BHP

Exploration
BHP Minerals

8 August 1996

Mr Gary Morgan
Elazac Mining Pty Ltd
GPO Box 2282U
MELBOURNE VIC 3001

Dear Gary,

RE: INTERNAL COMPOSITION OF GOLD NUGGETS FROM THE COMET CONGLOMERATE

Please find attached your copy of the findings from further SEM analysis of sectioned gold nuggets from the Comet Conglomerate.

The results are quite interesting in that they show that all the nuggets are of hydrothermal origin. The earlier work was misleading in that the supergene (later weathering) rims were masking the true origin of the nuggets in some cases.

This, to us, means that the gold in the conglomerate (or at least some of the gold) is probably related to cross structures (as it is at Just-in-Time) and not of original detrital origin. This may restrict the lateral continuity of the gold content of the conglomerate.

Yours sincerely,

R SKRZECZYNSKI
Exploration Manager Operations - Australia

BHP Minerals

Exploration Department

The Exploration Department is a part of the New Business Development Division of BHP Minerals which is a Business Group of The Broken Hill Proprietary Company Limited A.C.N. 004 028 077

Exploration Petrology Section
BHP Research

Memorandum

26 July, 1996

TO: R Skrzeczynski, Exploration, Brisbane

cc: L. Ellingford, TIS Brisbane, then circulate to: G. Murphy, D. Hedger

FROM: D Gilbert, Exploration Melbourne

OUR REF: CM7424;DJG:NC; EPM 96/284 (GSZ)

INCLUSION MINERALOGY, GANGUE MINERALOGY AND INTERNAL COMPOSITION OF ELUVIAL GOLD NUGGETS, COMET CONGLOMERATE, BAMBOO CREEK AREA, PILBARA, W.A.

SUMMARY and CONCLUSIONS

[see Figures 1 to 50, Table 1 and Plates 1 to 3, MRL25546 (i) & (ii)].

1. These sectioned gold nuggets show internal compositional variations and inclusions which were not evident in the earlier SEM qualitative analysis of the surficial features (see CM7416). Consequently their genesis has been revised, where they now all appear to be of hydrothermal origin, sometimes with a narrow discontinuous rim of pure supergene gold.
2. The silver content of these eluvial gold nuggets is variable, ranging from zero (grain 2) to 11.30% (grain 3). The average silver content of the silver-bearing gold nuggets is 9.41%. Deleterious elements such as mercury are absent.
3. Most of these hydrothermal gold nuggets contain minute sulphide inclusions such as chalcopyrite (most common), galena, pyrite and cobaltite (rare), where the latter occurs as an euhedral orthorhombic crystal in the nugget of pure gold (grain 2).
4. Associated gangue minerals include quartz, kaolinitic clay (some with fine pure supergene gold inclusions), iron-stained calcium aluminium silicate phase (? altered epidote or plagioclase)epidote, calcite (minute inclusions in quartz), goethite, leucoxene and chrome spinel (detrital grain adjacent to gold nugget no. 3). Minute inclusions of a sodium magnesium aluminium silicate phase occur in the chrome spinel, where these may represent dravidic tourmalines, though confirmatory boron could not be determined by SEM.

5. Minute inclusions of a copper-tin phase (61.31% Cu, 38.69% Sn) occur in the silver-bearing gold comprising grain 3. This copper-tin phase is of uncertain origin, where it may possibly represent contamination. However it does not have the composition of commercial bronze (90% Cu, 10% Sn), which suggests a possible natural occurrence.

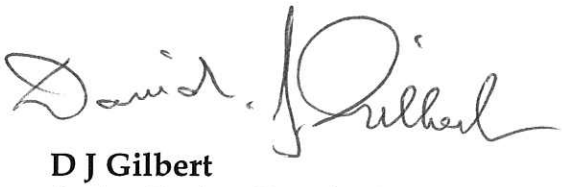
   During the fire assaying process it is known that certain impurities such as copper can carry gold into the cupel, which could explain some gold loss (Gasparrini, 1993). However this particular copper-tin phase, if natural, is in fact very rare and it would therefore be difficult to explain significant loss of gold.

6. Two generations of gold are evident in nugget no 3, comprising an earlier interpreted subrounded porous detrital grain (10.49% Ag) surrounded by second generation whiter higher silver gold (11.30% Ag) of hydrothermal origin. This may have some exploration significance for Rand-style gold mineralisation in the lower Proterozoic Comet Conglomerate.

REFERENCES

Gasparrini, C (1993), Gold and other precious metals from ore to market. Springer-Verlag.

Gilbert, D J (1996), Morphology and qualitative SEM analysis of eluvial gold nuggets collected near the Lower Proterozoic Comet Conglomerate, Pilbara Region, W.A. (CM7416).

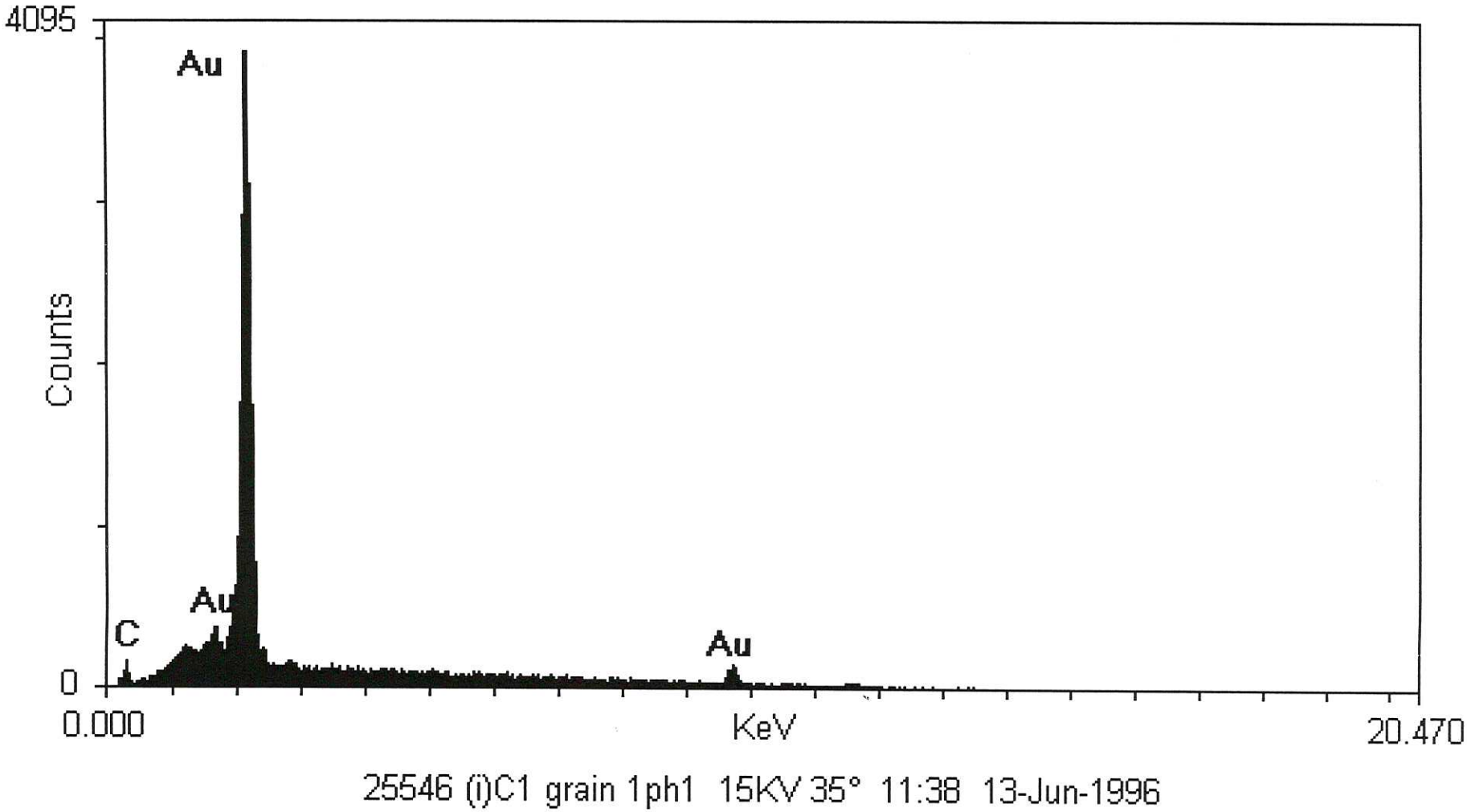


D J Gilbert
Senior Project Petrologist

TABLE 1 SEM QUALITATIVE/QUANTITATIVE ANALYSIS OF SECTIONED GOLD NUGGETS, COMET CONGLOMERATE, BAMBOO CREEK AREA, PILBARA, W.A.

Sample No. Gold nugget or grain no.	*SEM qualitative/quantitative analysis of gold in sectioned nuggets.*	*SEM qualitative/quantitative analysis of inclusions within gold nuggets and associated gangue coatings.*	*Revised genetic implications and comments.*
MRL25546 (i) (polished section) Grain 1 (See Plate 1a)	This nugget shows a discontinuous rim of pure orange-coloured gold (see Figure 1), surrounding a core of whiter silver-bearing gold (see Figures 2, 6, 9). According to EDS normalised quantitative analysis, the silver bearing gold comprises 91.12% Au, 8.88% Ag. Reference to Plate 1a, shows an inclusion of kaolinitic clay with finely intergrown pure gold, both of supergene origin (see Figures 7 & 8).	This gold nugget contains the inclusions listed below: (i) kaolinite (see Figures 3 and 7) (ii) galena (see Figure 4) (iii) goethite of supergene origin (see Figure 5)	This nugget comprises a core of silver-bearing gold (8.88% Ag), surrounded by a narrow discontinuous rim of pure supergene gold. The silver-bearing gold contains rare galena inclusions (2 microns), substantiating hydrothermal origin. The original diagnosis is not quite correct (see CM7416), where the surface analysis was obviously taken within the rim of pure supergene gold. However other supergene minerals are present including goethite and kaolinitic clay, where fine grained pure gold is intergrown with the latter.
MRL25546 (i) (polished section) Grain 2 (see Plate 1b, 1c, 1d)	Silver was not detected in several point analyses taken inside this gold nugget (see Figures 14, 15, 20, 23).	This gold nugget contains the inclusions listed below: (i) chalcopyrite (see Figures 10, 16) (ii) quartz (see Figures 11, 18, 19) (iii) cobaltite (euhedral crystal; see Figure 17). Reference to Figure 19, shows that traces of Mg, Al are present in the quartz suggesting that it replaced an earlier phyllosilicate (?chlorite). This particular gold nugget is partly surrounded by quartz (see Figures 13, 21), containing minute inclusions of epidote (see Figure 12) and calcite (see Figure 22). Traces of leucoxene also appear to be present.	Internally, this nugget comprises <u>pure</u> gold, which was originally thought to indicate supergene origin (see CM7416). However the presence of minute inclusions of chalcopyrite and euhedral cobaltite prove hydrothermal origin. This gold nugget is partly surrounded by ? hydrothermal quartz which contains minute inclusions of calcite and suspected epidote (propylitic assemblage).

