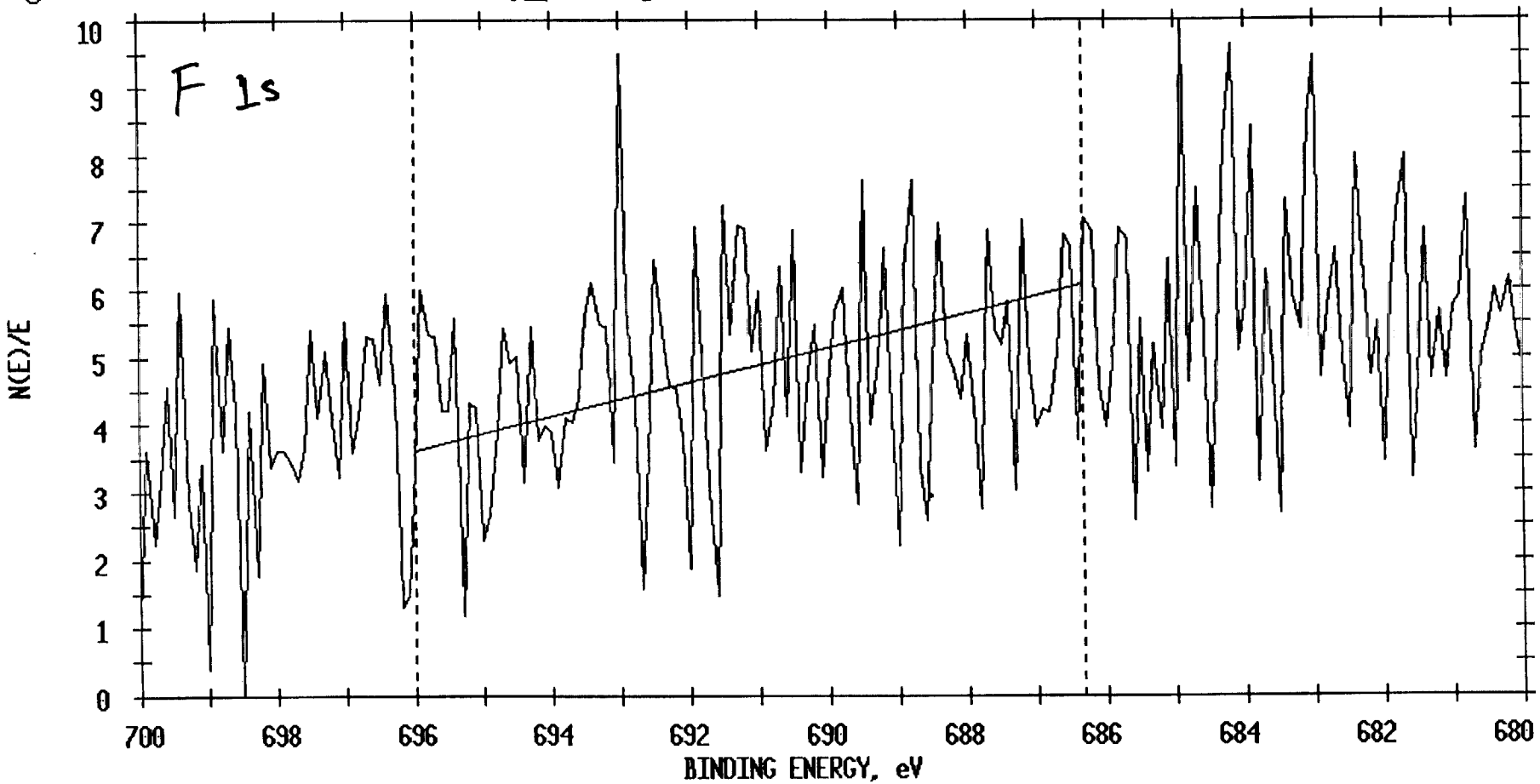
i Right

g Analysis 696.00 Counts 18396

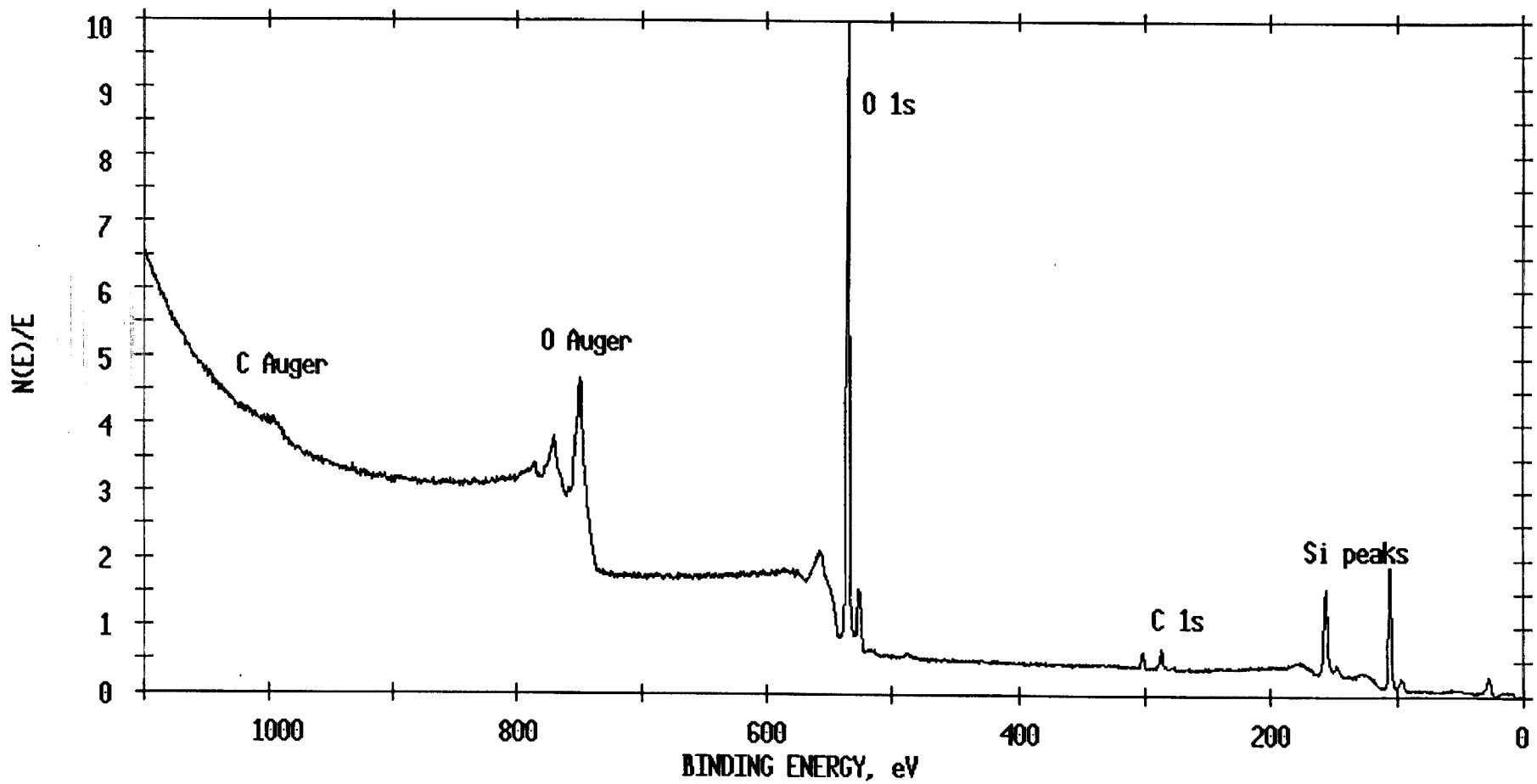
j Analysis 686.30 Counts 18686

h Entered Counts 1841

k Entered Counts 1861



ESCA SURVEY 12/12/91 ANGLE= 45 deg ACQ TIME=4.40 min
FILE: cm0145_3 NASA, Si/Al/Pyrex Flight sample
SCALE FACTOR= 42.353 k c/s, OFFSET= 4.633 k c/s PASS ENERGY= 89.450 eV Mg 250 W



Print AC Table | Exclude Region | Display Curve | More Softkeys | AC to AC Summary | Exit

Atomic Concentration

a User Settings Previous New b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

Atomic Concentration Table

File: cm0145_2 NASA, Si/Al/Pyrex Flight sample

Lens: Large Area Omni-Focus Source: Standard

Element	Area (cts-eV/s)	Sensitivity Factor	Concentration (%)
Si2p	29994	0.339	29.47
O1s	131362	0.711	61.54
C1s	5830	0.296	6.56
N1s	866	0.477	0.60
F1s	2328	1.000	0.78
Na1s	0	1.685	0.00
Cl2p	0	0.891	0.00
Al2p	734	0.234	1.04