Sample No. Gold nugget or grain no.	*SEM qualitative/quantitative analysis of gold in sectioned nuggets.*	*SEM qualitative/quantitative analysis of inclusions within gold nuggets and associated gangue coatings.*	*Revised genetic implications and comments.*
MRL25546 (ii) (polished section) Grain 5 (see Plate 3)	This nugget comprises whiter silver-bearing gold (see Figures 47, 50), sometimes with a discontinuous rim of orange-coloured pure supergene gold (see Figure 49). A normalised quantitative EDS analysis of the whiter silver-bearing gold core material gives: 90.92% Au, 9.08% Ag.	Minute sulphide inclusions in this gold nugget include: (i) chalcopyrite (see Figure 46, Plate 3a) (ii) pyrite (see Figure 48, Plate 3b).	This gold nugget comprises a core of hydrothermal silver-bearing gold (9.08% Ag), surrounded by a discontinuous rim of pure supergene gold. Hydrothermal origin for this nugget is substantiated by the presence of minute chalcopyrite and pyrite inclusions in the silver-bearing gold. The original gold analysis was obviously taken in the supergene rim (see CM7416), leading to the incorrect conclusion that the <u>whole</u> gold nugget was of supergene origin. In actual fact, silver-bearing gold of hydrothermal origin is partly rimmed with pure supergene gold.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C
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25546 (i)C1 grain 1ph1 15KV 35° 11:38 13-Jun-1996

Fig 1

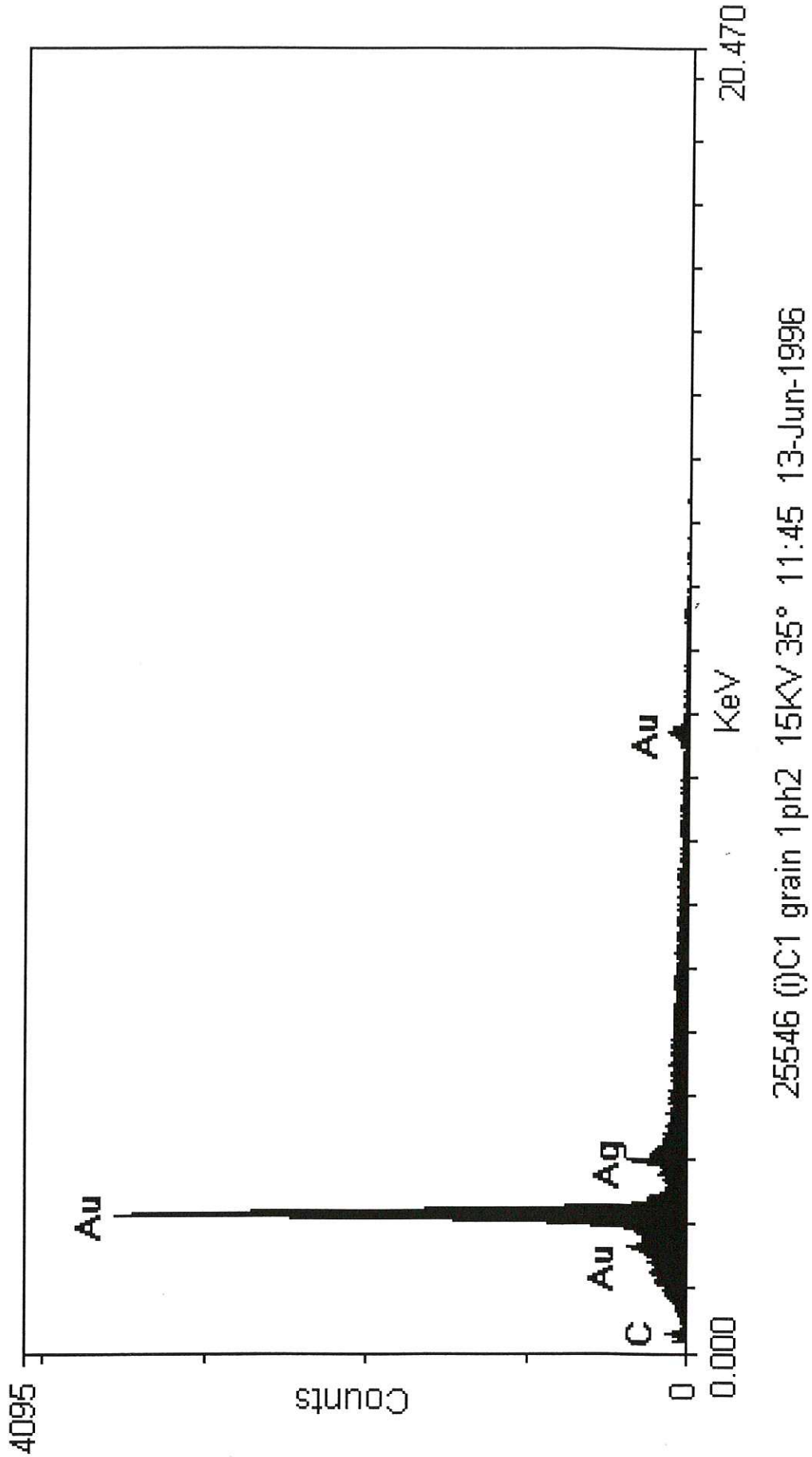
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Fig 2

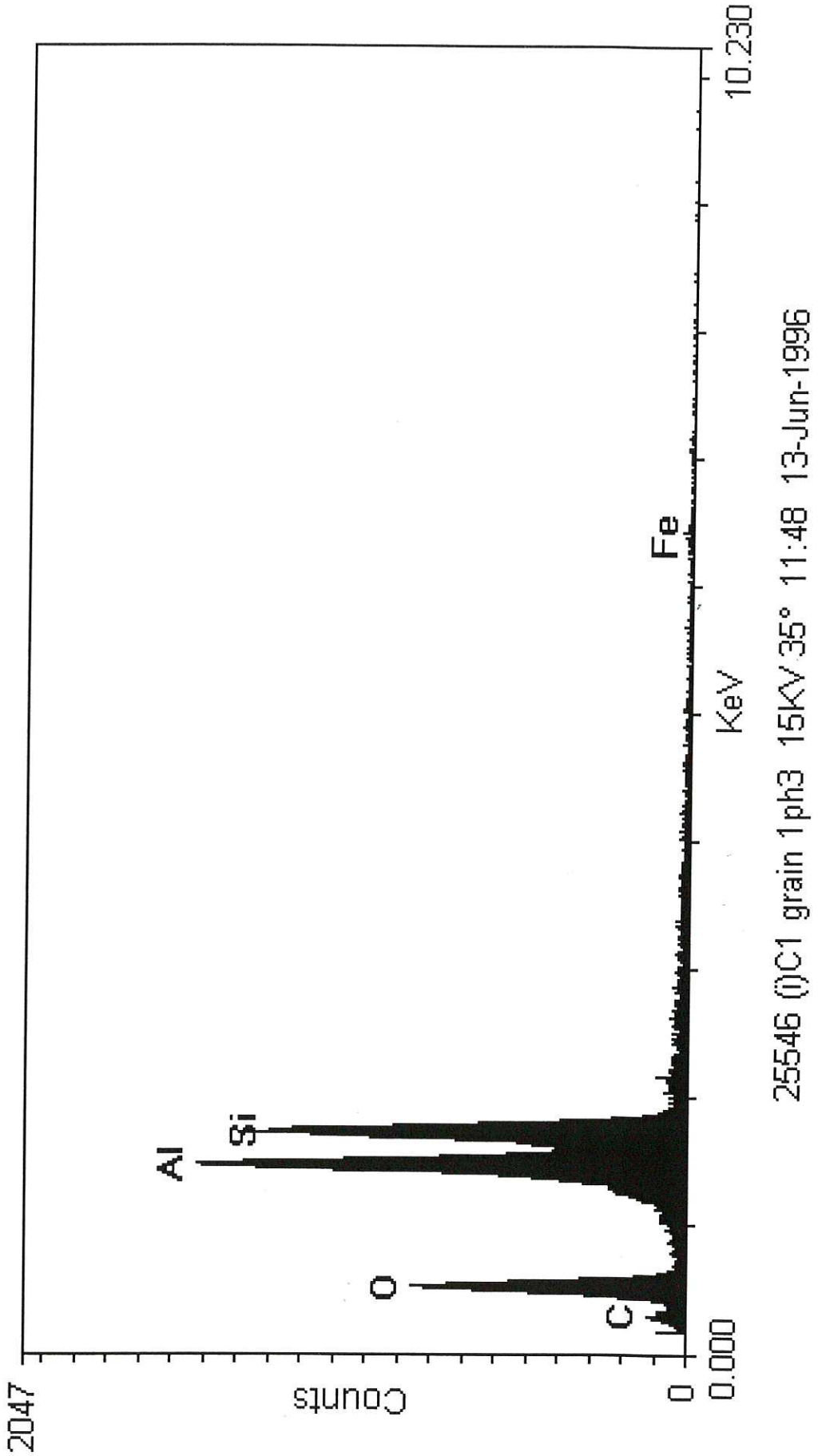
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Fig 3

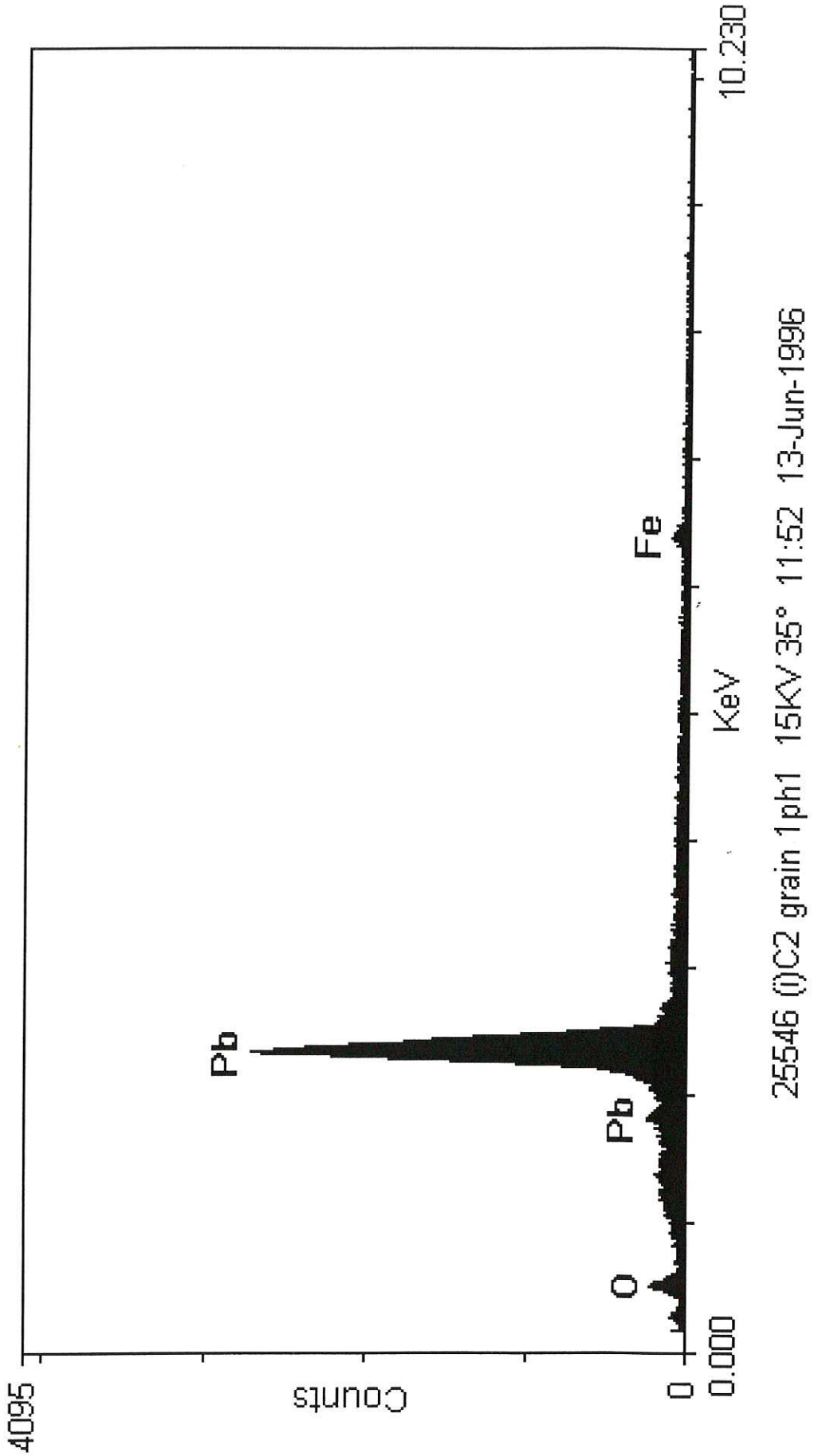
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Fig 4