Ion Gun: OFF X-ray: ON Mg Acquiring Technique: ESCA

0.5mPa 12/12/91 11:37

Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

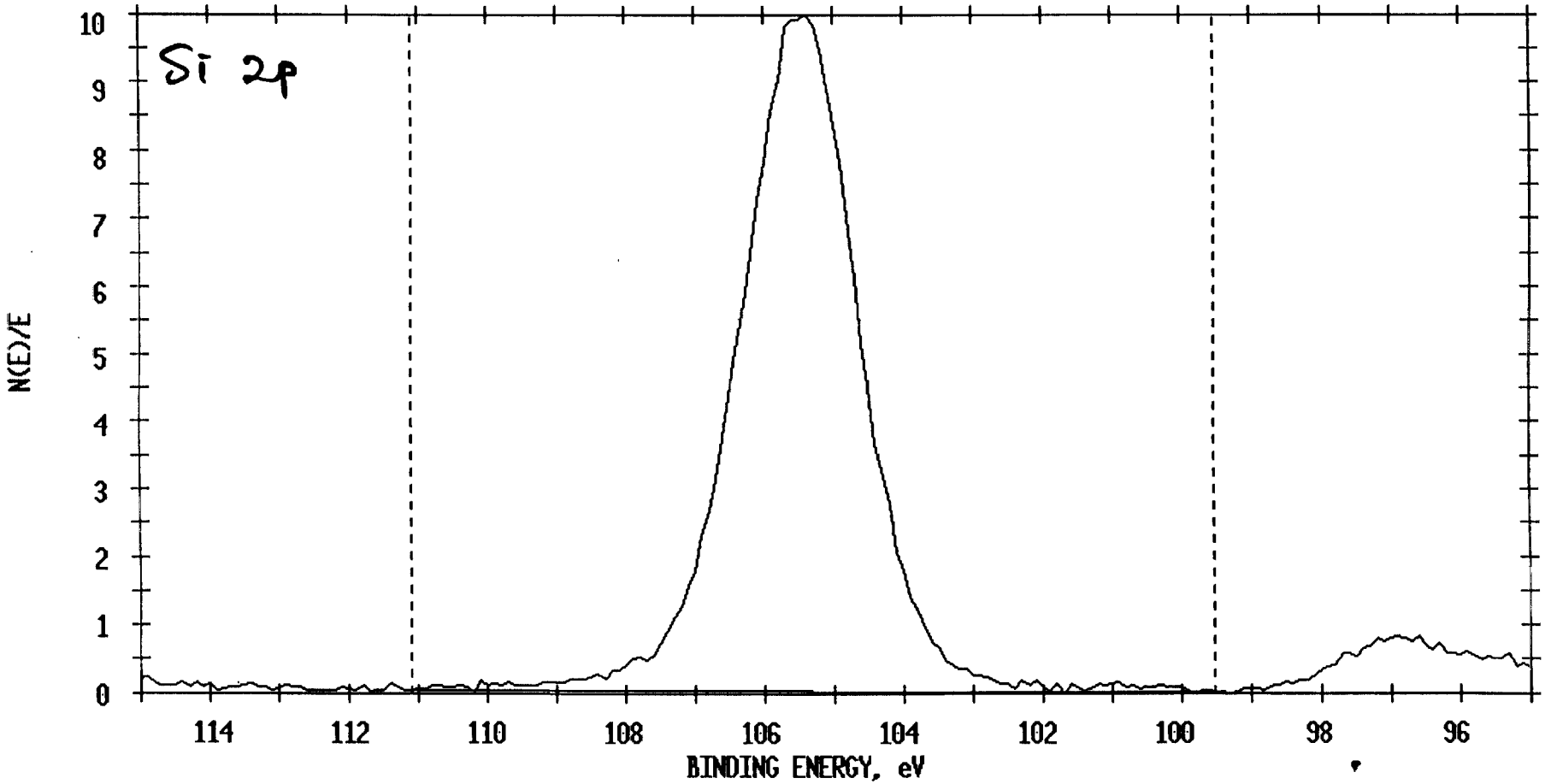
i Right

g Analysis 111.10 Counts 966

j Analysis 99.50 Counts 952

h Entered Counts 96

k Entered Counts 95



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

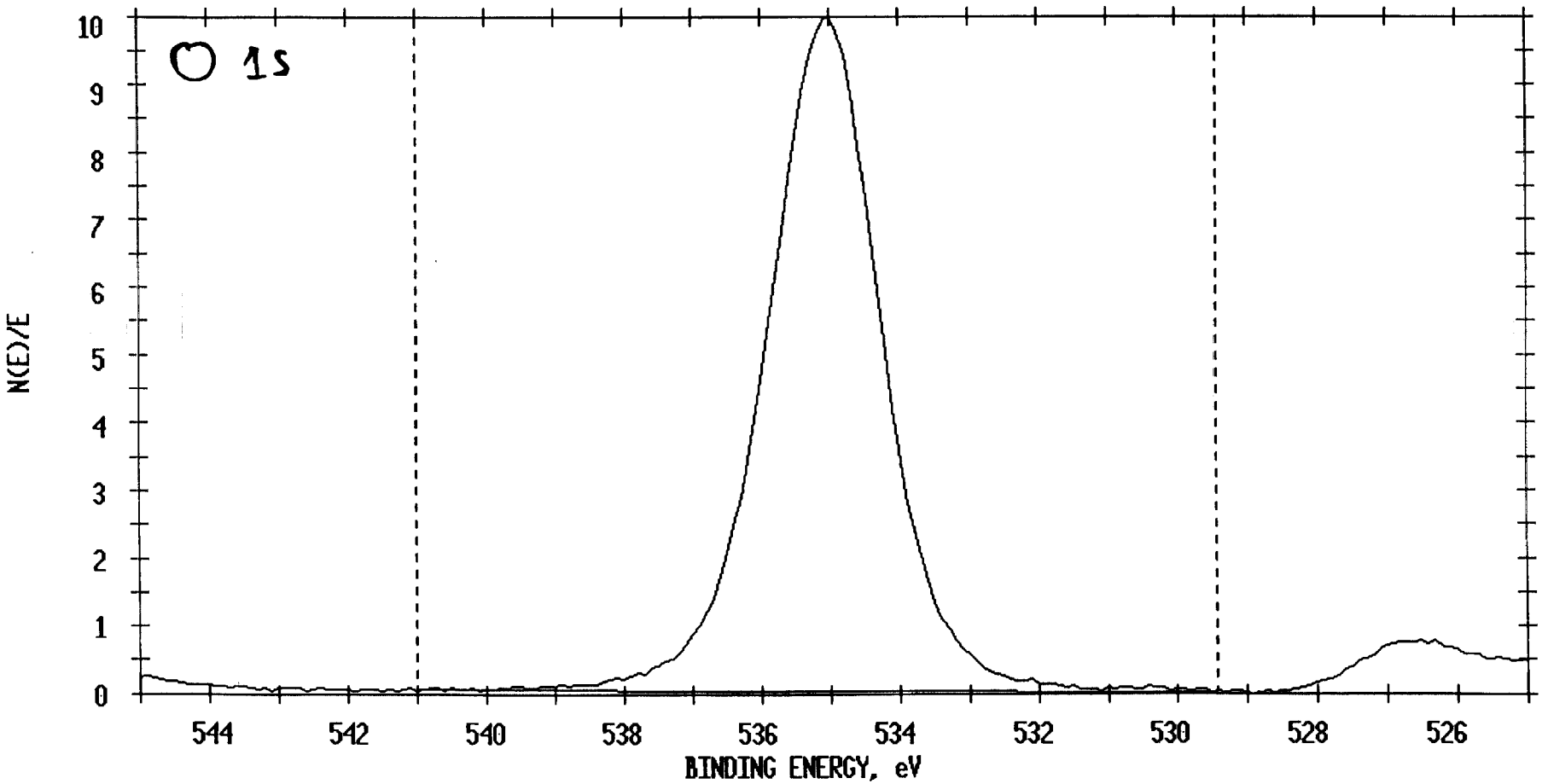
i Right

g Analysis 541.00 Counts 2856

j Analysis 529.40 Counts 2804

h Entered Counts 291

k Entered Counts 274



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

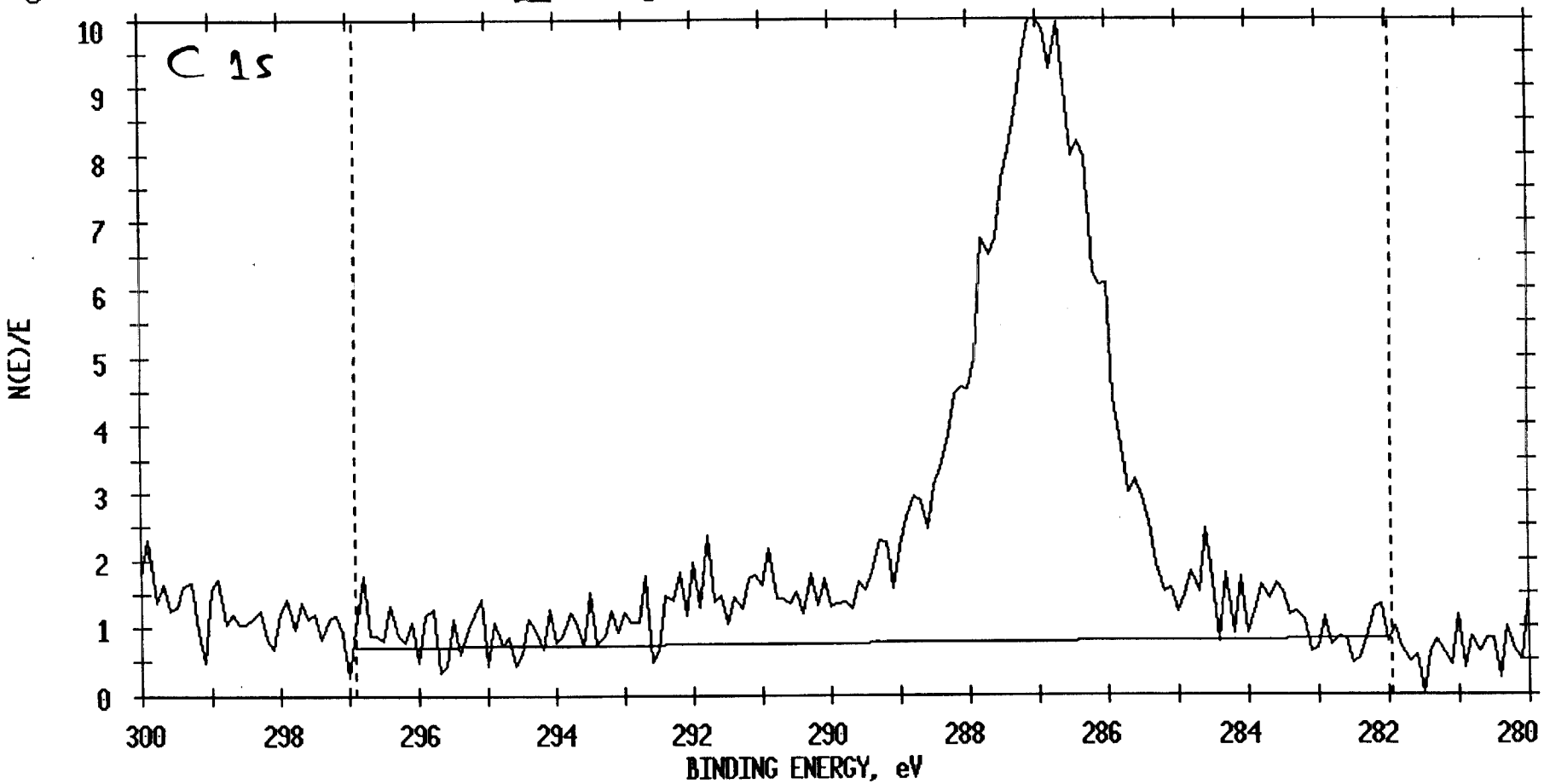
i Right

g Analysis 296.90 Counts 1762

j Analysis 281.90 Counts 1766

h Entered Counts 1730

k Entered Counts 1745



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

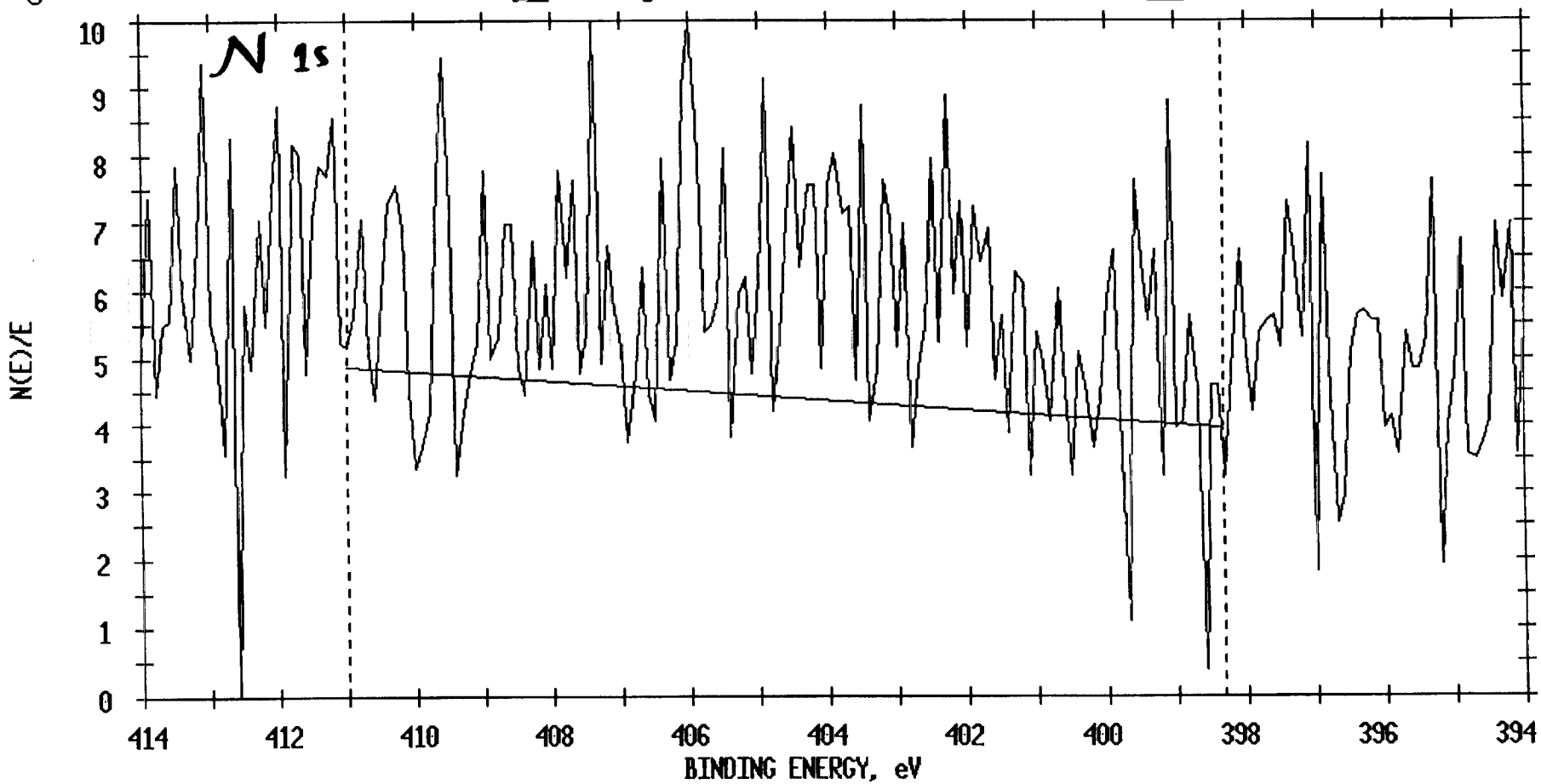
i Right

g Analysis 411.00 Counts 1926

j Analysis 398.30 Counts 1878

h Entered Counts 191

k Entered Counts 189



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

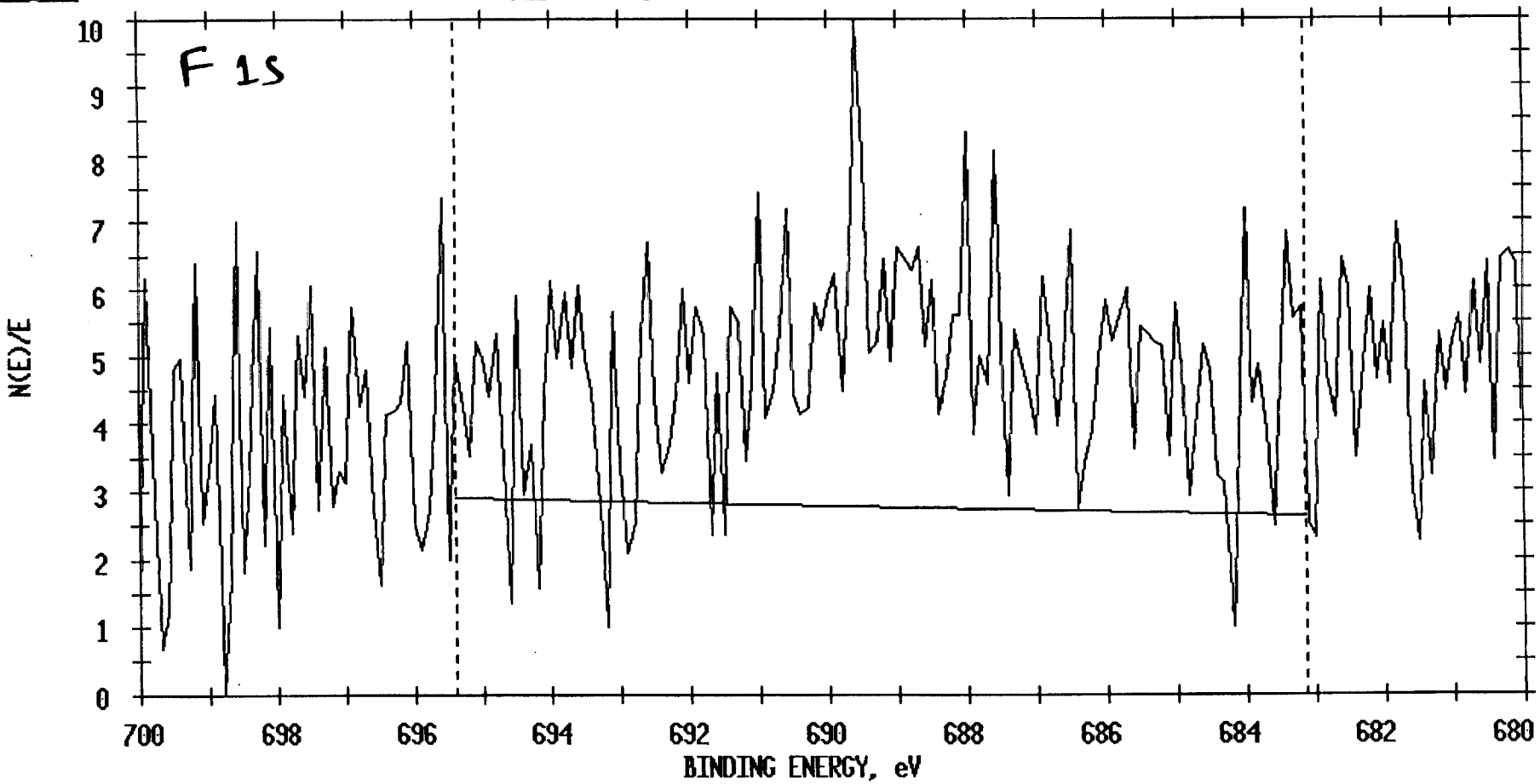
i Right

g Analysis 695.40 Counts 5076

j Analysis 683.10 Counts 4964

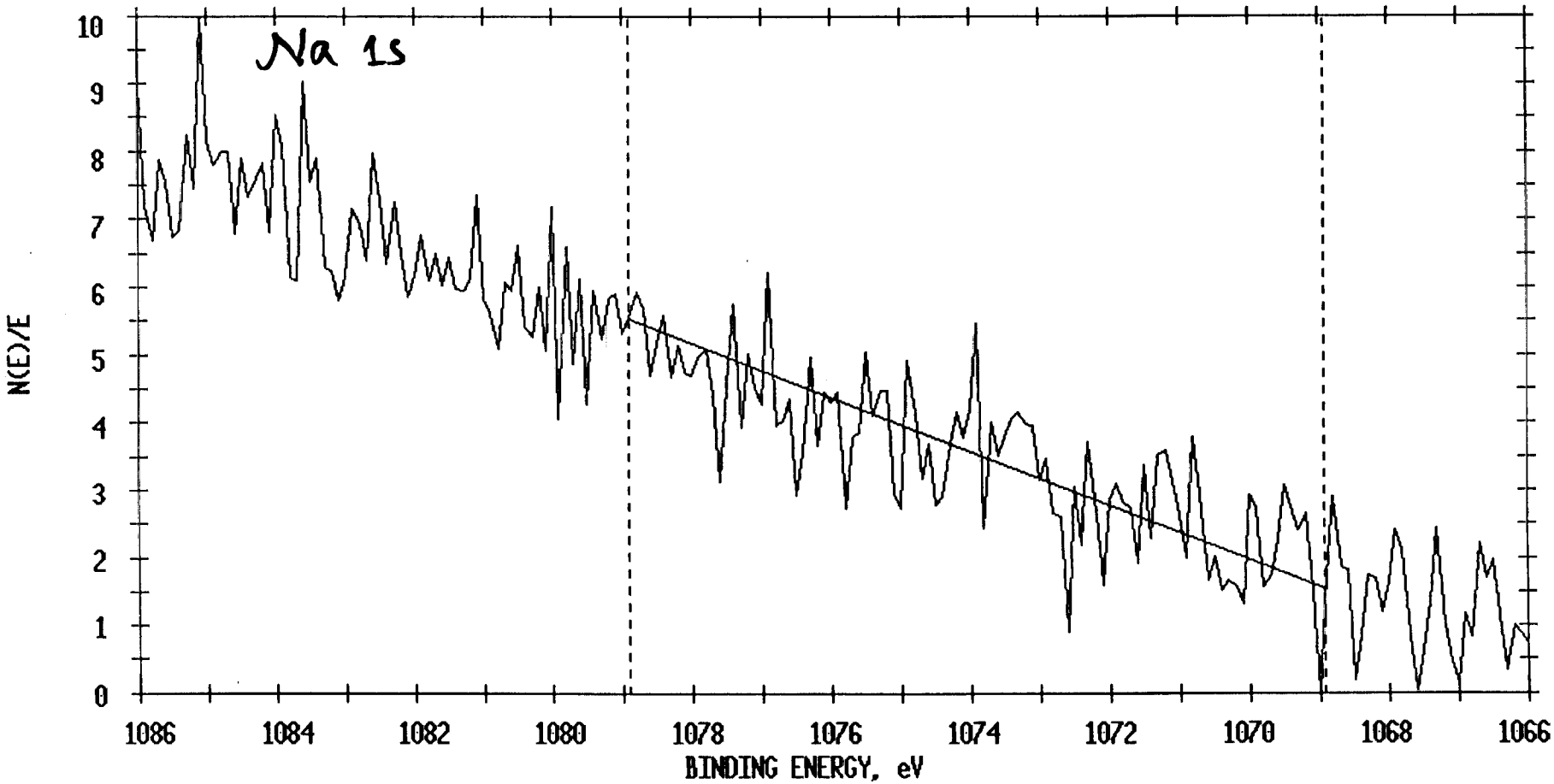
h Entered Counts 4982

k Entered Counts 4969



Atomic Concentration

a User Settings Previous New b Element Name
c Mode Area Height d Baseline Linear Integrated
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1
f Left g Analysis 1078.90 Counts 11192 h Entered Counts 1119
i Right j Analysis 1068.90 Counts 10664 k Entered Counts 1063



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

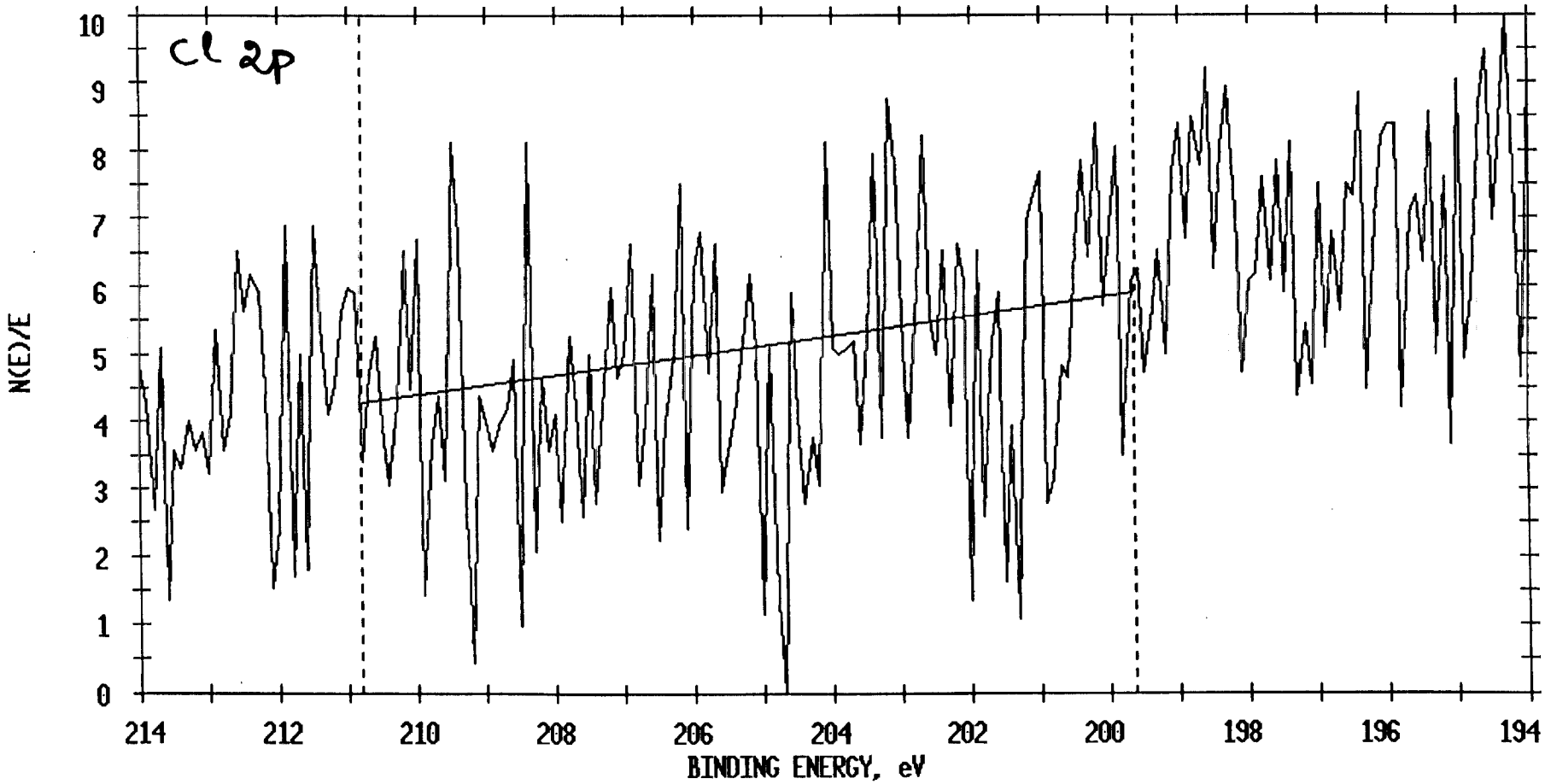
i Right

g Analysis 210.80 Counts 1798

j Analysis 199.60 Counts 1862

h Entered Counts 1818

k Entered Counts 1855



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 All

f Left

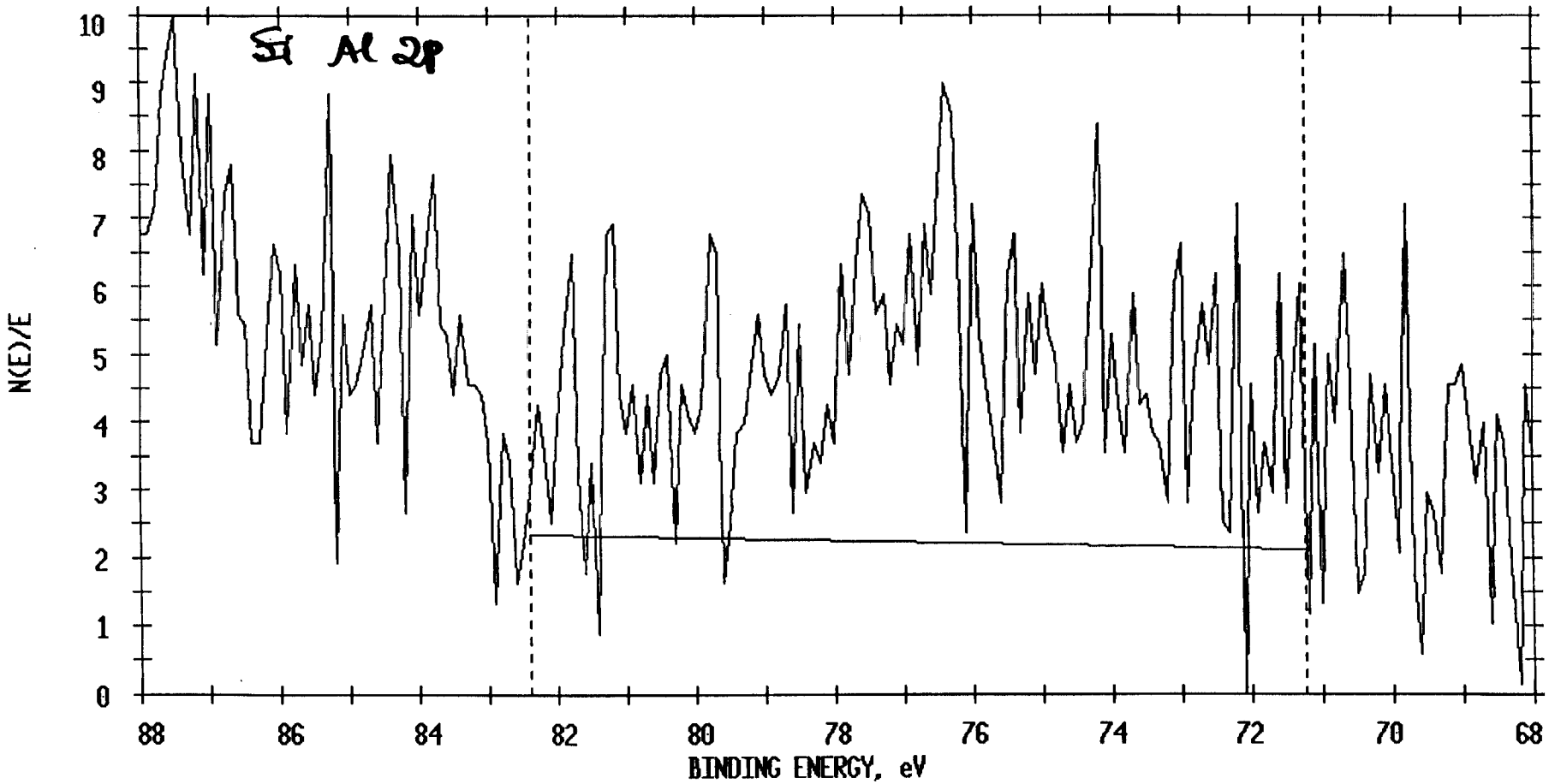
i Right

g Analysis 82.40 Counts 864

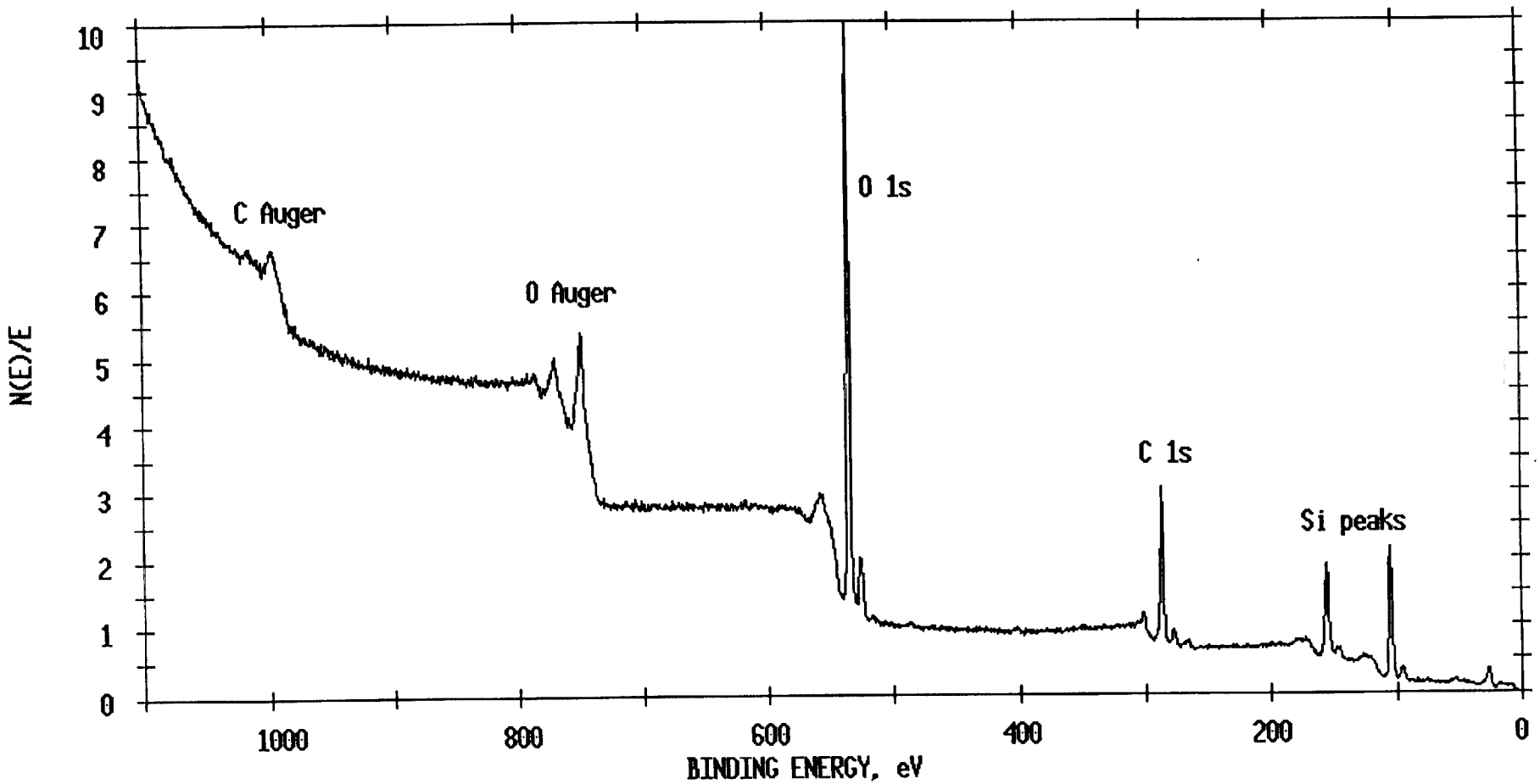
j Analysis 71.20 Counts 840

h Entered Counts 850

k Entered Counts 85



ESCA SURVEY 12/16/91 ANGLE= 45 deg ACQ TIME=4.59 min
FILE: sample2_1 NASA, Si/Al/Pyrex, Control sample
SCALE FACTOR= 25.368 k c/s, OFFSET= 4.320 k c/s PASS ENERGY= 89.450 eV Mg 250 W



Print
AC Table AC Table

Exclude
Region
Atomic Concentration

Display
Curve

More
Softkeys

AC to AC
Summary

Exit

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

File: sample2_2
Lens: Large Area Omni-Focus

Atomic Concentration Table
NASA, Si/Al/Pyrex, Control sample
Source: Standard

Element	Area (cts-eV/s)	Sensitivity Factor	Concentration (%)
Si2p	20842	0.339	23.80
O1s	79100	0.711	43.07
C1s	22466	0.296	29.39
N1s	1694	0.477	1.37
F1s	490	1.000	0.19
Na1s	2310	1.685	0.53
Cl2p	902	0.891	0.39
Al2p	756	0.234	1.25