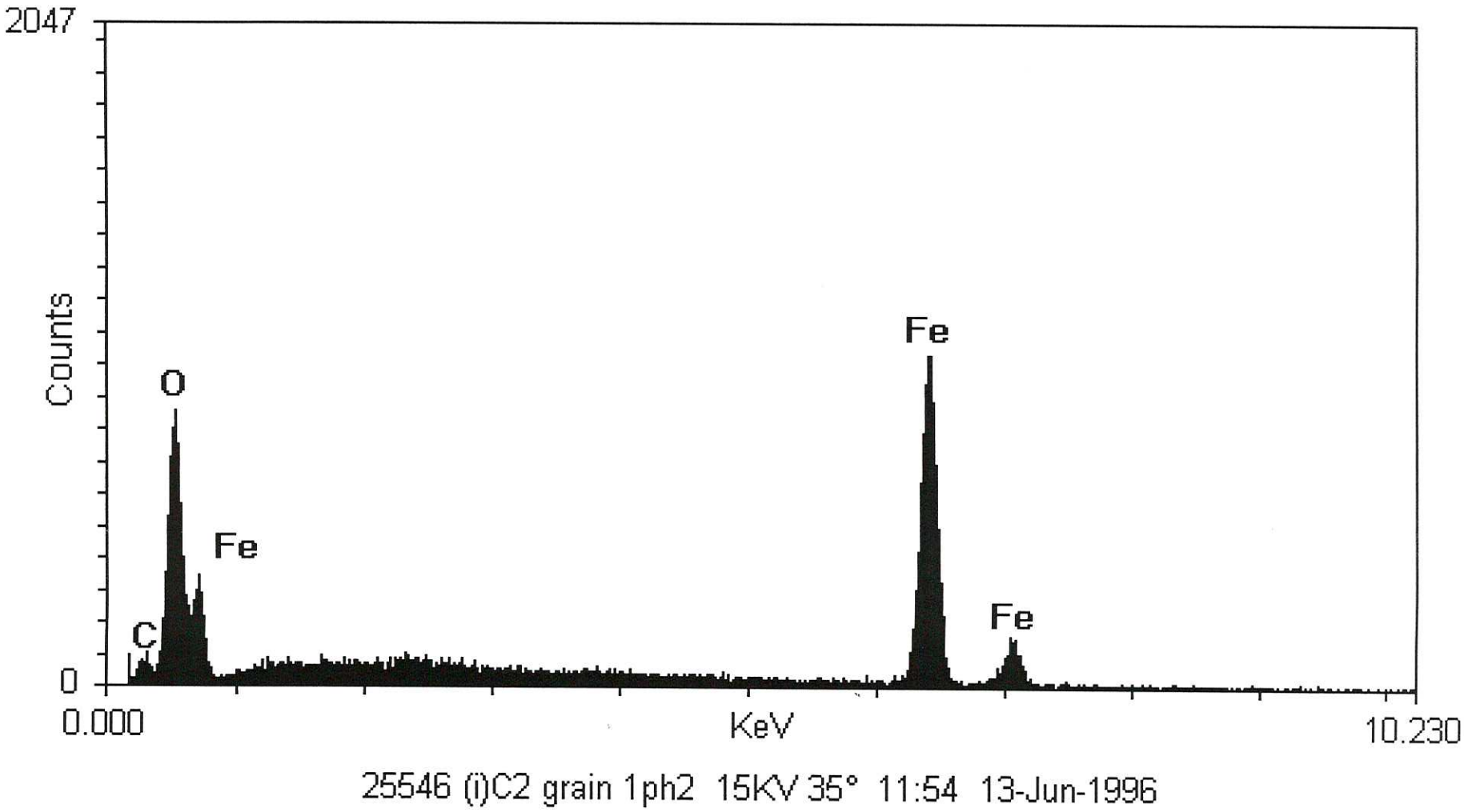
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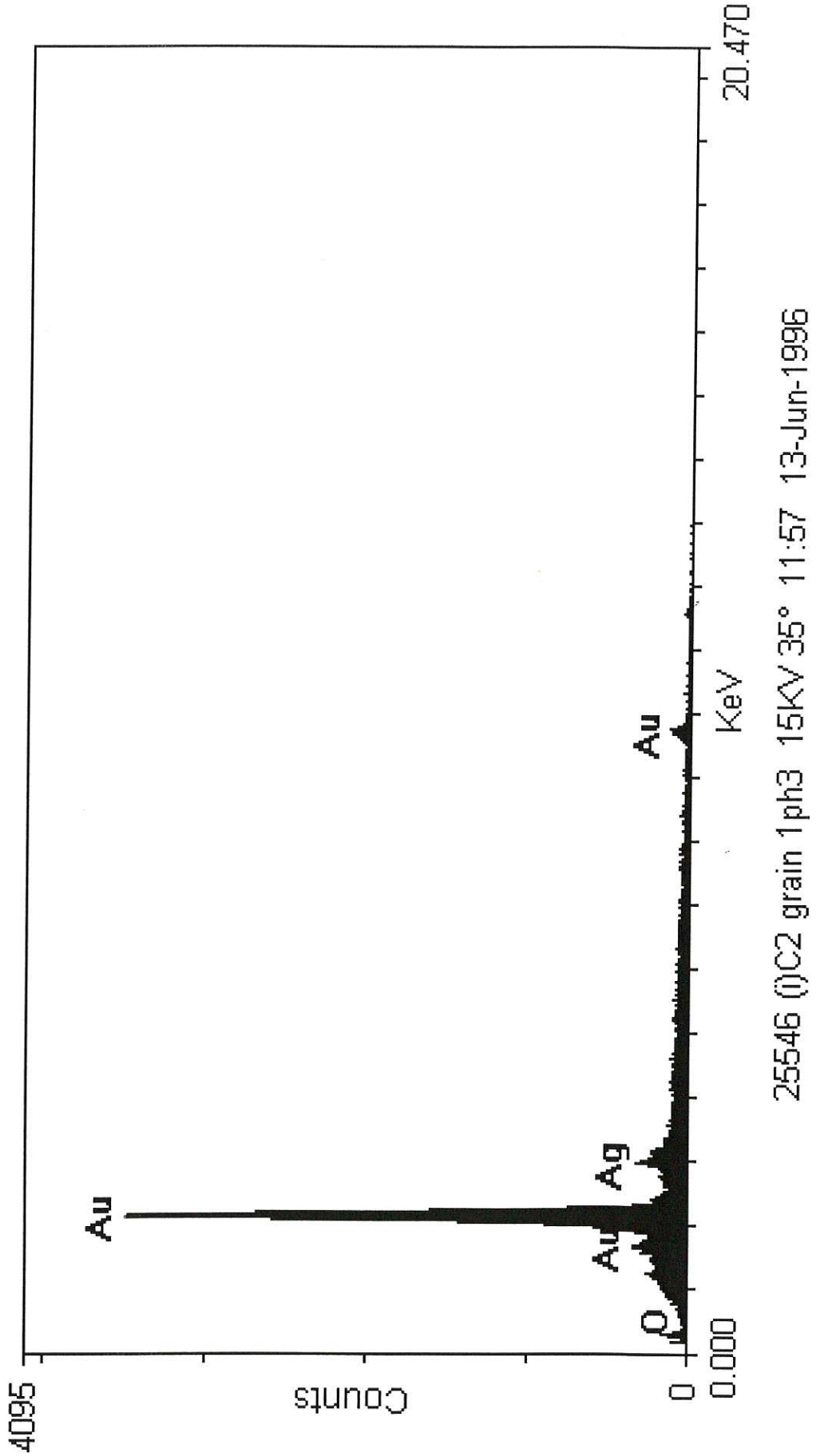
Fig5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Ag
Au
O
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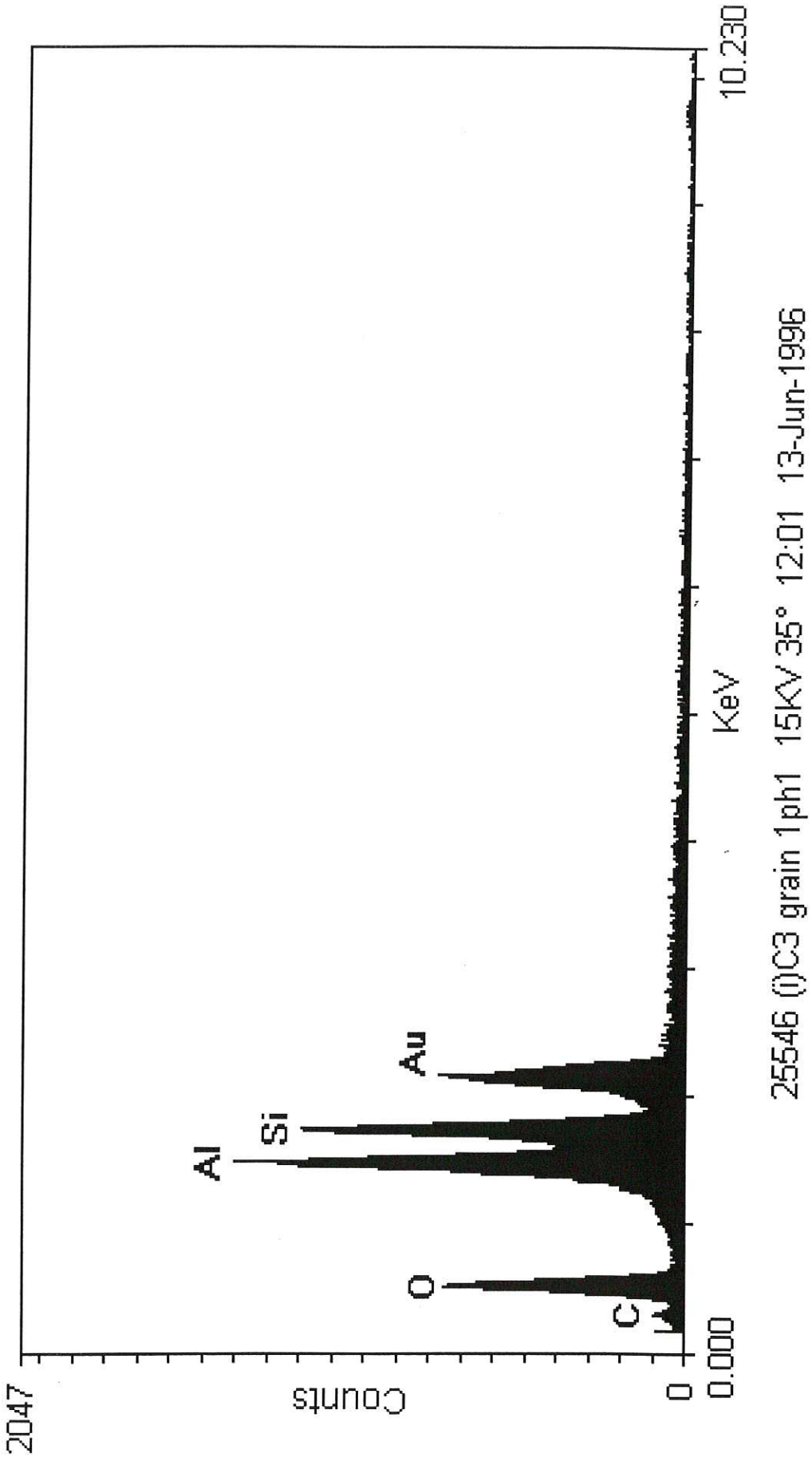
Fig 6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Al
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Au
KeV
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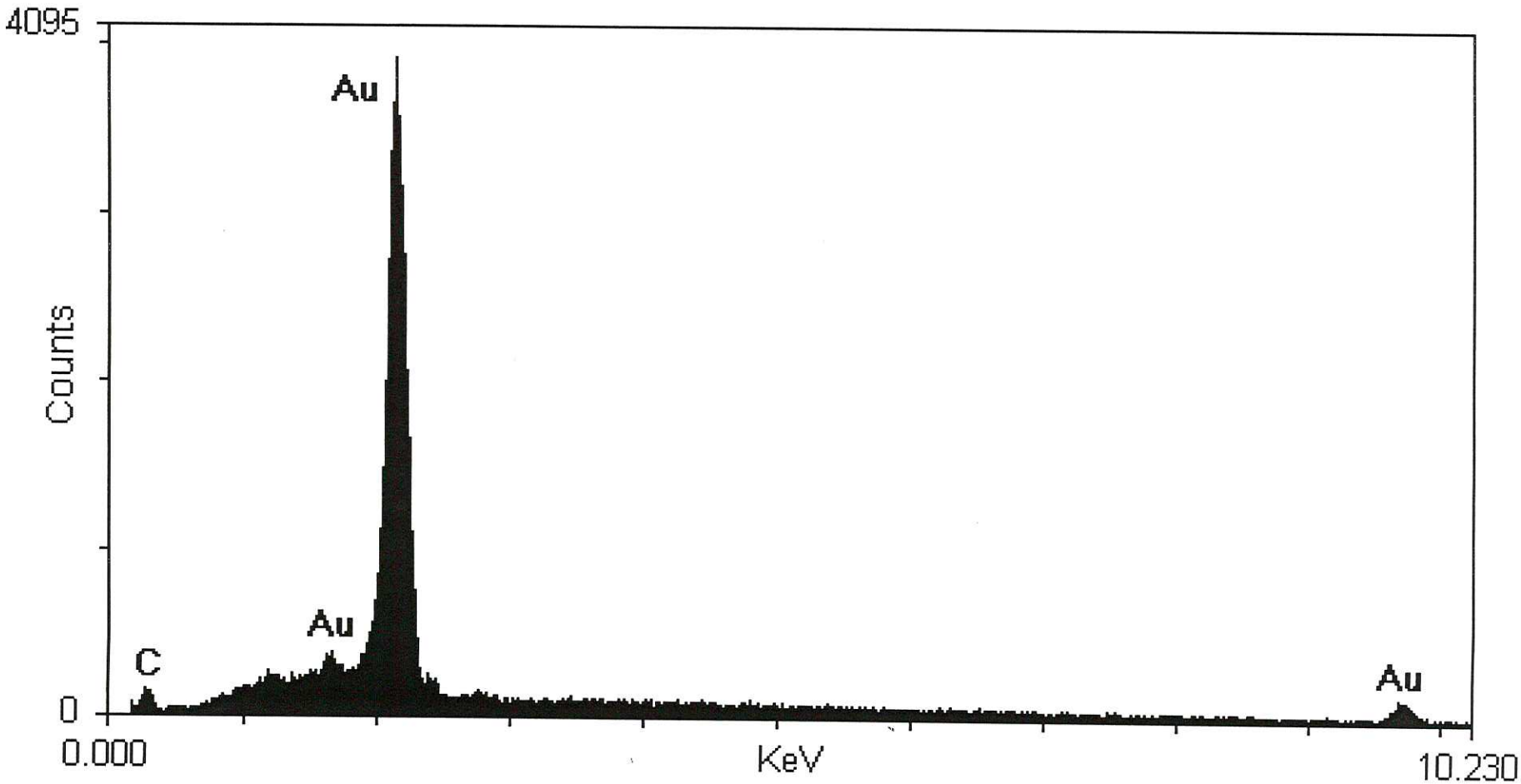
Fig 7