Ion Gun: OFF
0.5mPa

X-ray: ON Mg

Acquiring

Technique: ESCA
12/16/91 17:12

Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

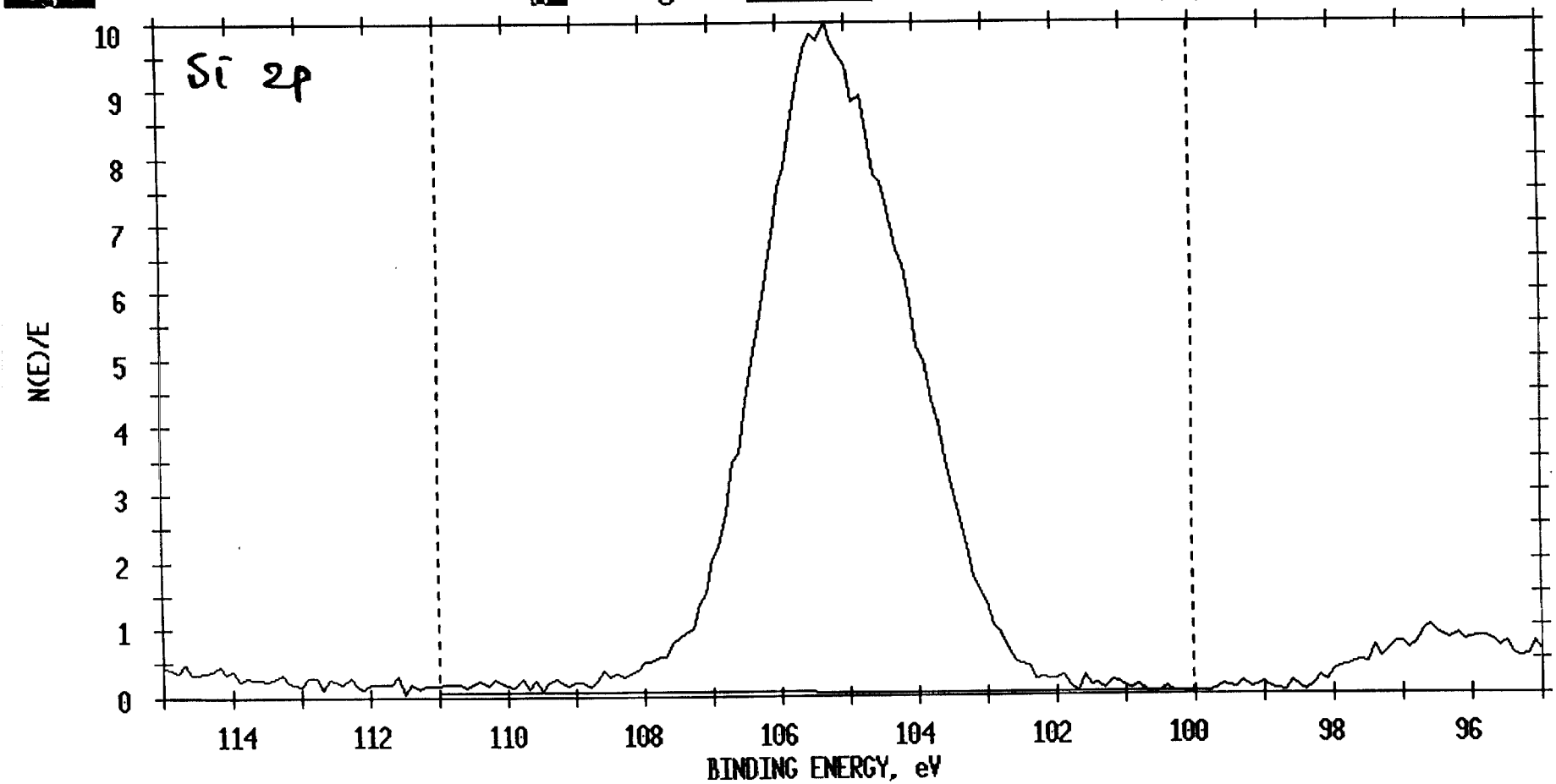
i Right

g Analysis 111.00 Counts 1004

j Analysis 100.00 Counts 958

h Entered Counts 965

k Entered Counts 95



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

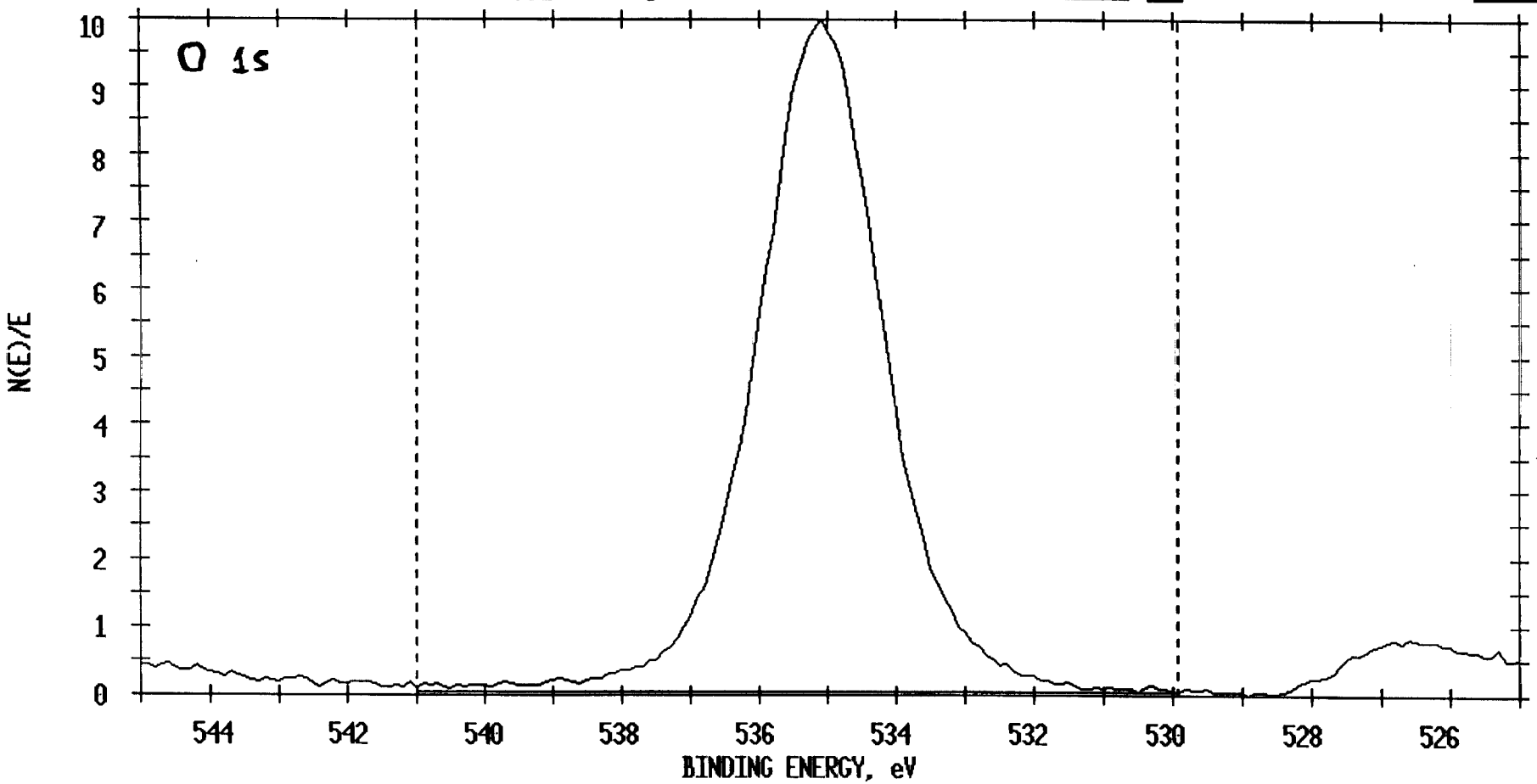
i Right

g Analysis 541.00 Counts 2702

j Analysis 529.90 Counts 2578

h Entered Counts 260

k Entered Counts 260



Atomic Concentration

a User Settings Previous New

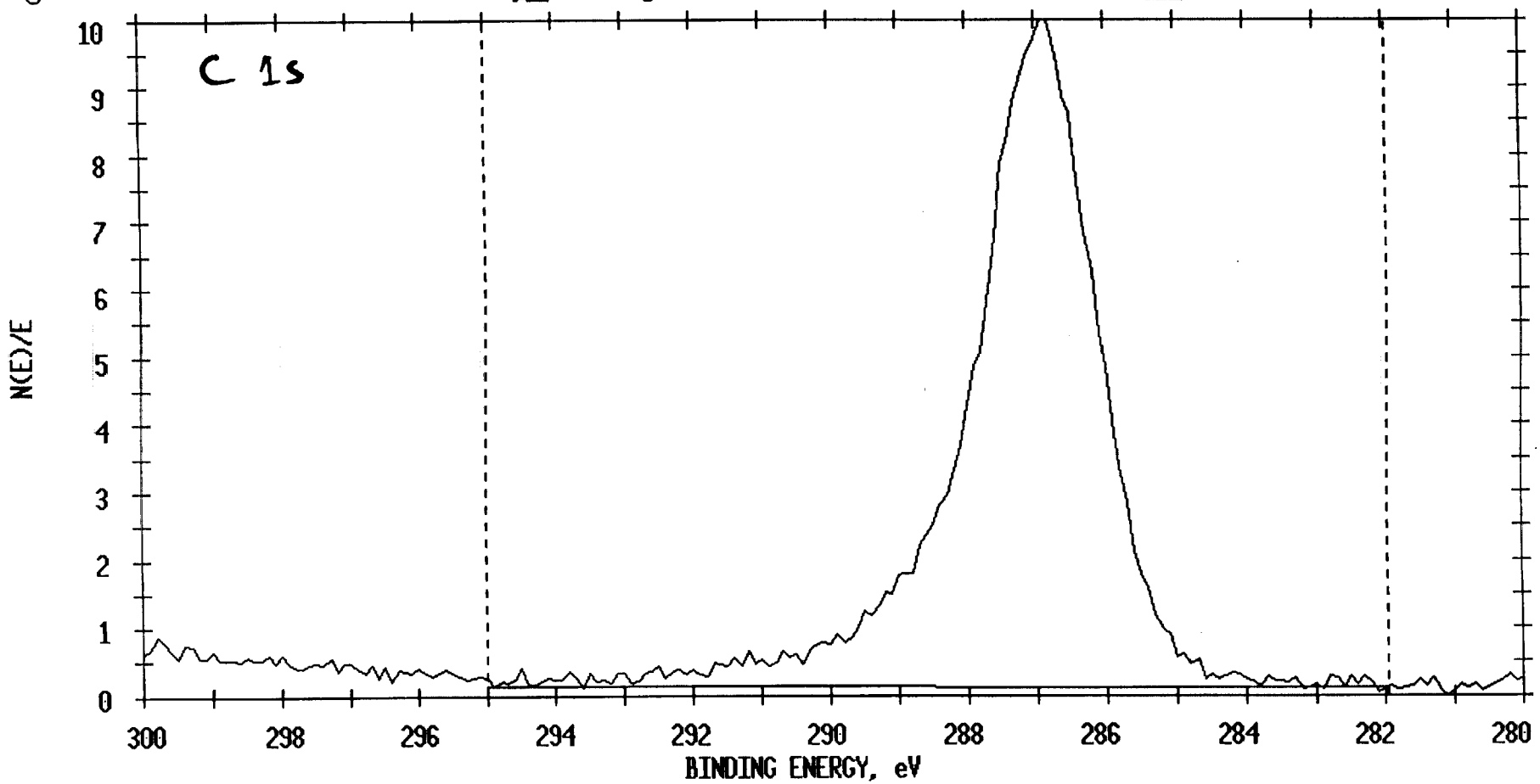
b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left g Analysis 295.00 Counts 1914 h Entered Counts 184

i Right j Analysis 281.90 Counts 1844 k Entered Counts 183



Atomic Concentration

a User Settings Previous New

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

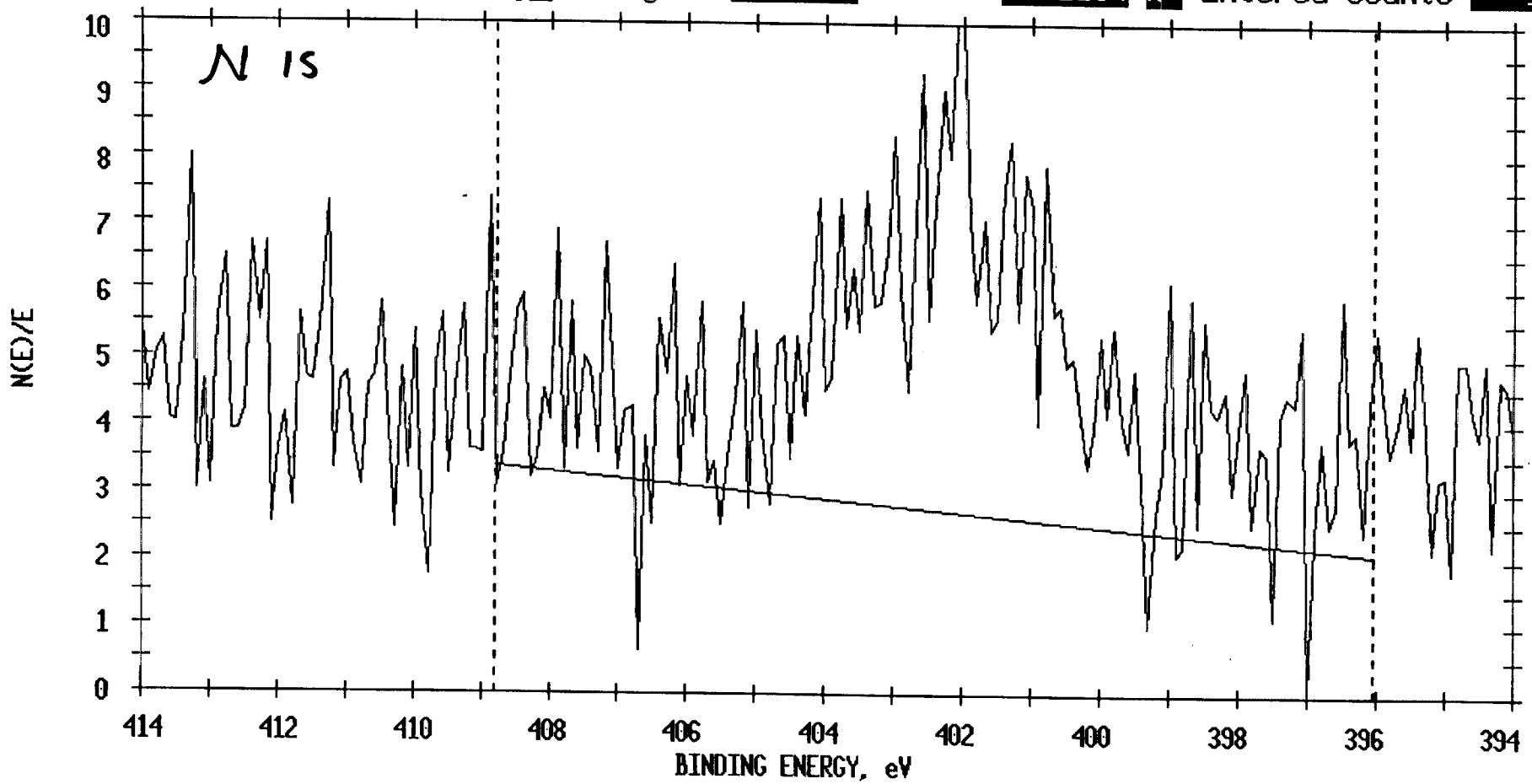
f Left

i Right

b Element Name

g Analysis 408.80 Counts 2030 h Entered Counts 2040

j Analysis 396.00 Counts 2104 k Entered Counts 1999



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

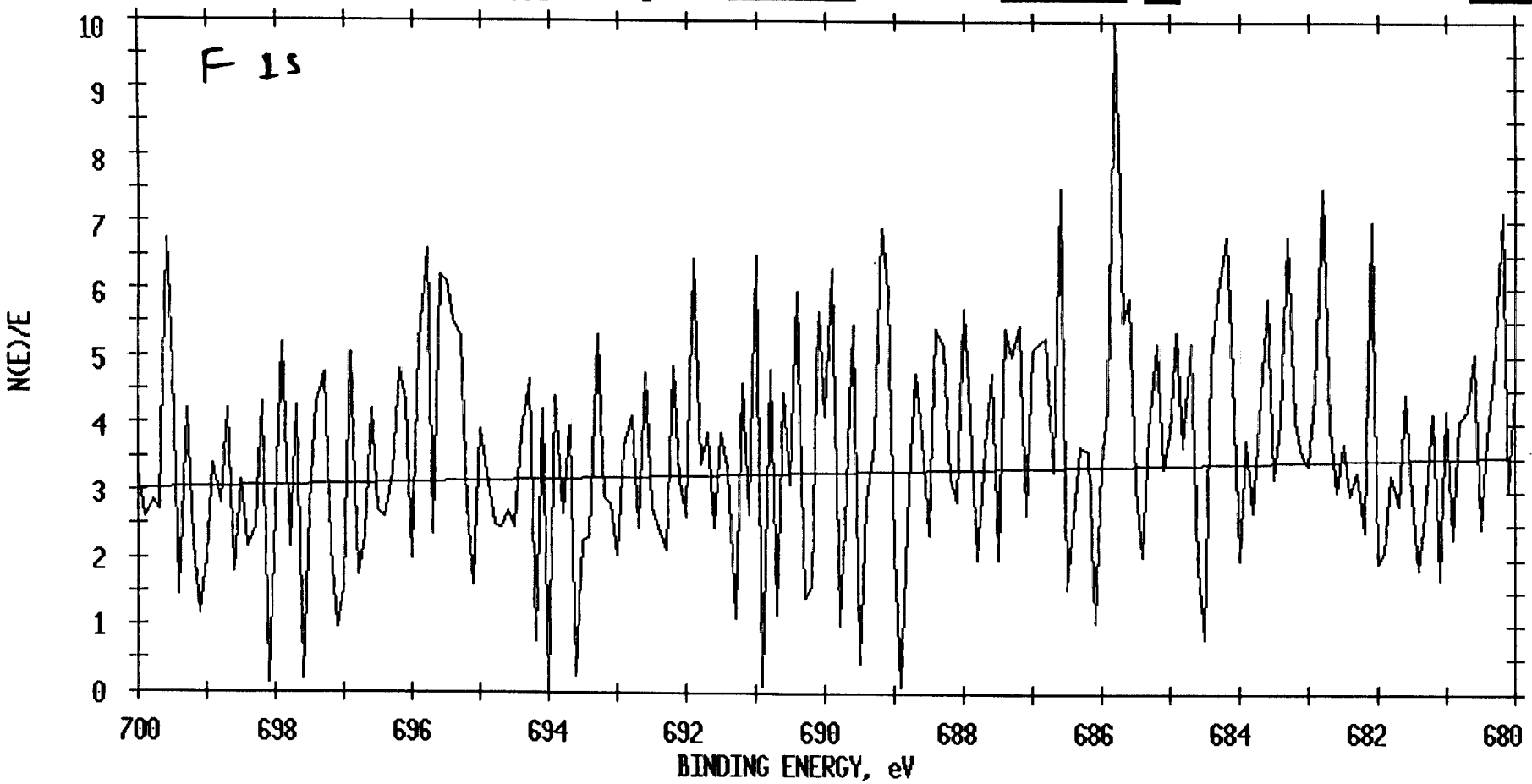
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

i Right

g Analysis 700.00 Counts 4652 h Entered Counts 464

j Analysis 680.00 Counts 4702 k Entered Counts 466



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

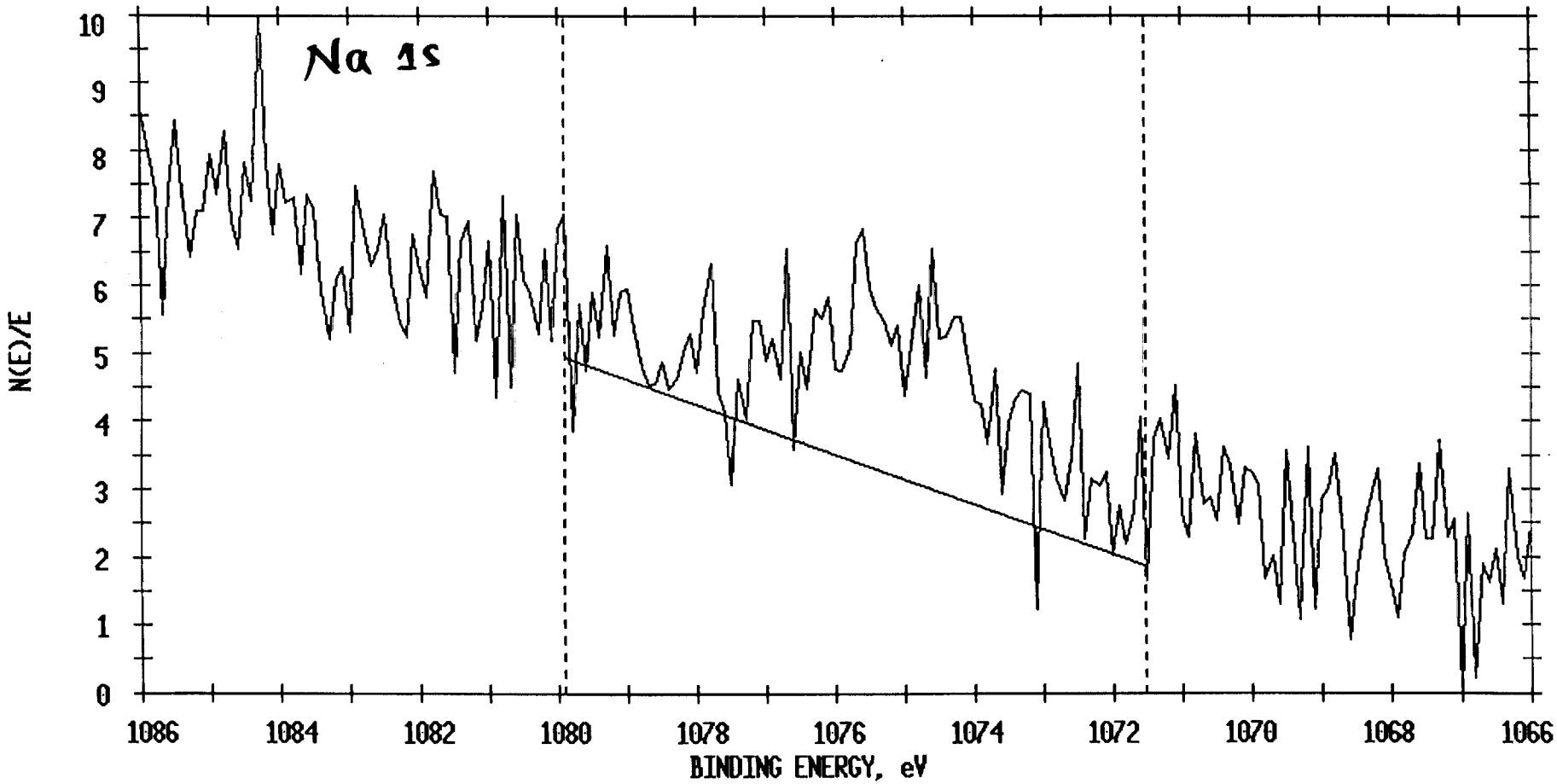
i Right

g Analysis 1079.90 Counts 9644

j Analysis 1071.50 Counts 9056

h Entered Counts 9410

k Entered Counts 9082



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

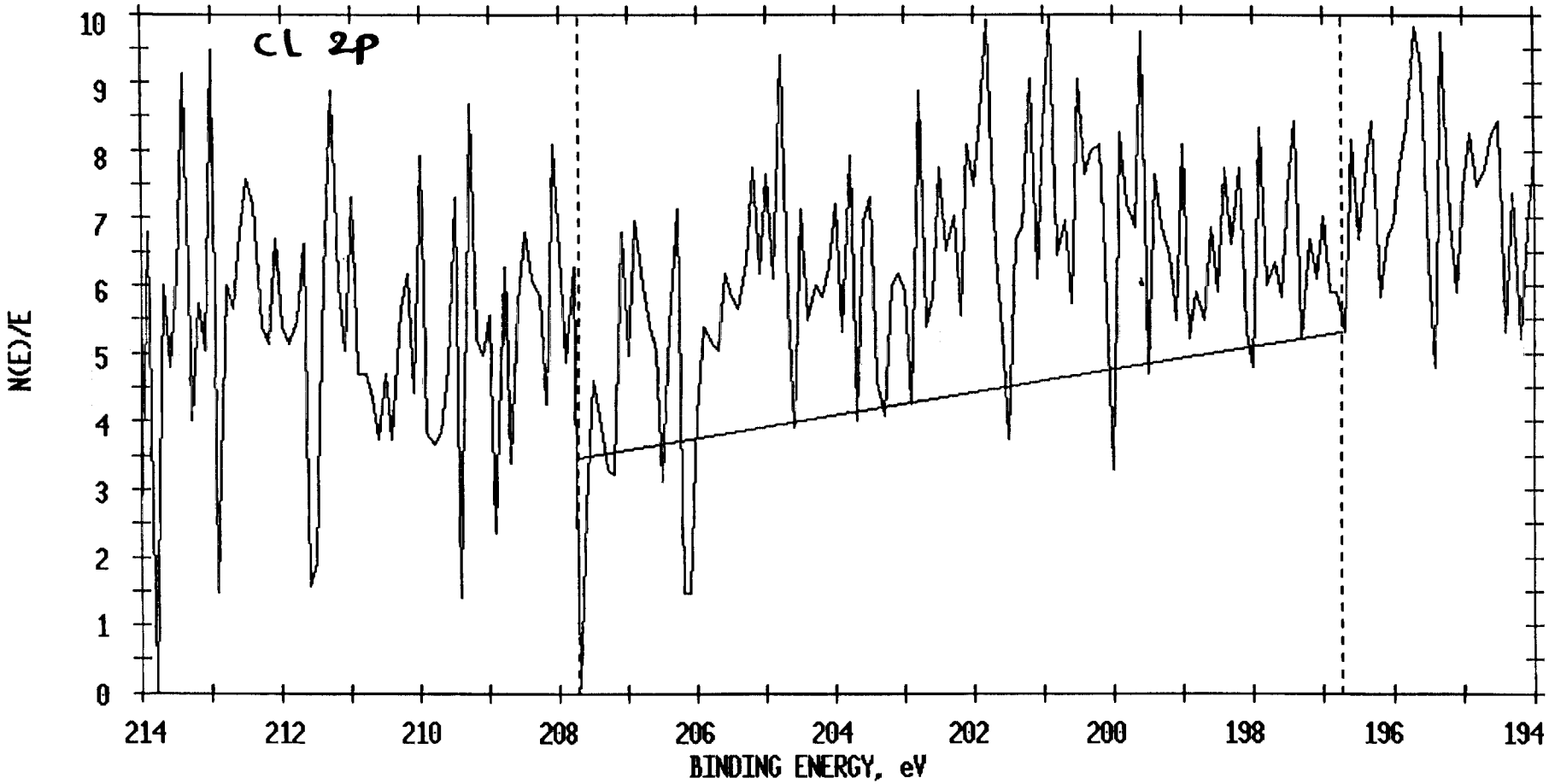
g Analysis 207.70 Counts 1650

h Entered Counts 172

i Right

j Analysis 196.70 Counts 1770

k Entered Counts 177



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

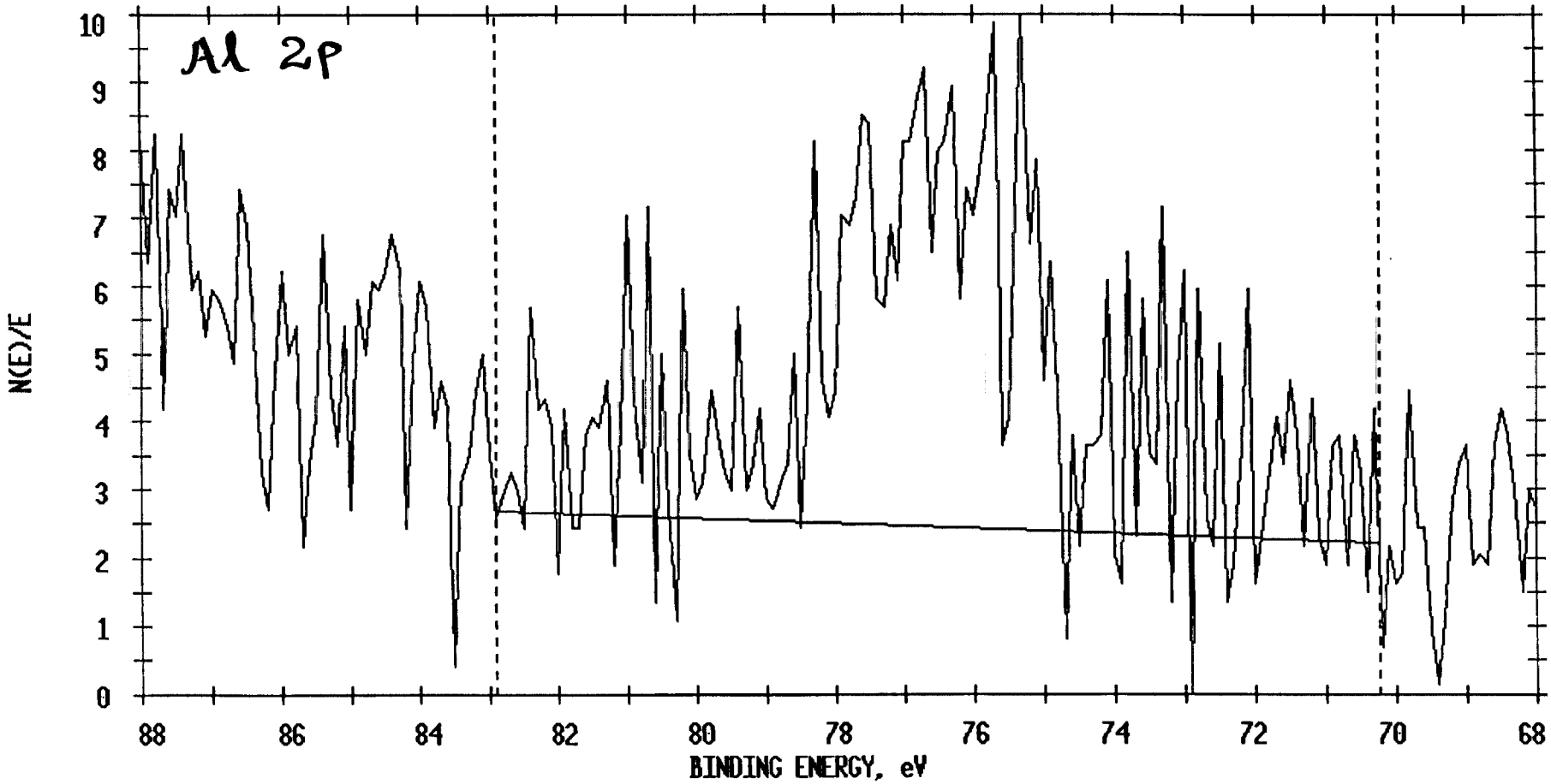
g Analysis 82.90 Counts 876

h Entered Counts 878

i Right

j Analysis 70.20 Counts 848

k Entered Counts 87



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

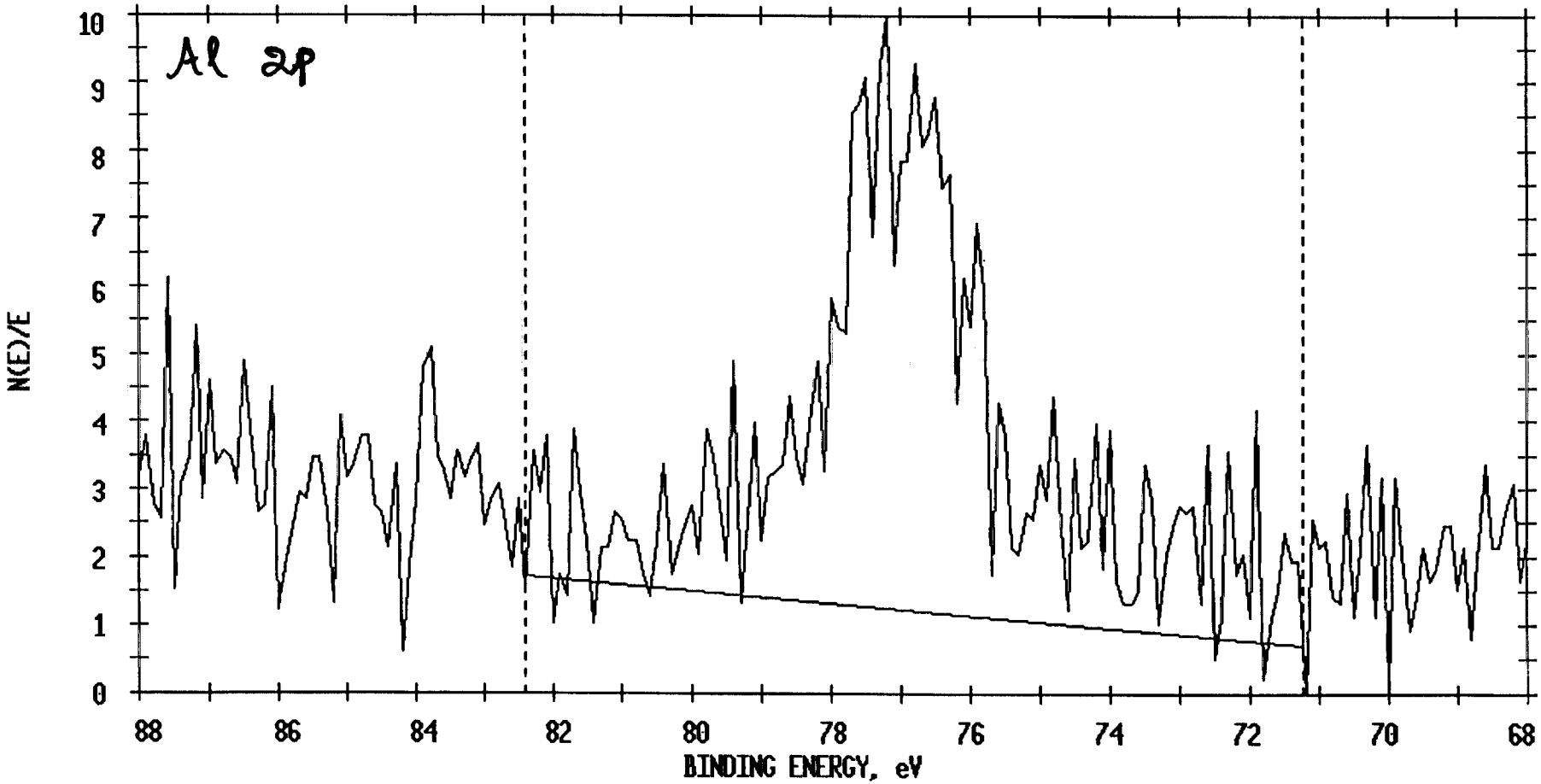
i Right

g Analysis 82.40 Counts 842

j Analysis 71.20 Counts 812

h Entered Counts 840

k Entered Counts 820



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

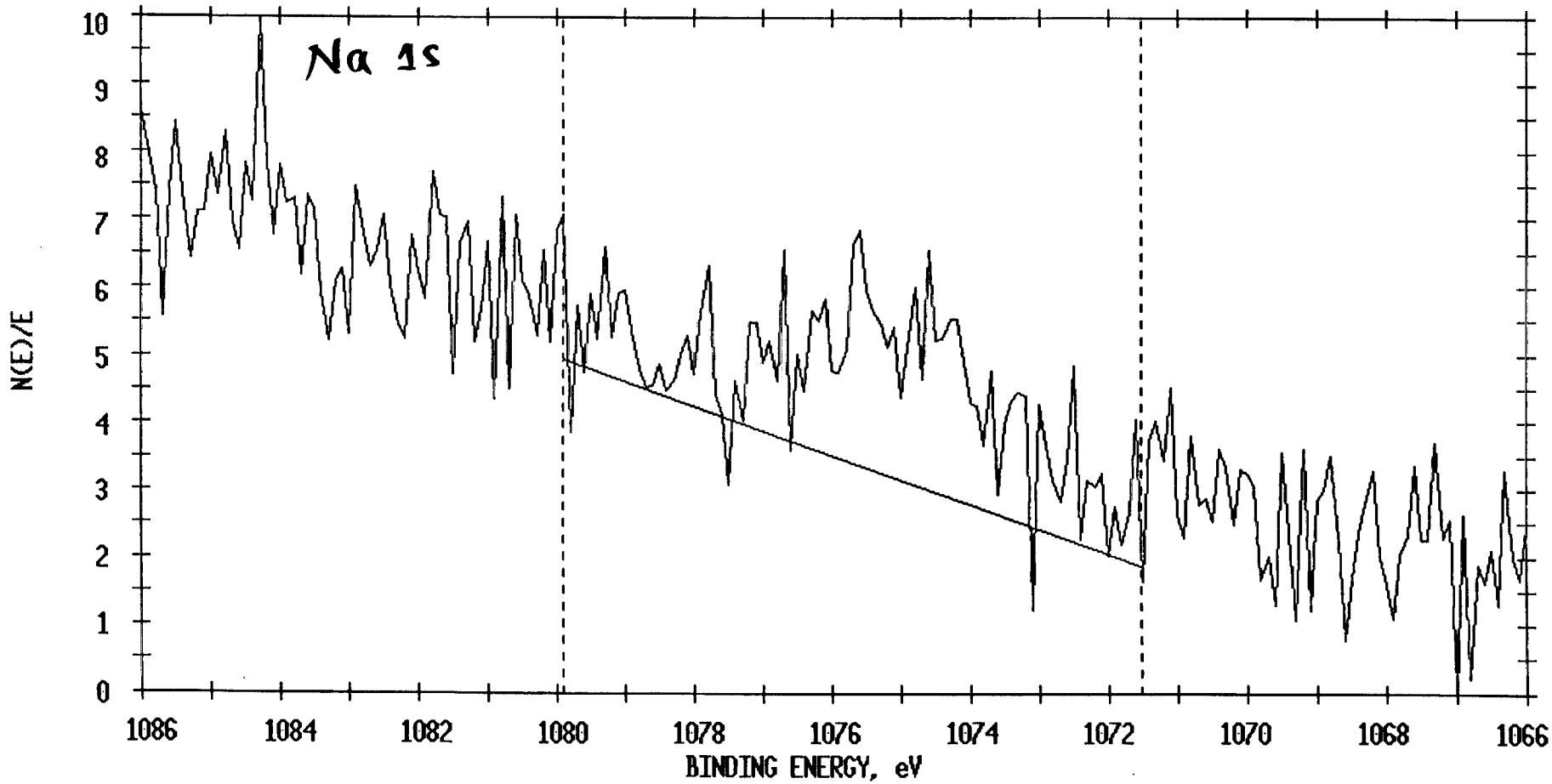
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