25546 (i)C3 grain 1ph1b Au inc in clay 15KV 35° 12:04 13-Jun-1996

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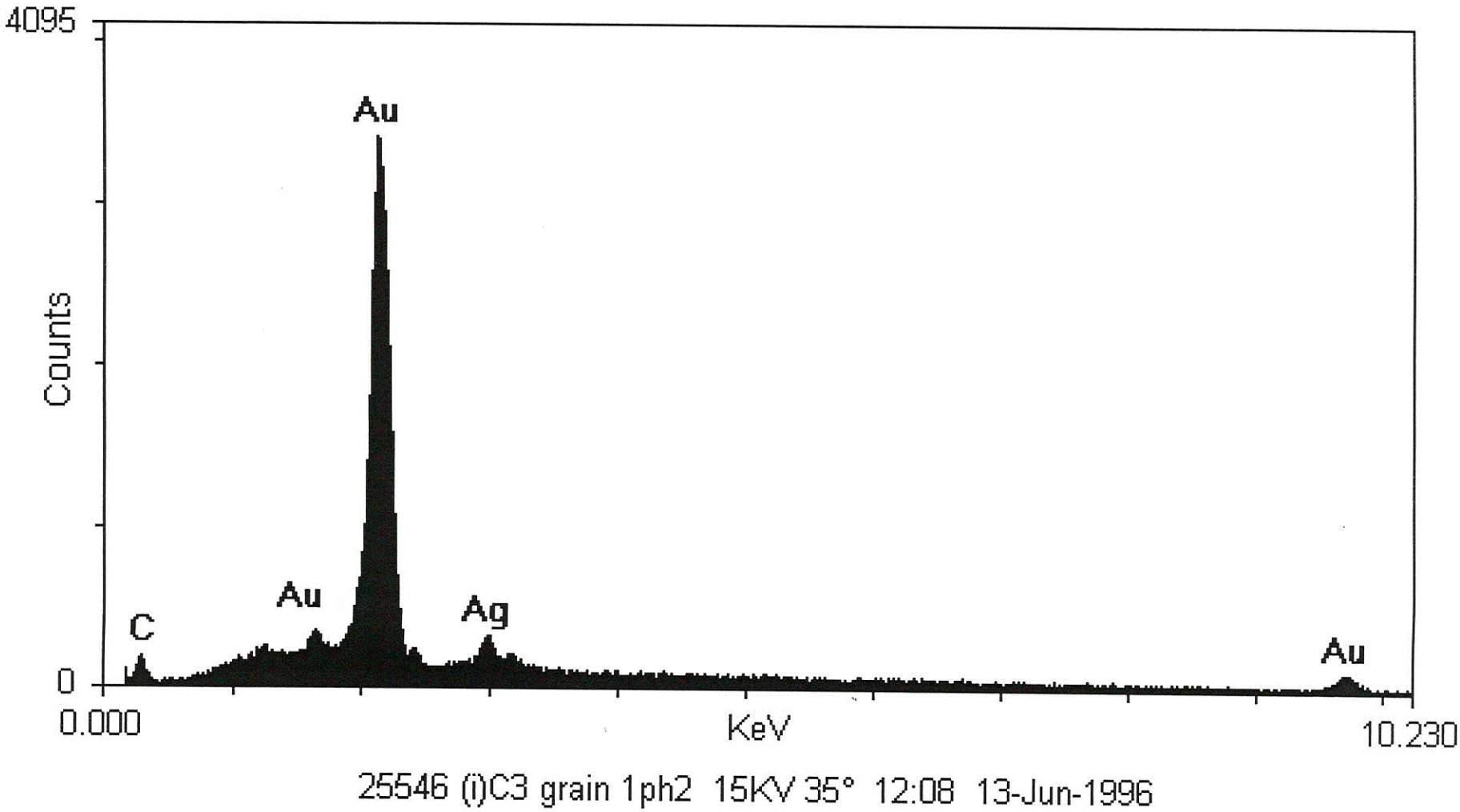
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Fig 9

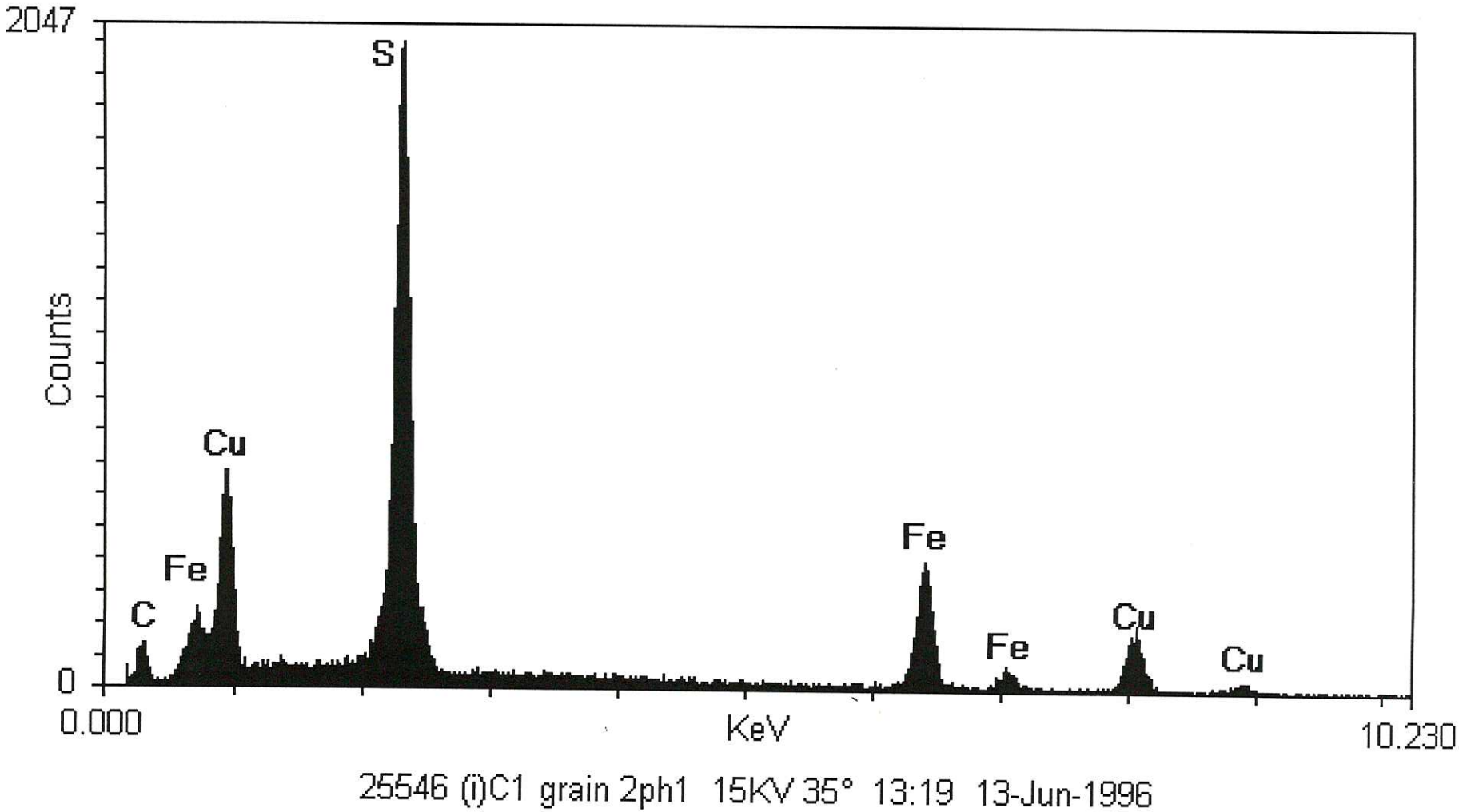
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Fig 10