i Right

g Analysis 1079.90 Counts 9644 h Entered Counts 9410

j Analysis 1071.50 Counts 9056 k Entered Counts 9082



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

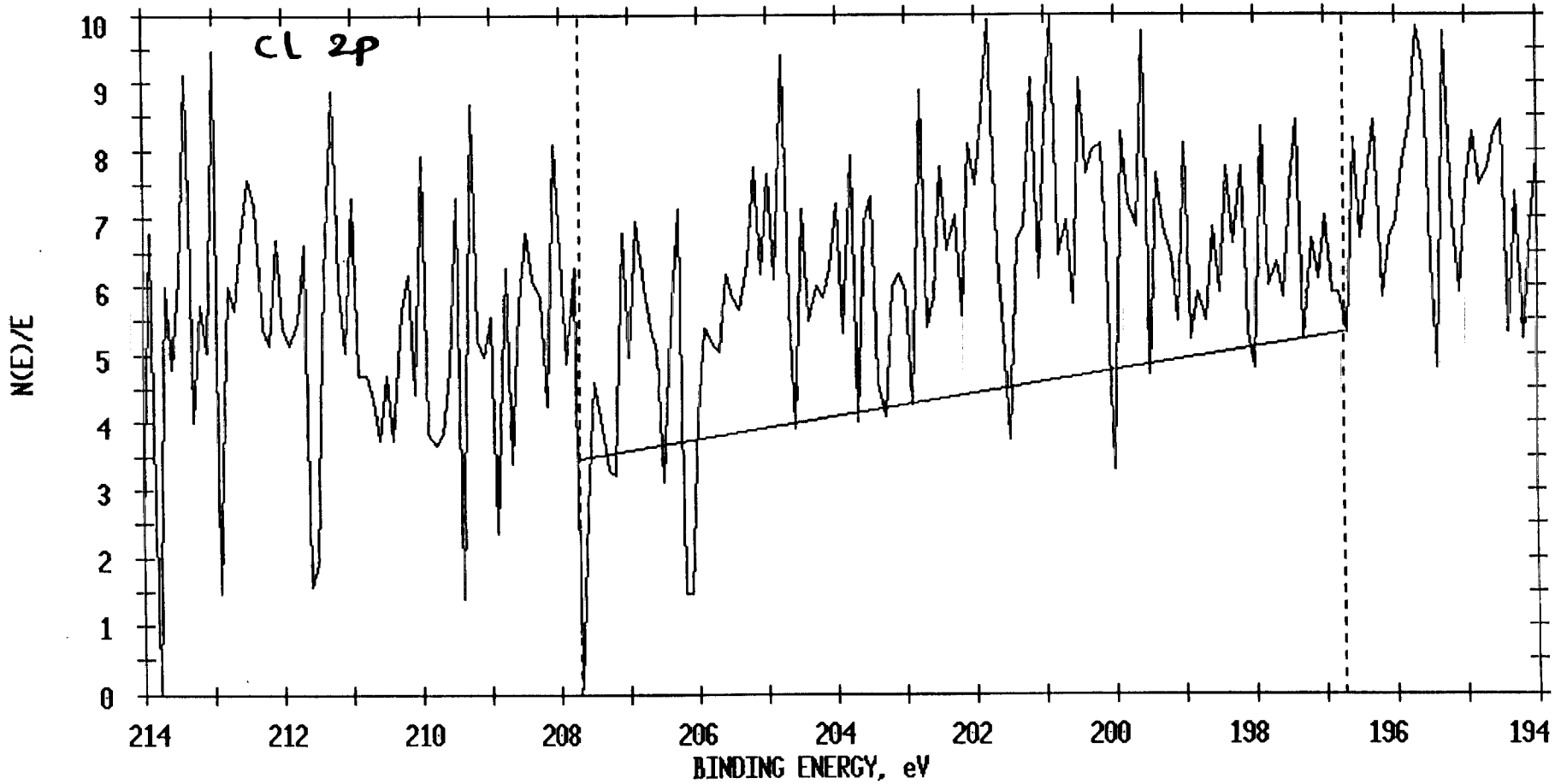
g Analysis 207.70 Counts 1650

h Entered Counts 1728

i Right

j Analysis 196.70 Counts 1770

k Entered Counts 1771



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

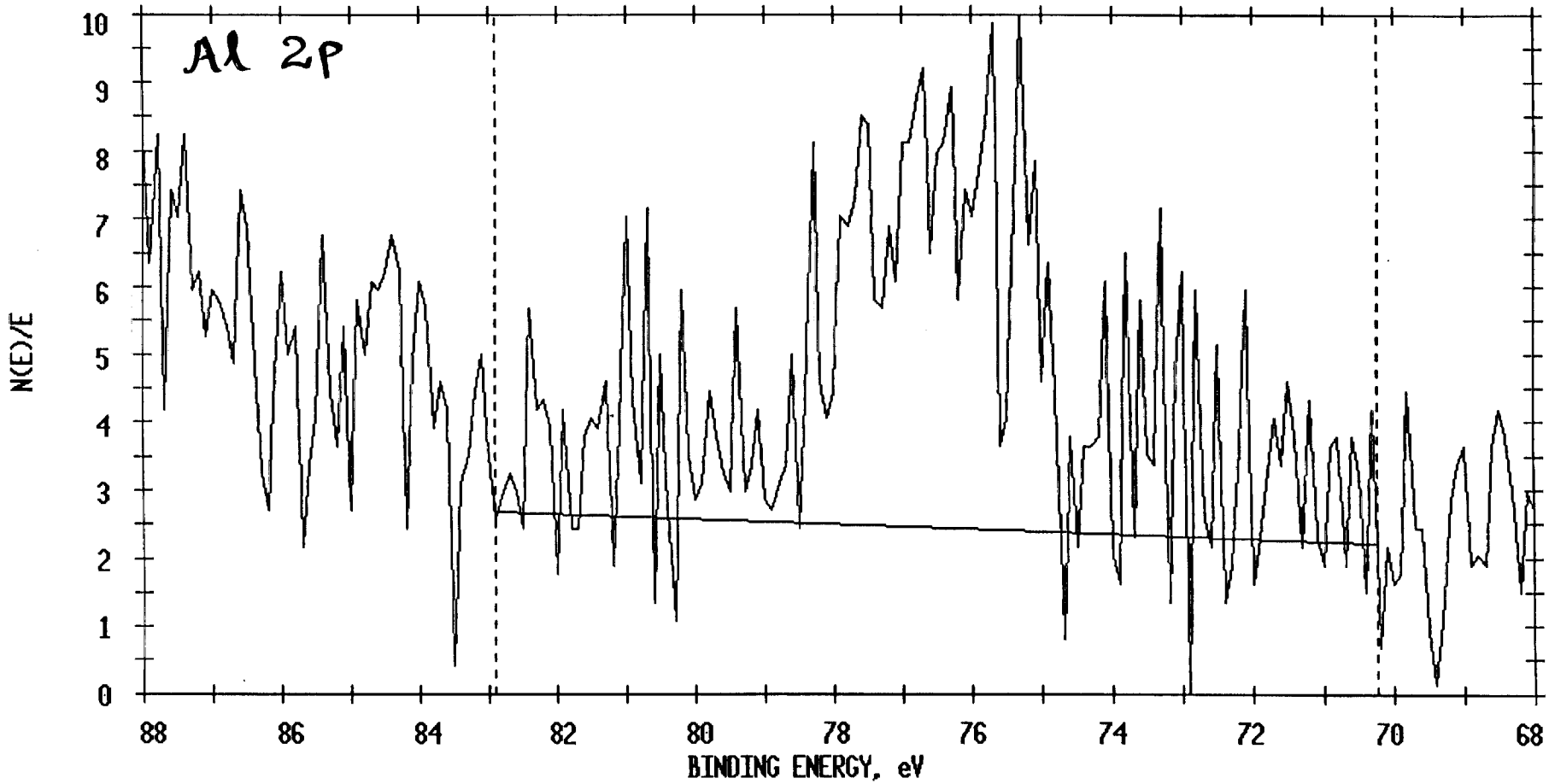
i Right

g Analysis 82.90 Counts 876

j Analysis 70.20 Counts 848

h Entered Counts 878

k Entered Counts 87



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

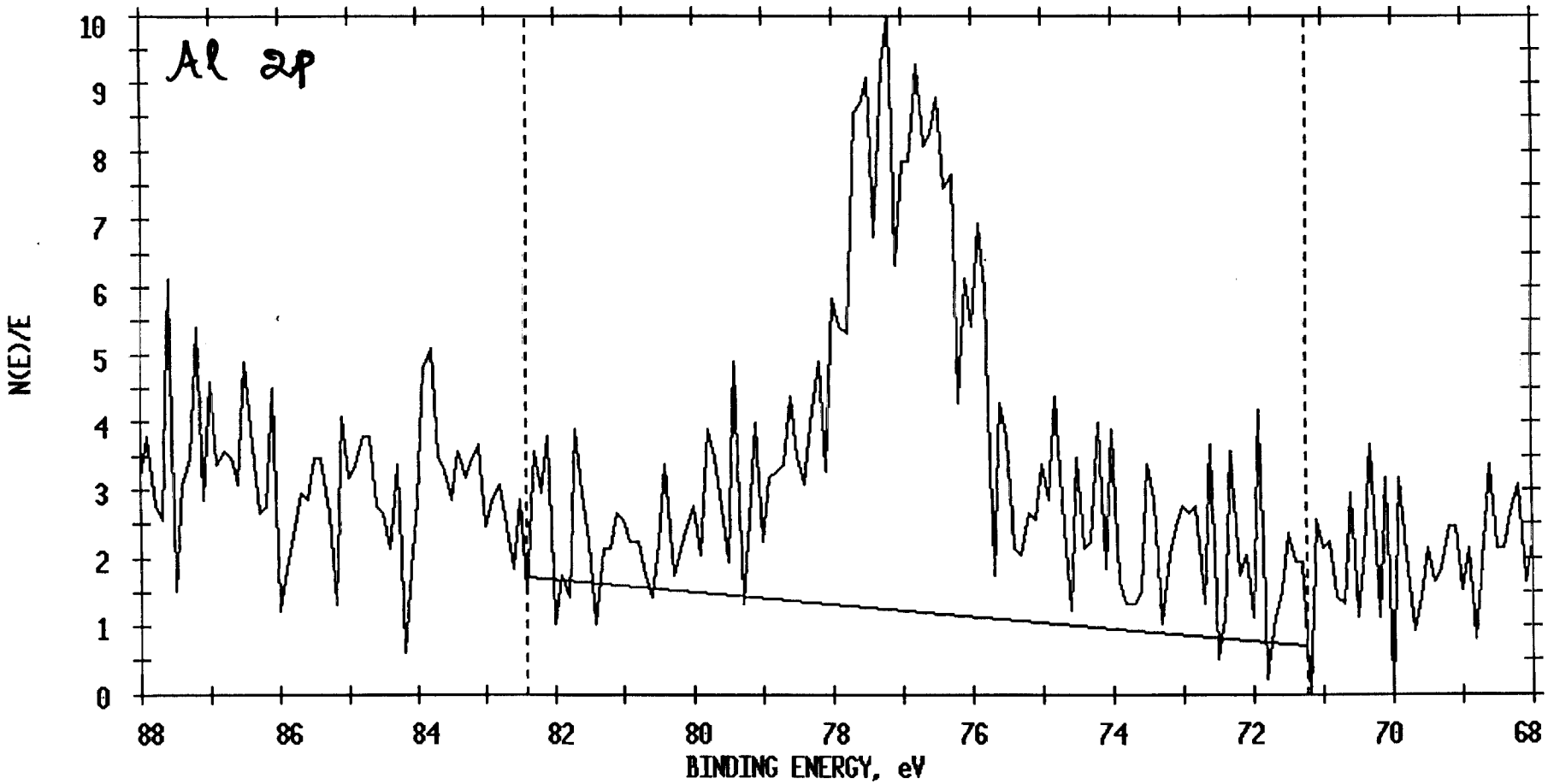
i Right

g Analysis 82.40 Counts 842

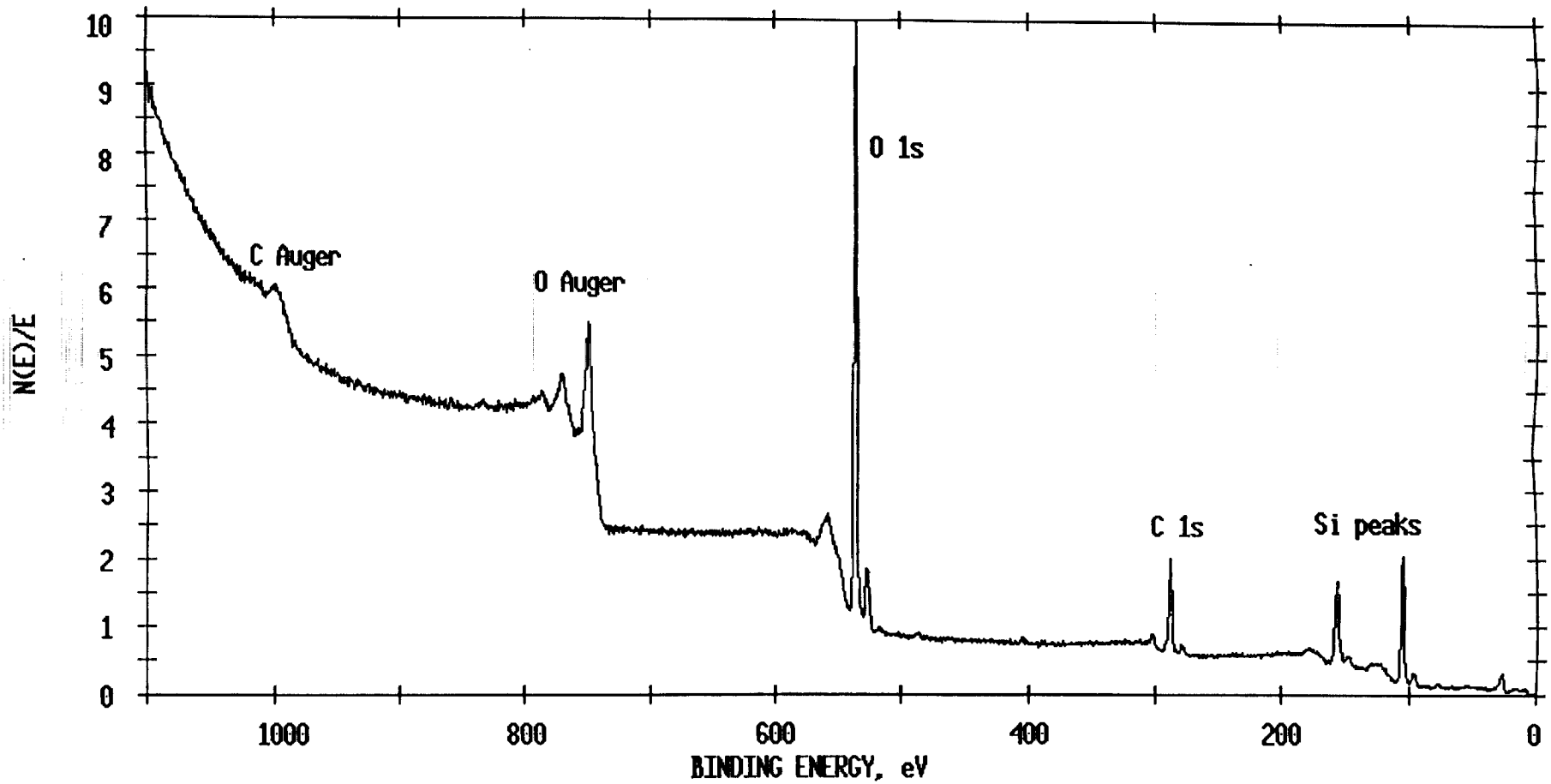
j Analysis 71.20 Counts 812

h Entered Counts 841

k Entered Counts 821



ESCA SURVEY 12/12/91 ANGLE= 45 deg ACQ TIME=4.40 min
FILE: smaple5_1 NASA, Si/Al/Pyrex, control sample
SCALE FACTOR= 27.973 k c/s, OFFSET= 4.333 k c/s PASS ENERGY= 89.450 eV Mg 250 W



Print AC Table | Exclude Region Atomic Concentration | Display Curve | More Softkeys | AC to AC Summary | Exit

a User Settings Previous New b Element Name