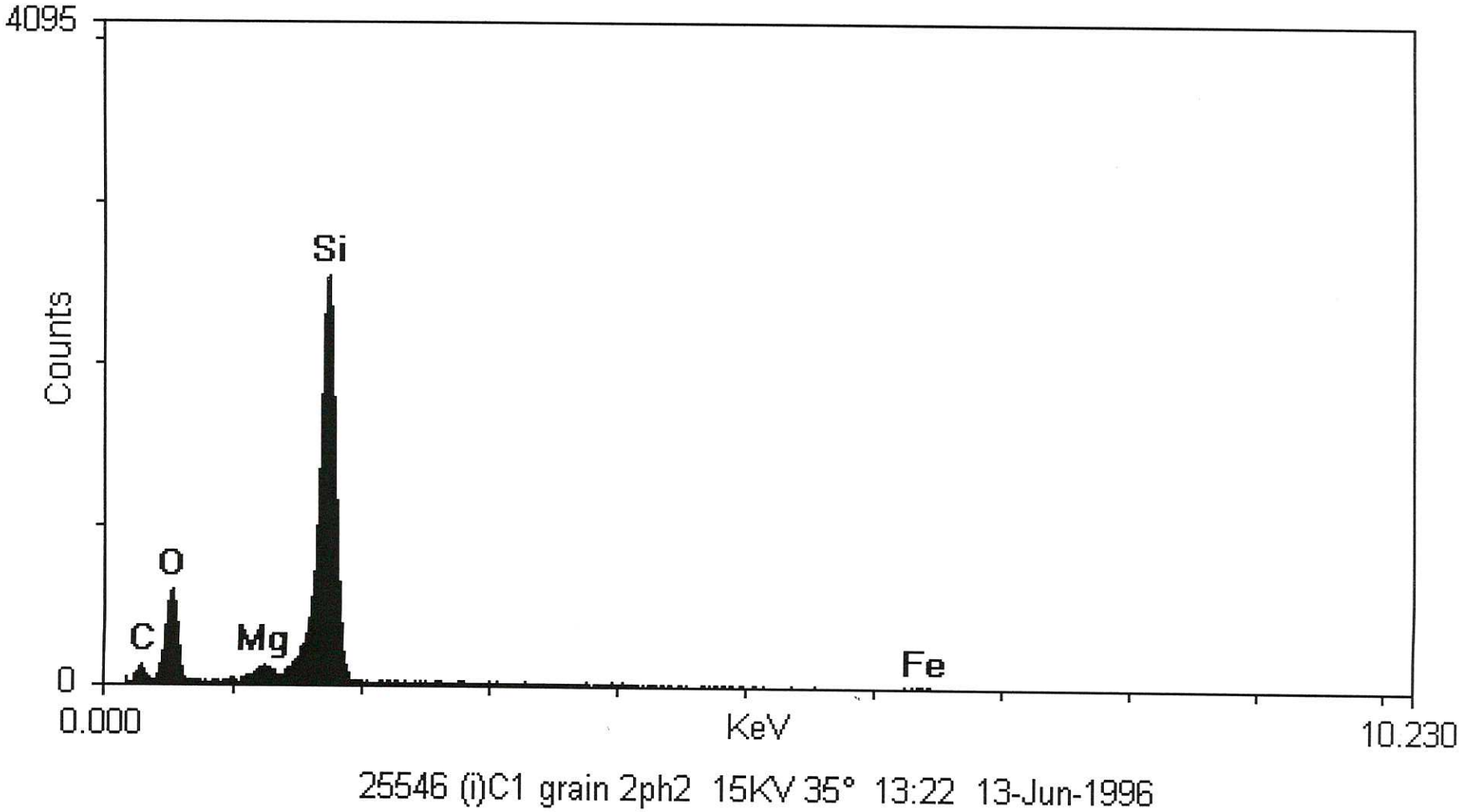
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Fig 11

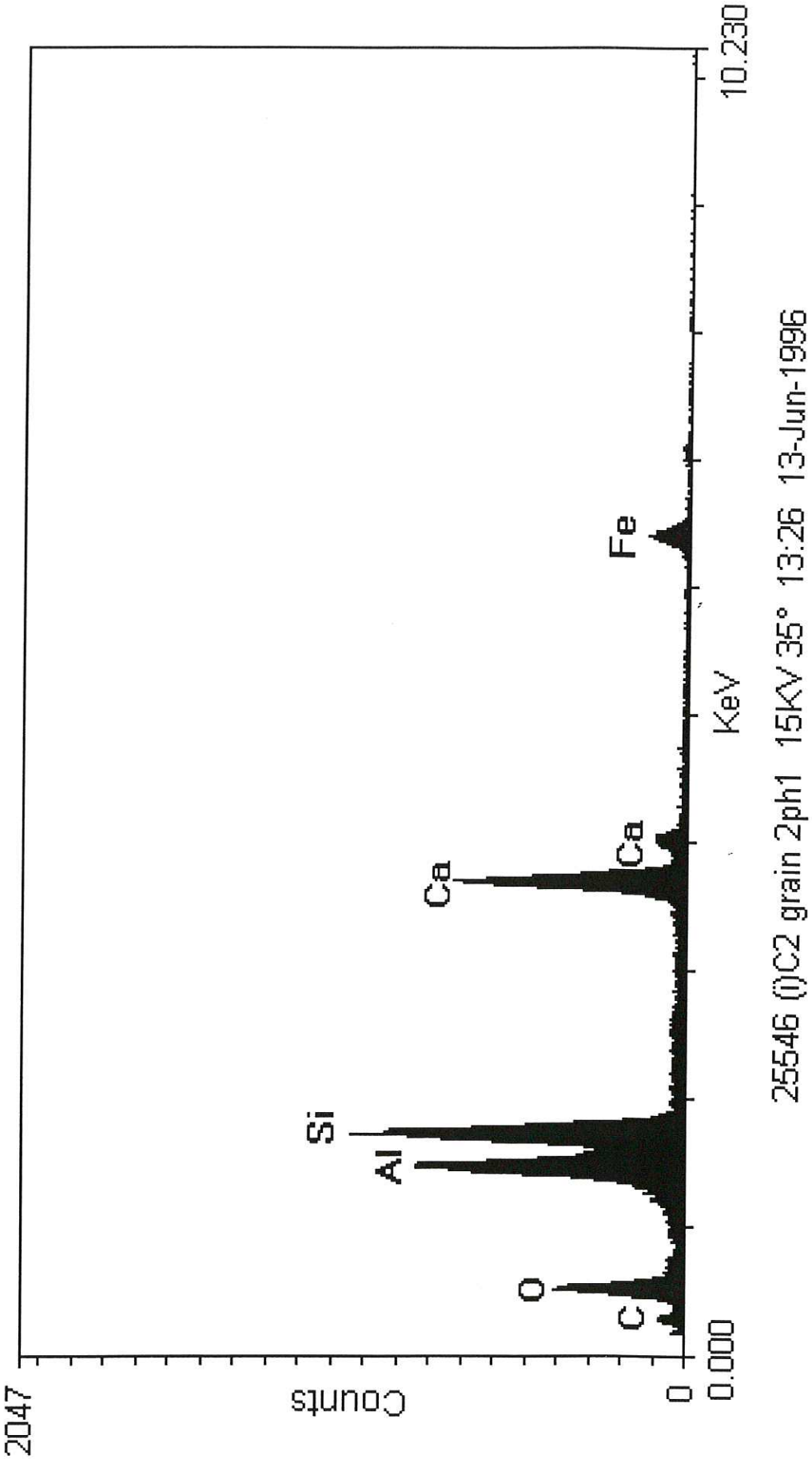
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Fig 12

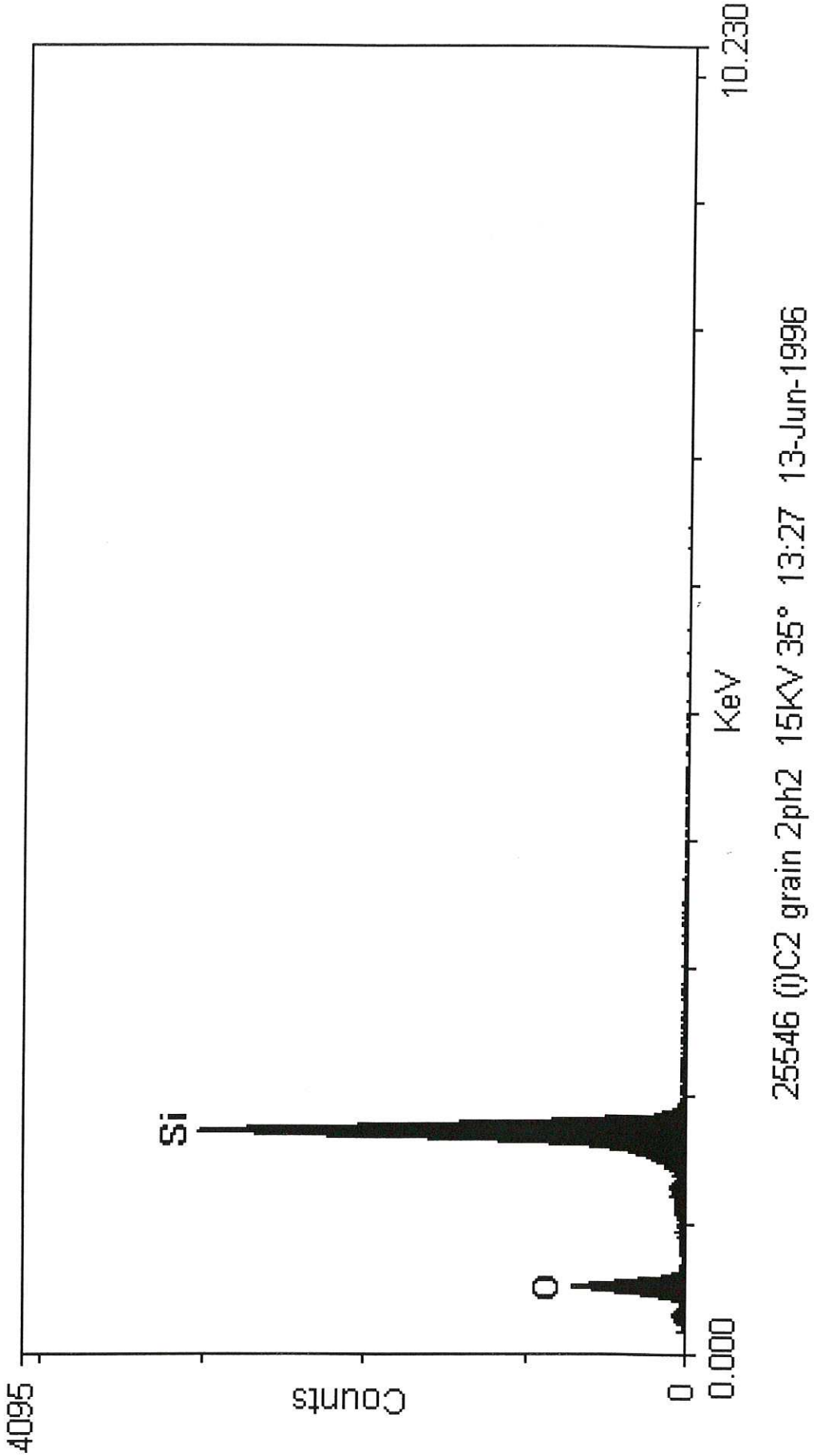
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Fig 13

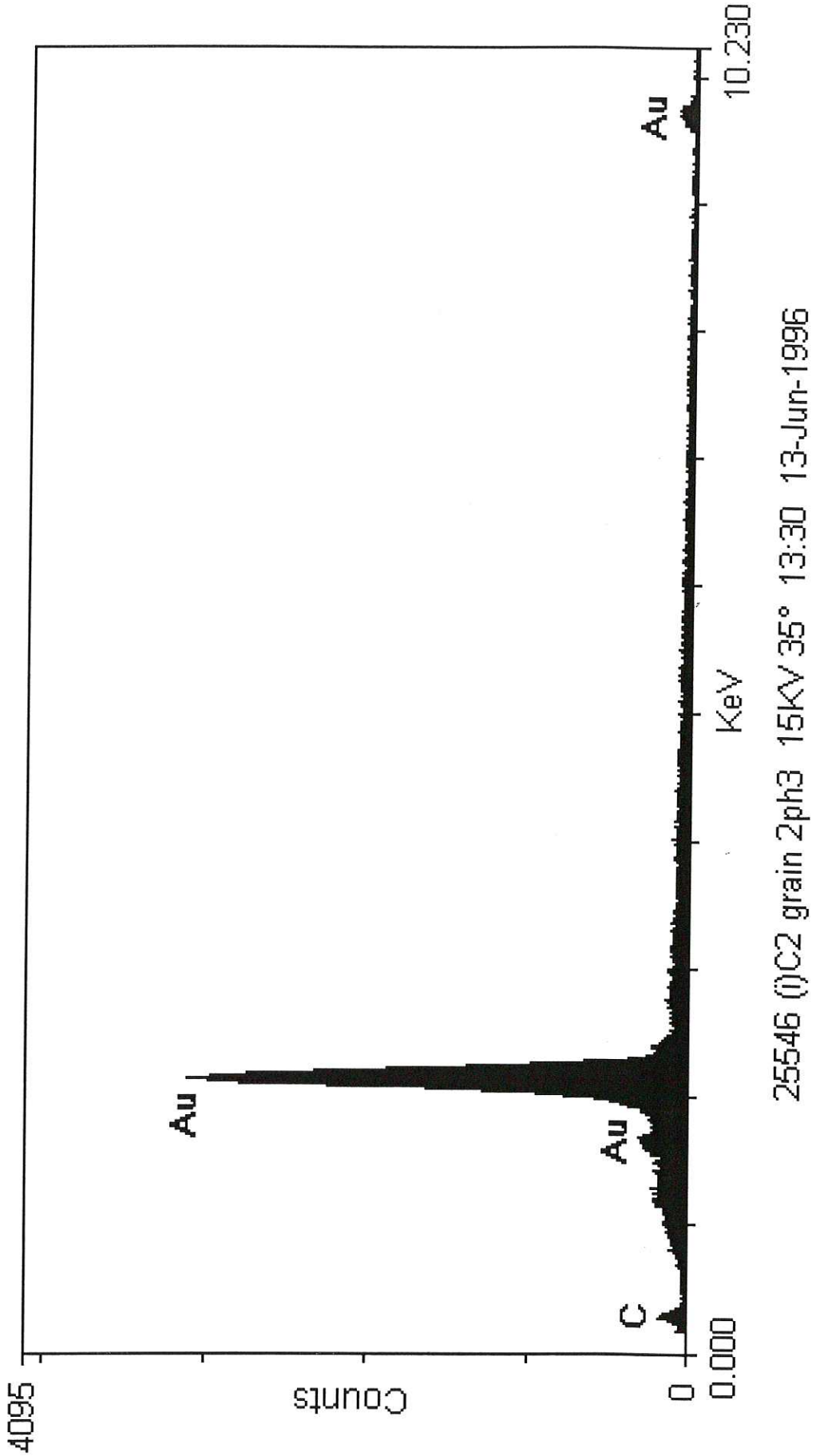
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Fig 14