c Mode Area Height d Baseline Linear Integrated
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

Atomic Concentration Table

File: sample5_2 NASA, Si/Al/Pyrex, control sample
Lens: Large Area Omni-Focus Source: Standard

Element	Area (cts-eV/s)	Sensitivity Factor	Concentration (%)
Si2p	21276	0.339	24.76
O1s	89432	0.711	49.62
C1s	16312	0.296	21.74
N1s	1954	0.477	1.62
F1s	420	1.000	0.17
Na1s	980	1.685	0.23
Cl2p	382	0.891	0.17
Al2p	1008	0.234	1.70

Ion Gun: OFF X-ray: ON Mg Acquiring Technique: ESCA
0.5mPa 12/12/91 11:15

Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

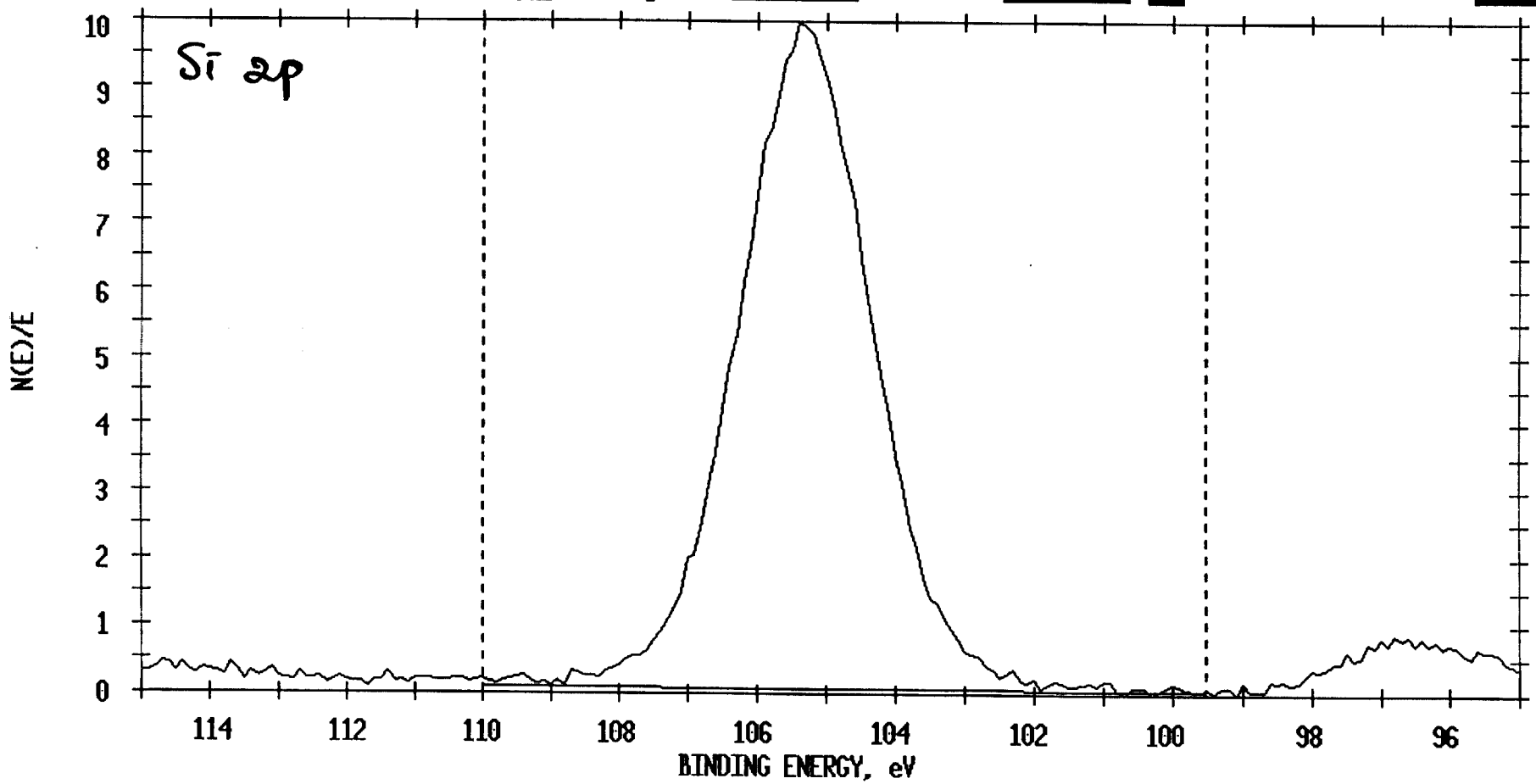
i Right

g Analysis 110.00 Counts 1010

j Analysis 99.50 Counts 938

h Entered Counts 954

k Entered Counts 92



Atomic Concentration

a User Settings Previous New

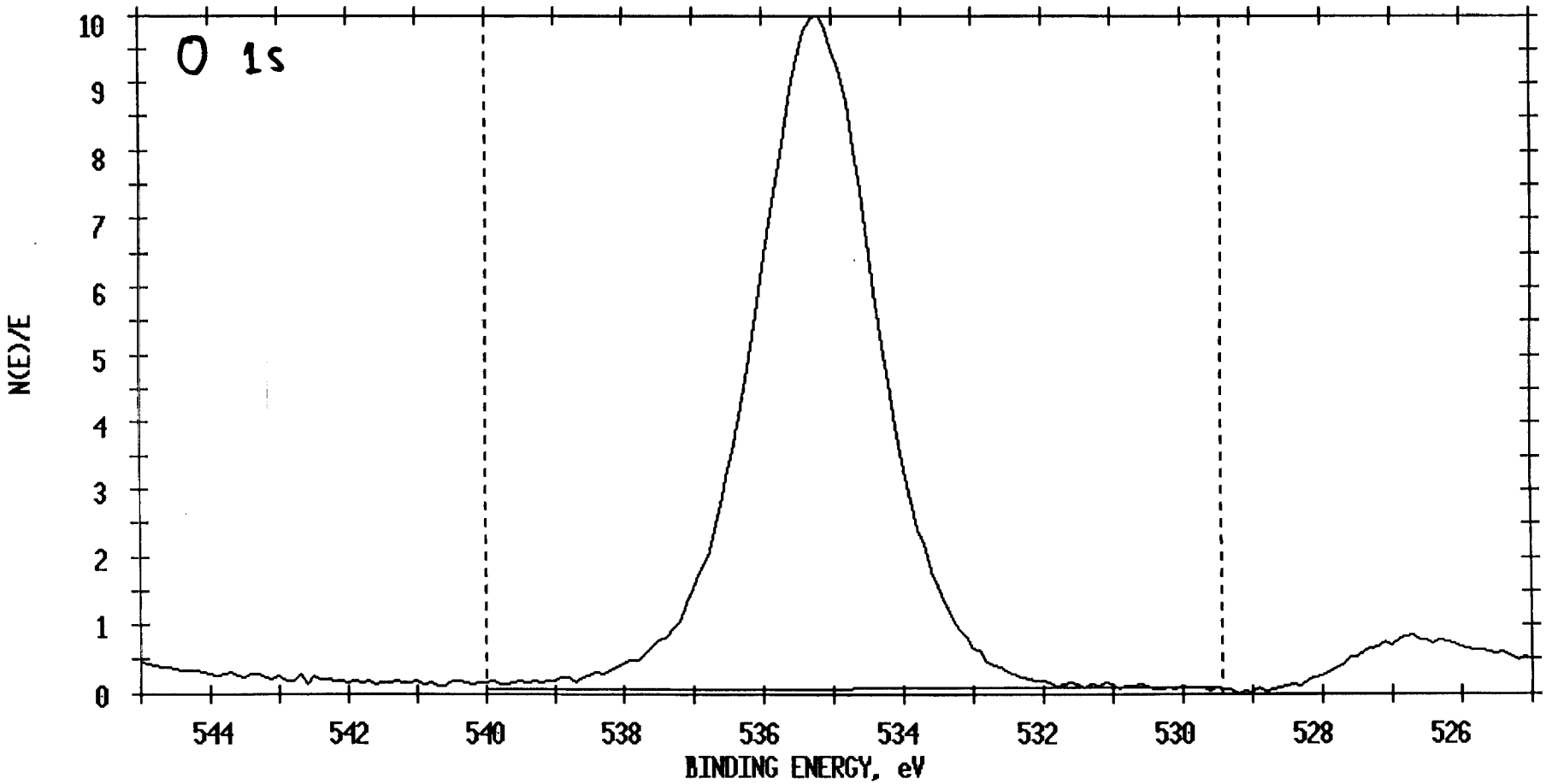
b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left g Analysis 540.00 Counts 2796 h Entered Counts 261

i Right j Analysis 529.40 Counts 2626 k Entered Counts 265



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

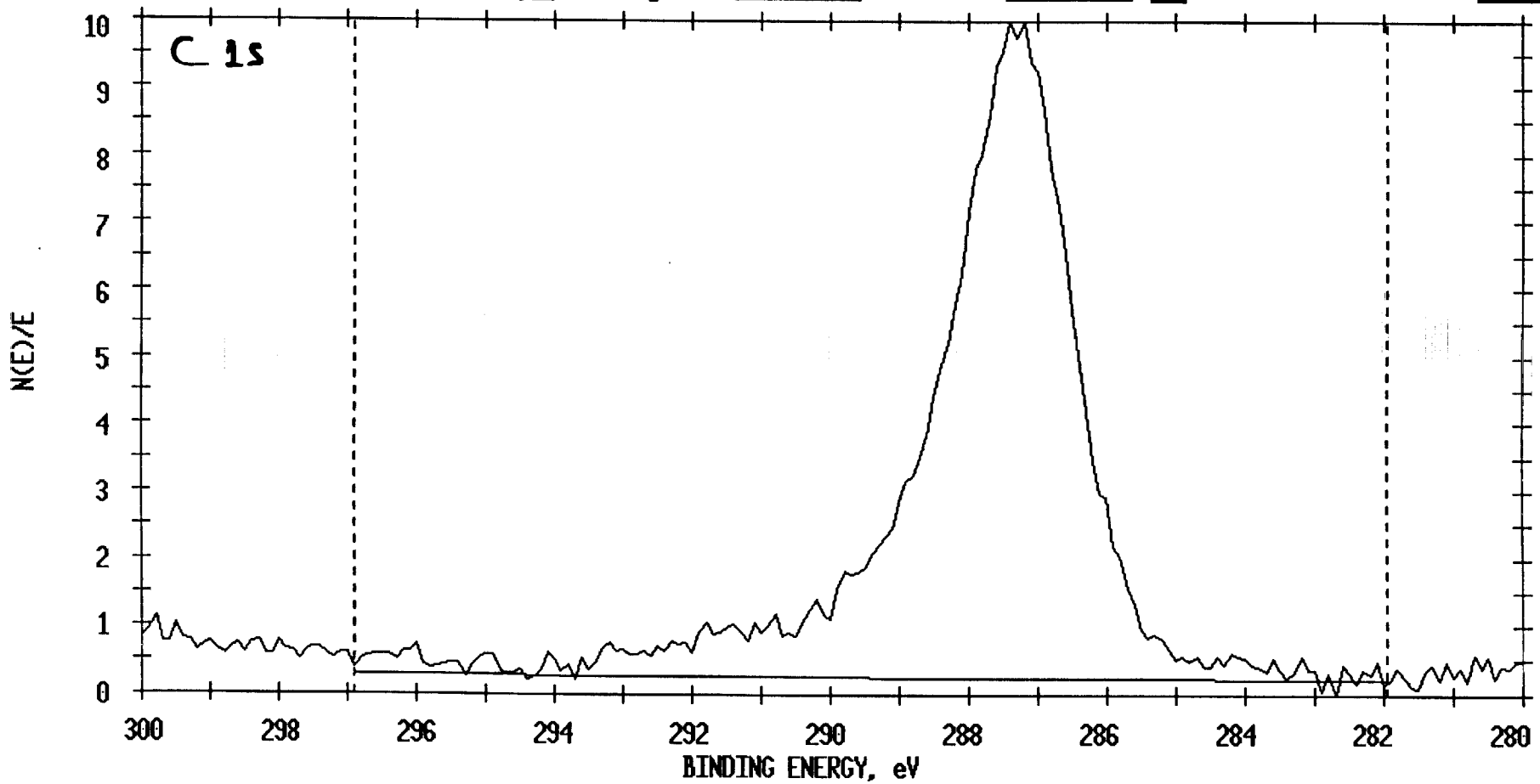
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