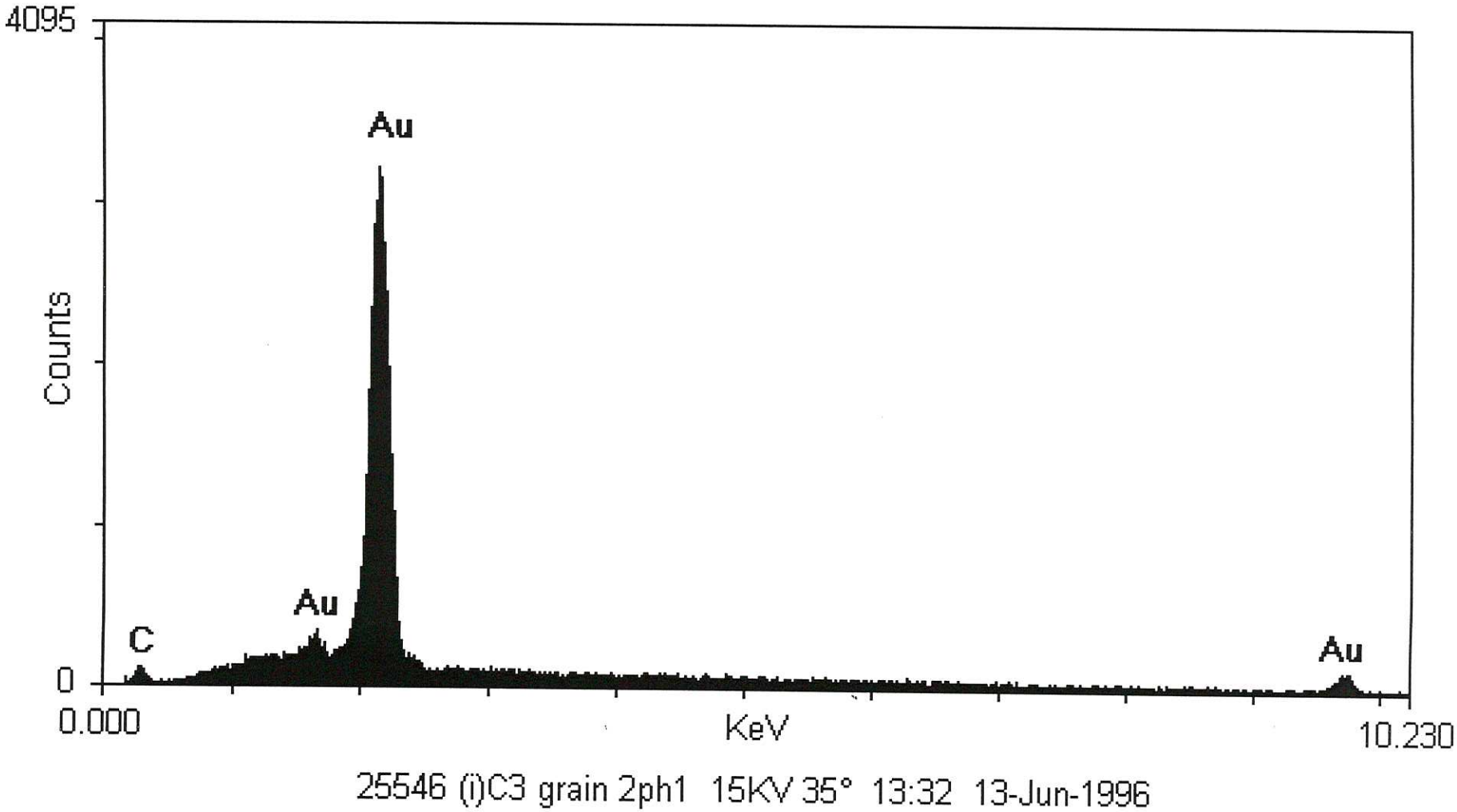
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Fig 15

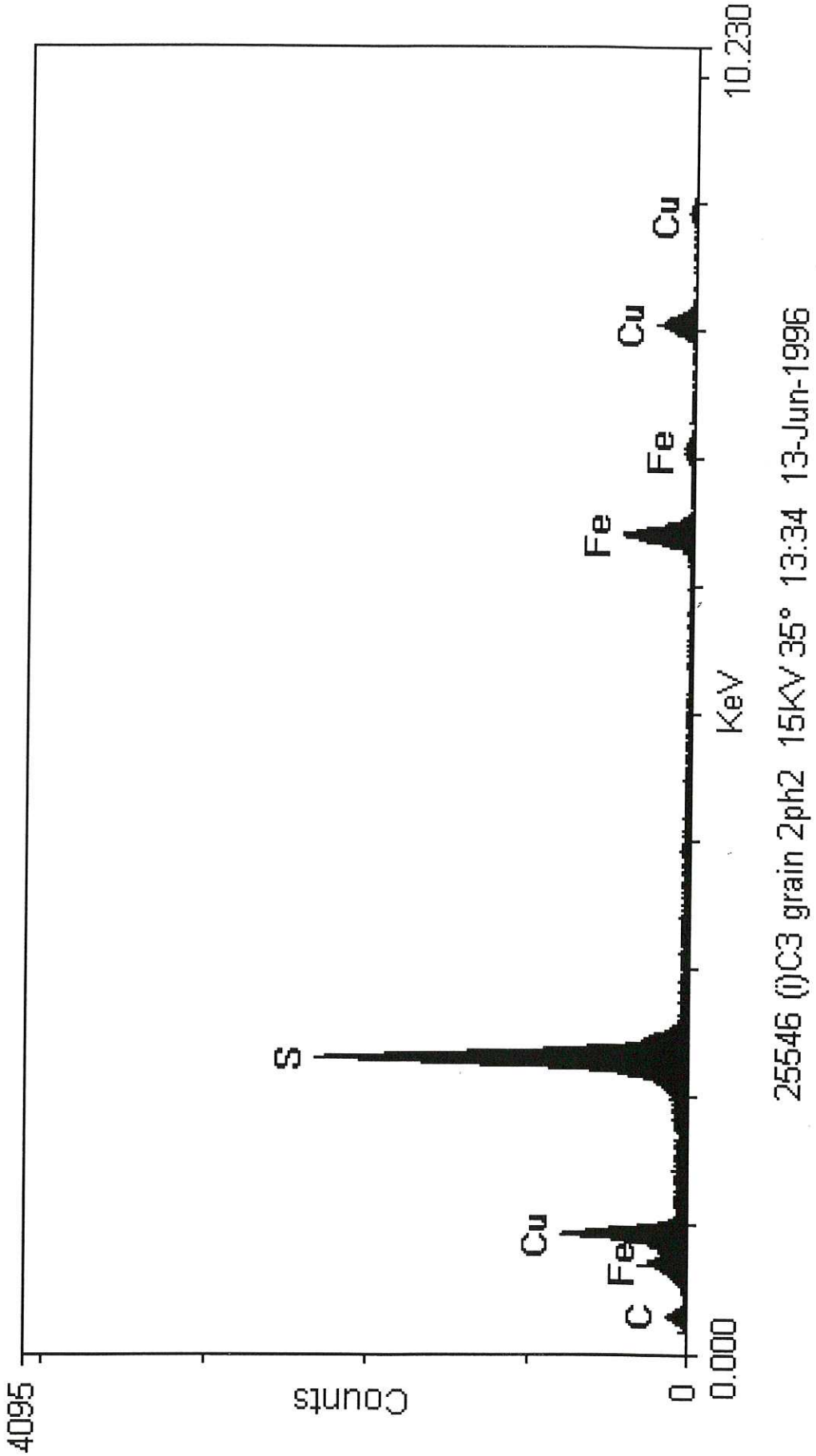
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Fig 16

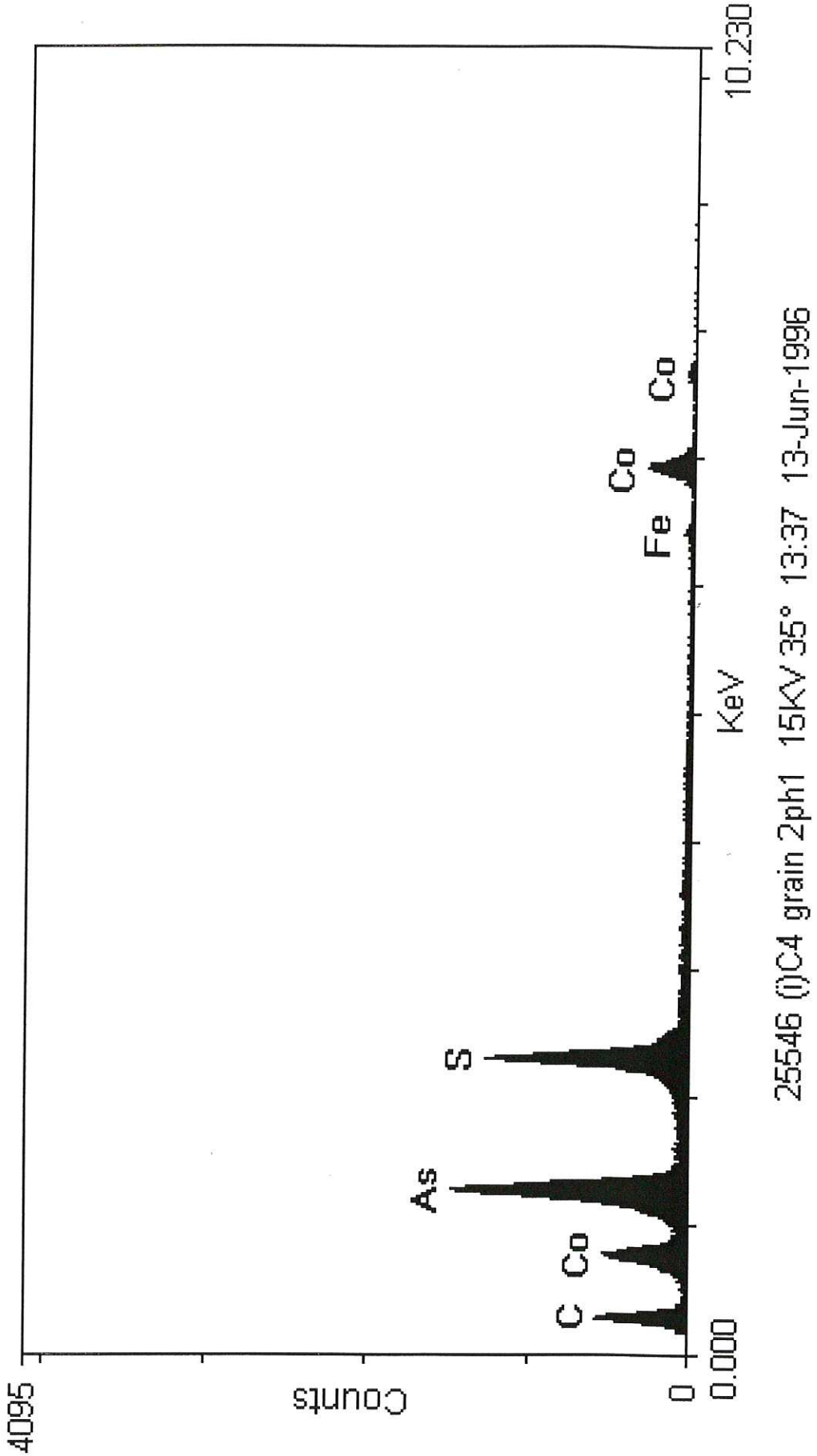
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Fig 17

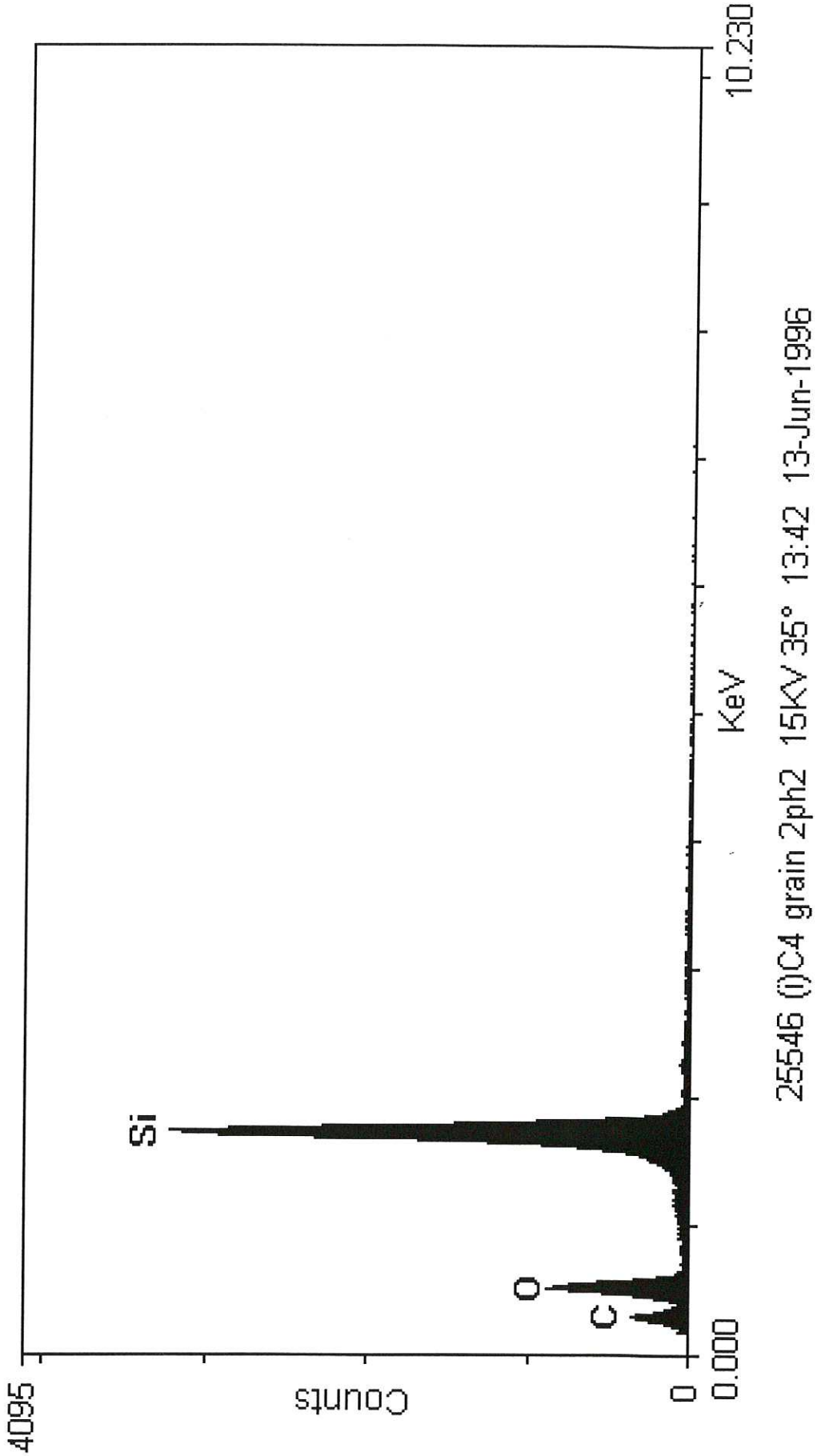
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Fig 18

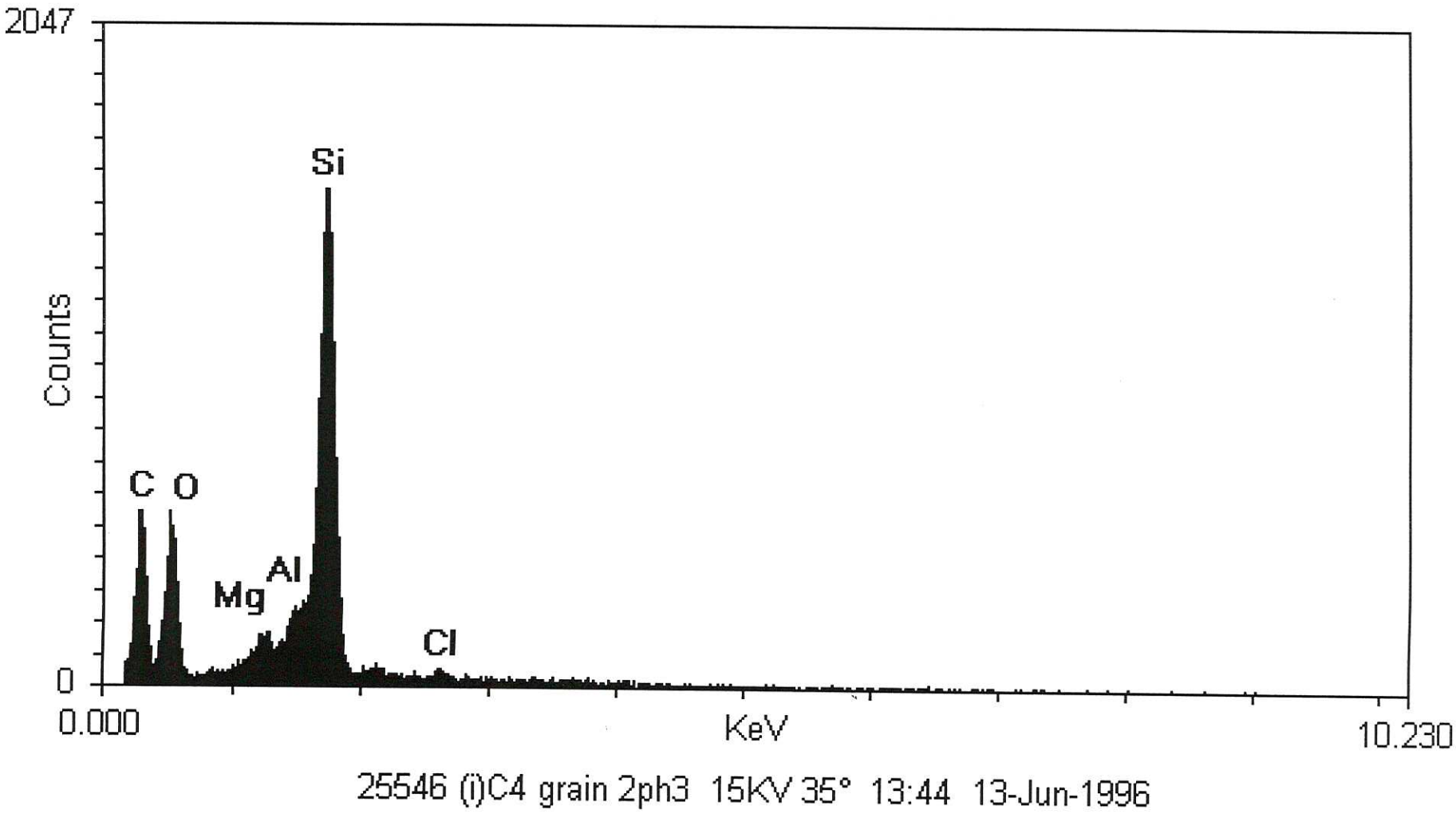
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Fig 19