i Right

g Analysis 296.90 Counts 1786 h Entered Counts 175

j Analysis 281.90 Counts 1730 k Entered Counts 1730



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

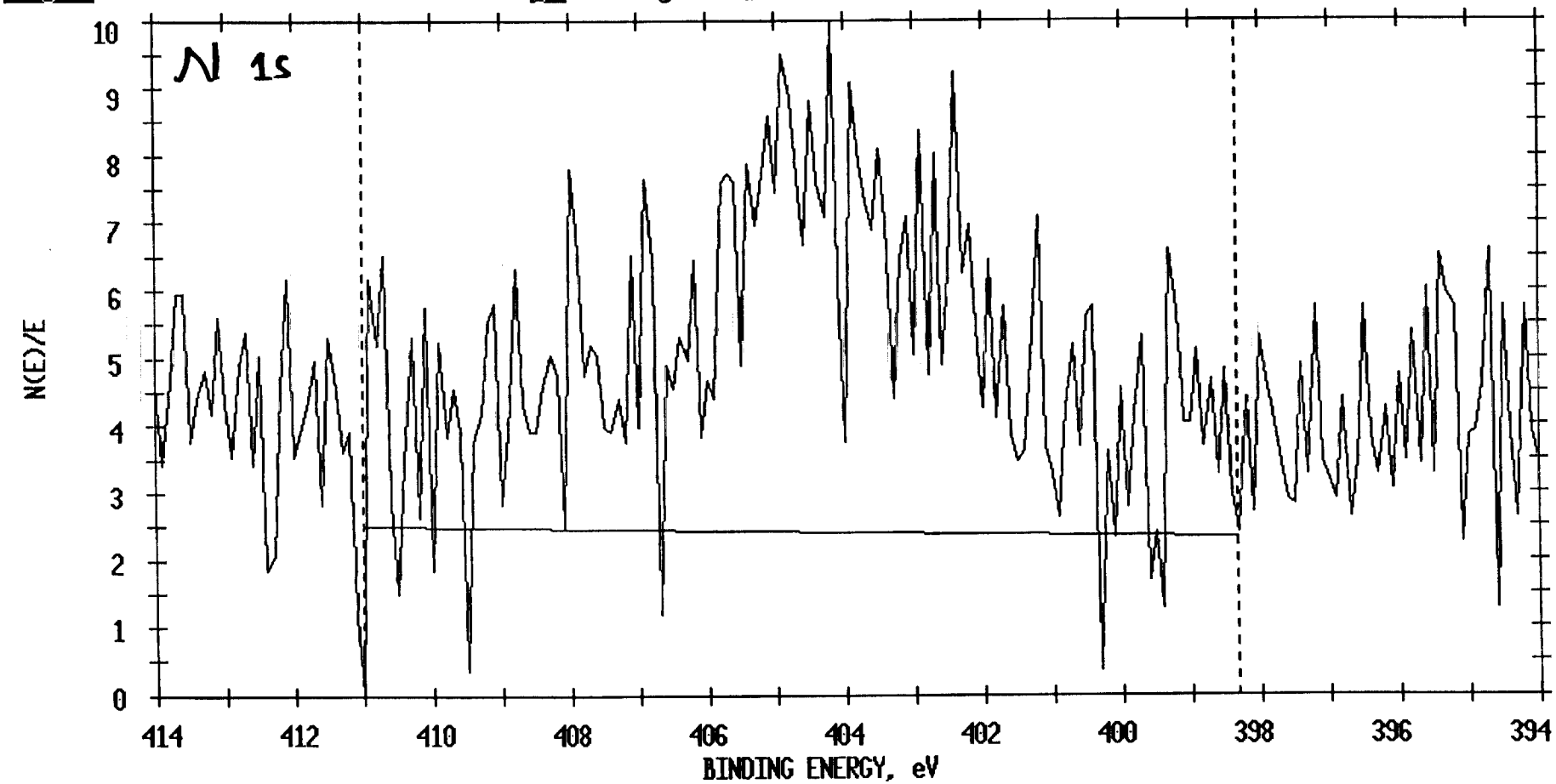
i Right

g Analysis 411.00 Counts 1856

j Analysis 398.30 Counts 1924

h Entered Counts 192

k Entered Counts 192



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

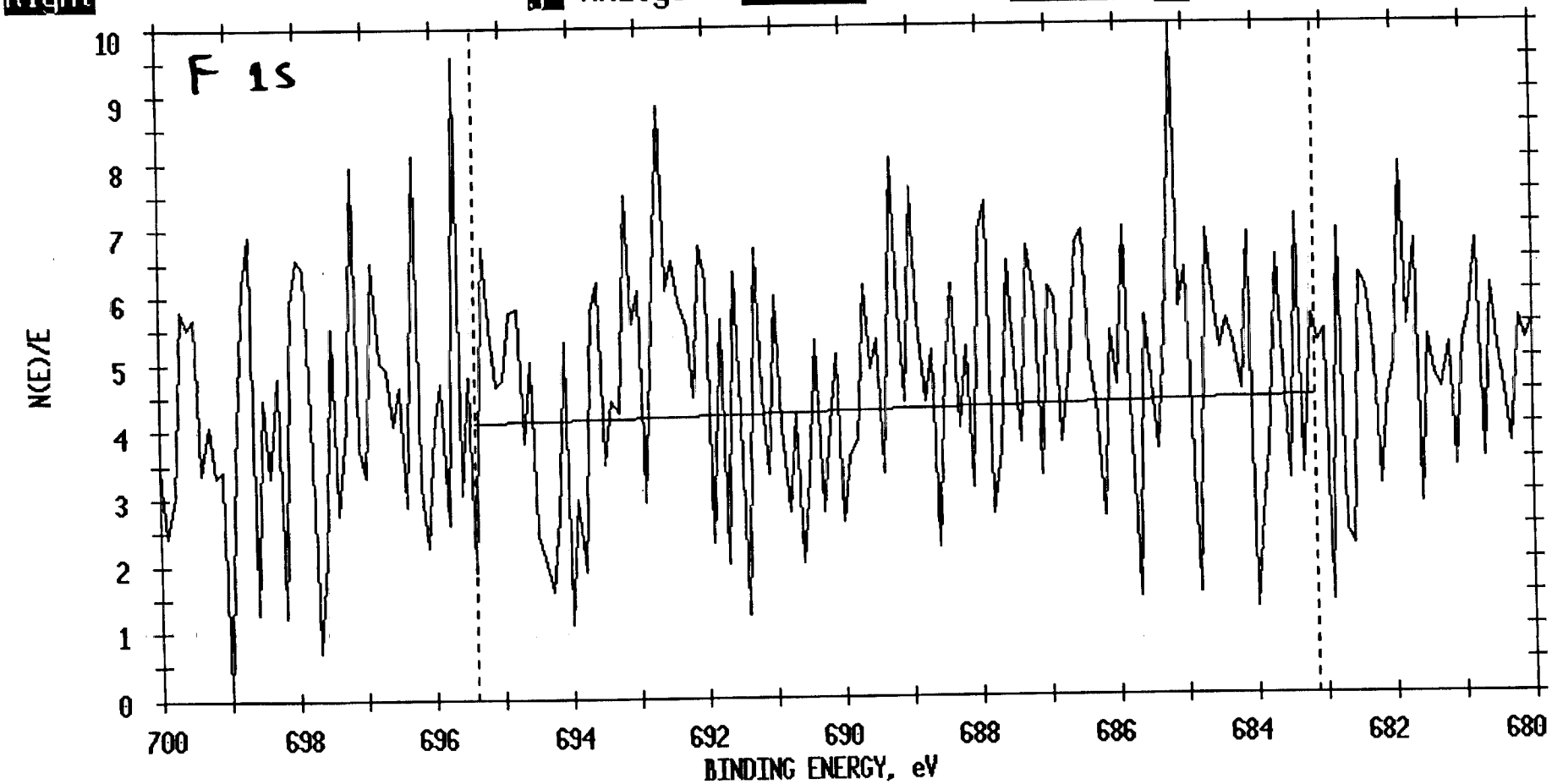
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

i Right

g Analysis 695.40 Counts 4550 h Entered Counts 463

j Analysis 683.10 Counts 4672 k Entered Counts 464



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

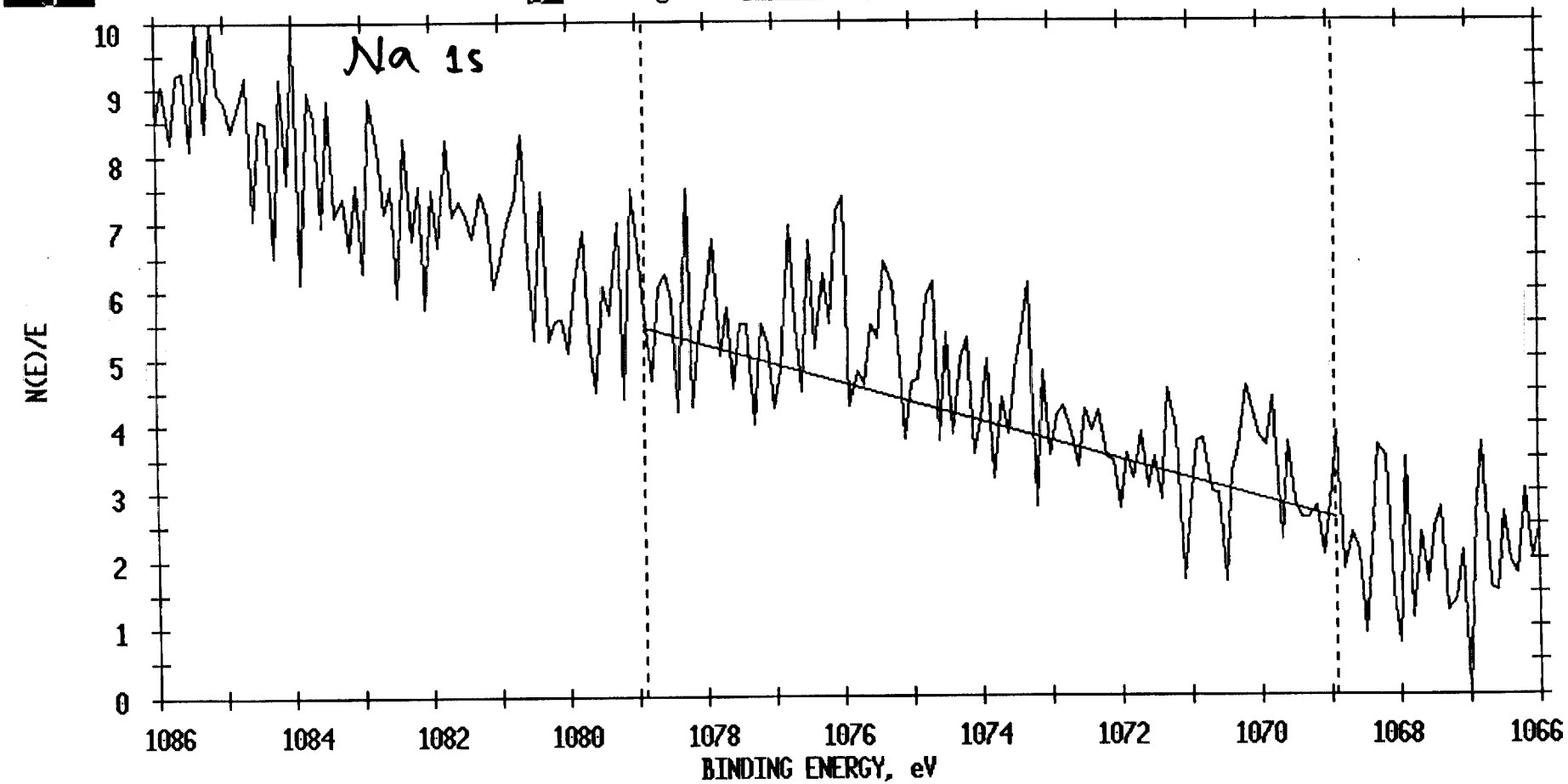
i Right

g Analysis 1078.90 Counts 10280

j Analysis 1068.90 Counts 10068

h Entered Counts 1025

k Entered Counts 9920



Atomic Concentration

a User Settings Previous New

b Element Name

c Mode Area Height d Baseline Linear Integrated

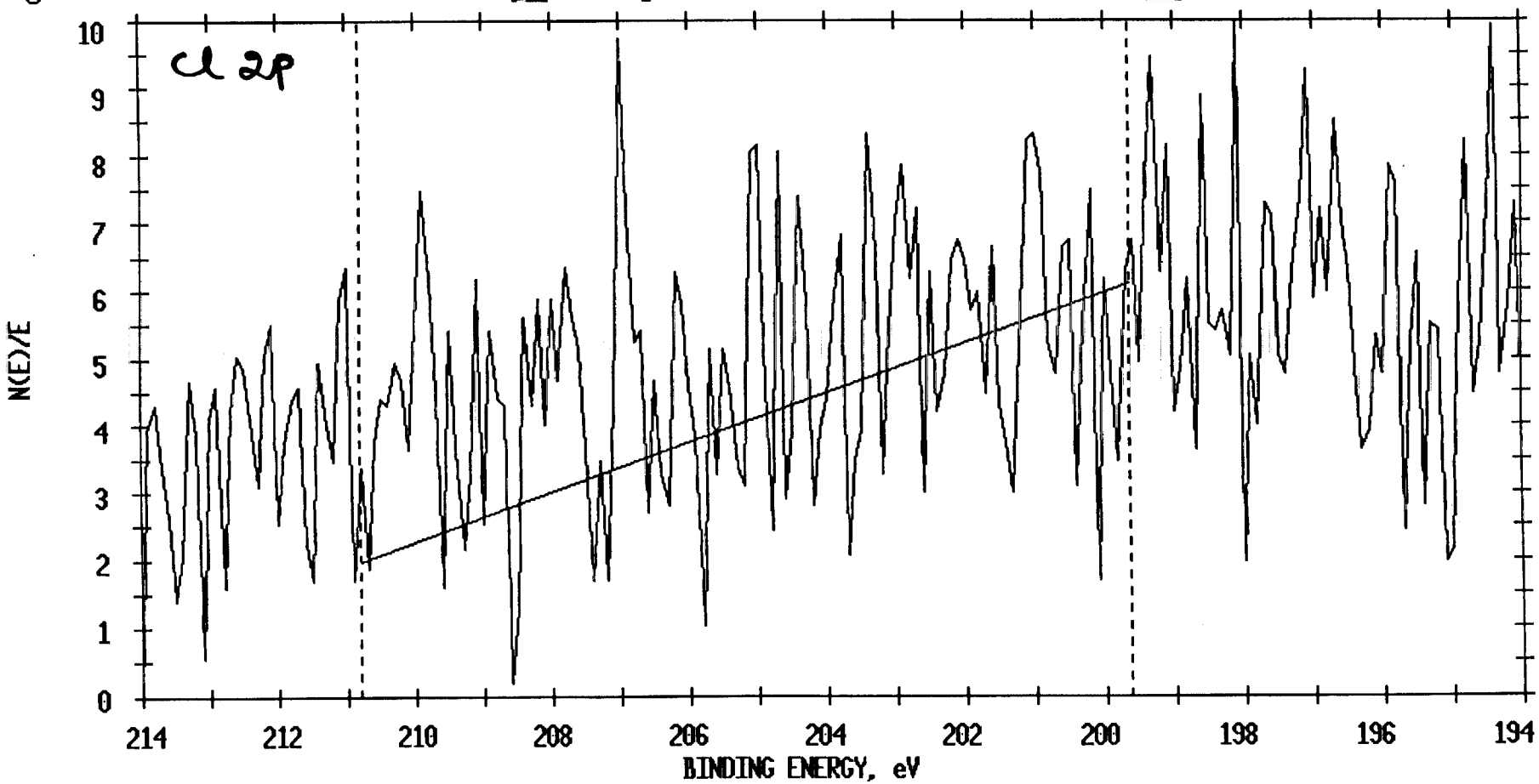
e Regions Si1 O1 C1 N1 F1 Na1 Cl1 Al1

f Left

i Right

g 210.80 Counts 1712

j Analysis 199.60 Counts 1784

h Entered Counts 168

k Entered Counts 177