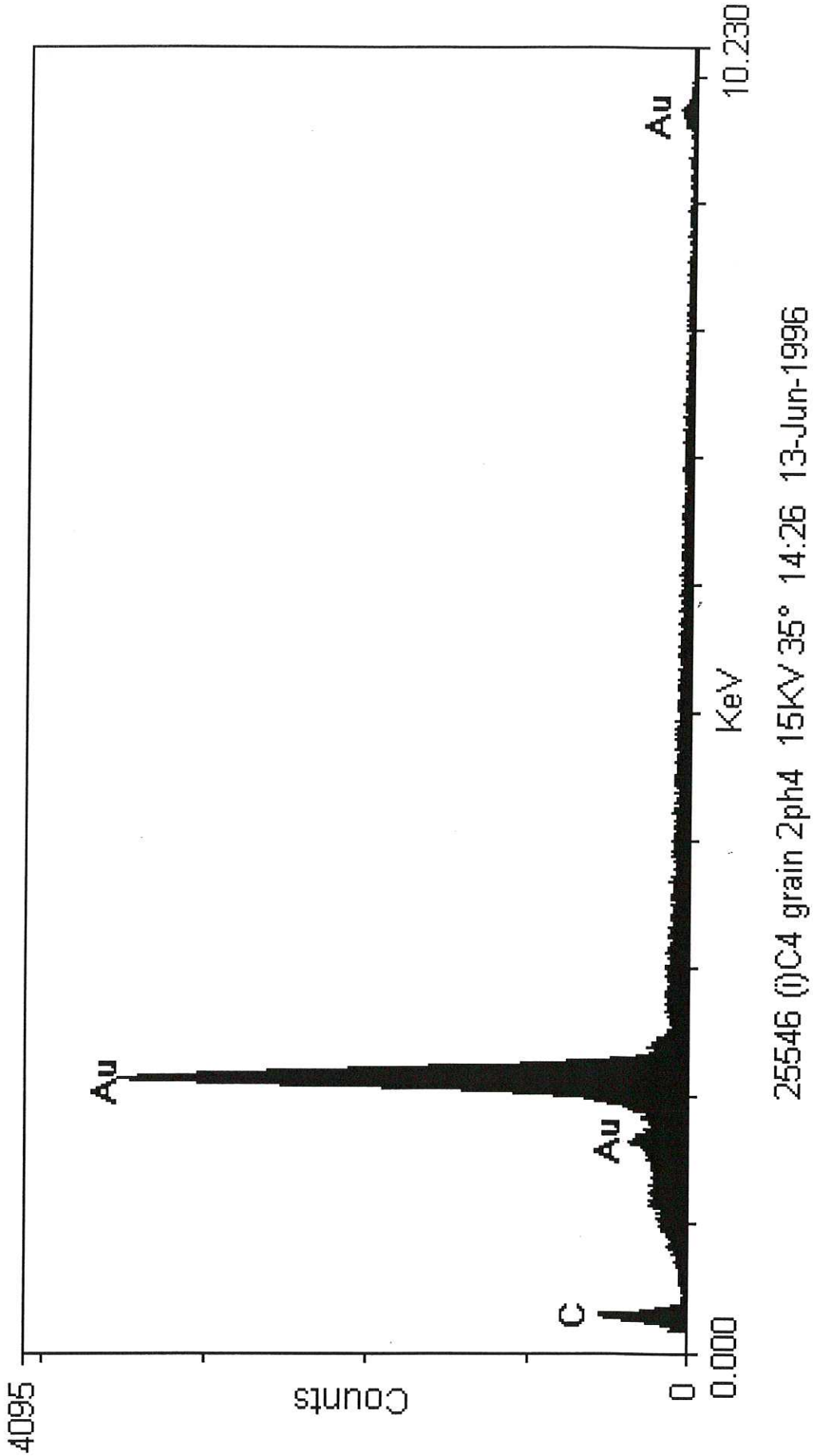
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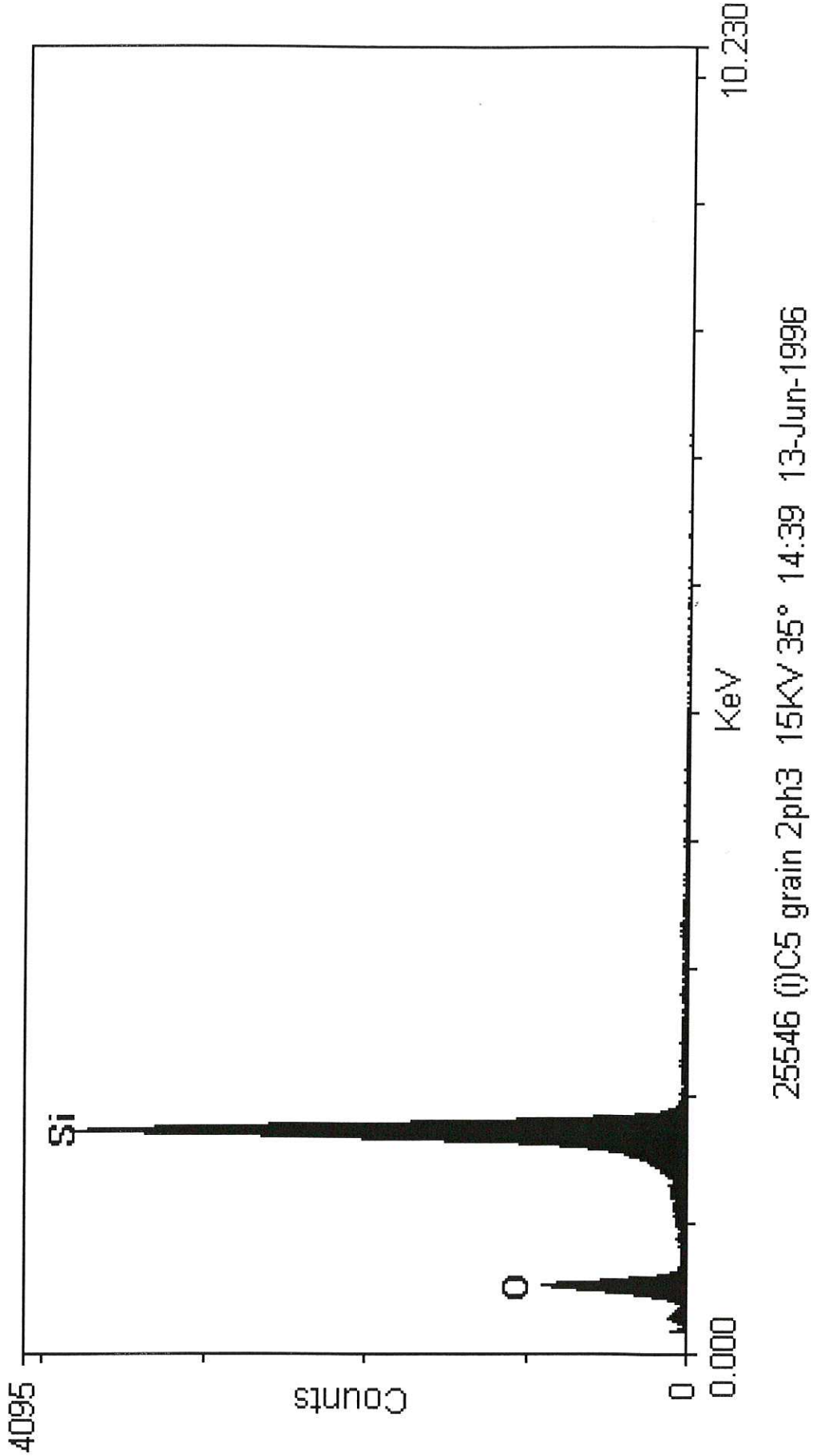
Fig 20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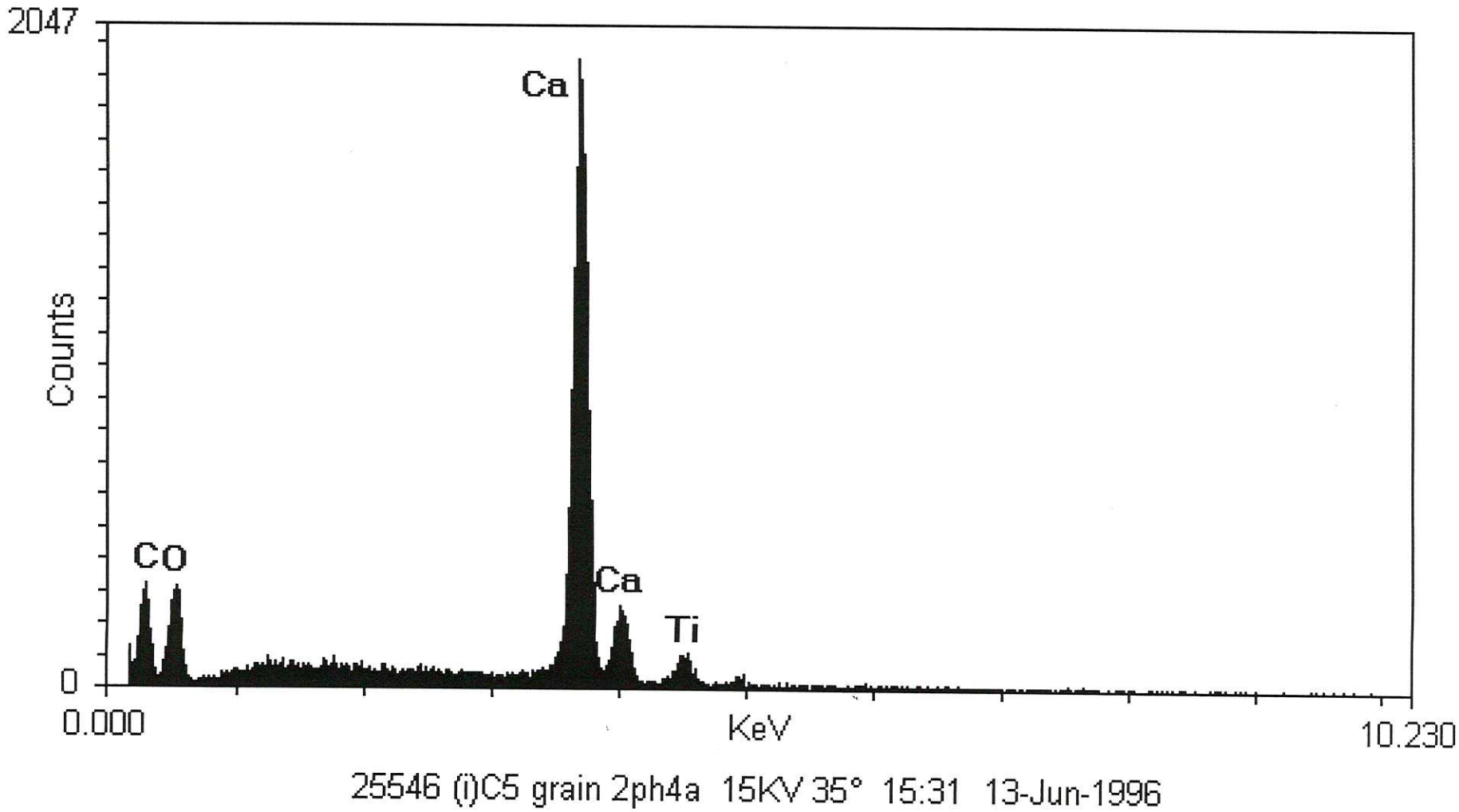
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Fig 22

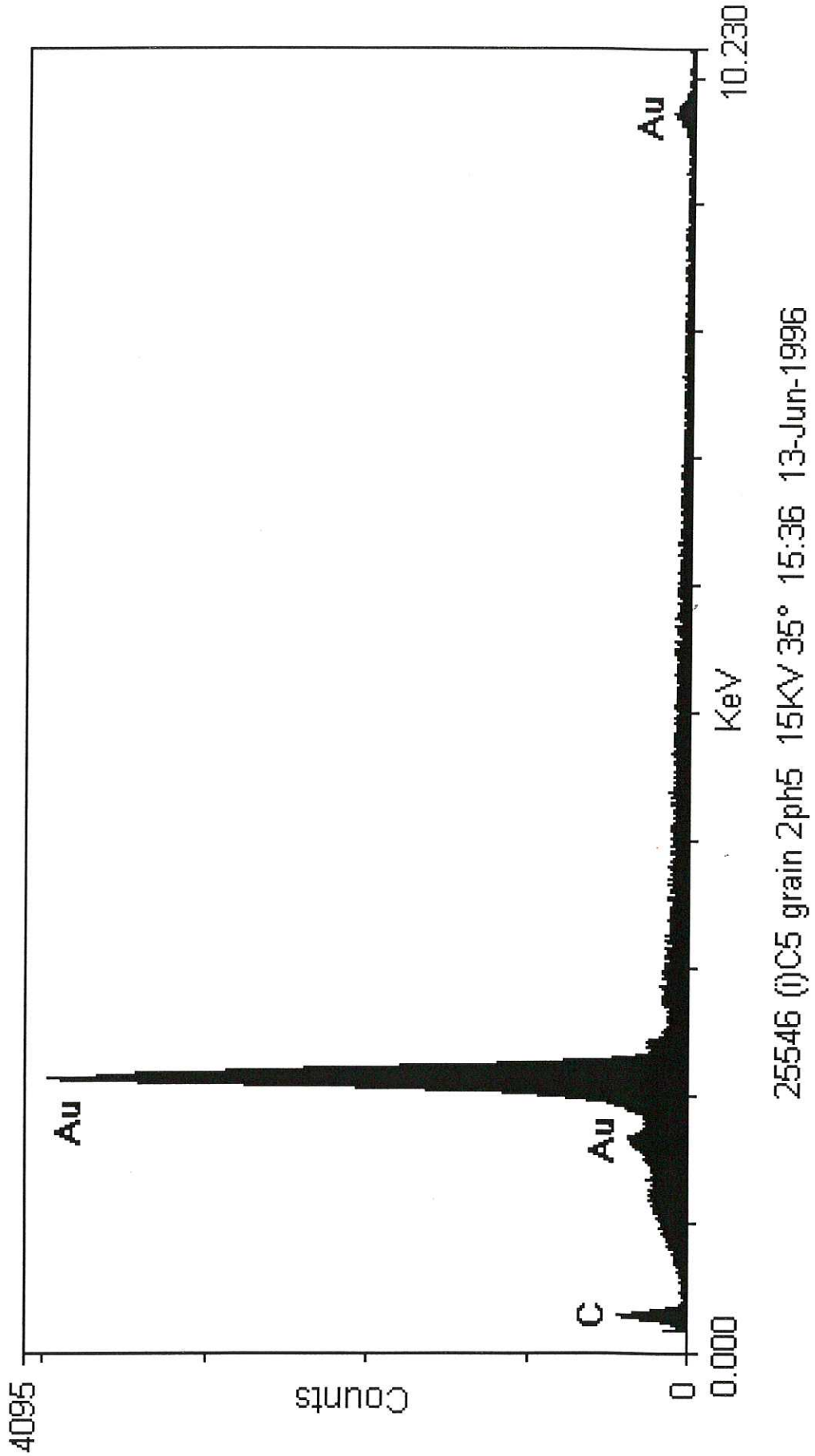
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Fig 23

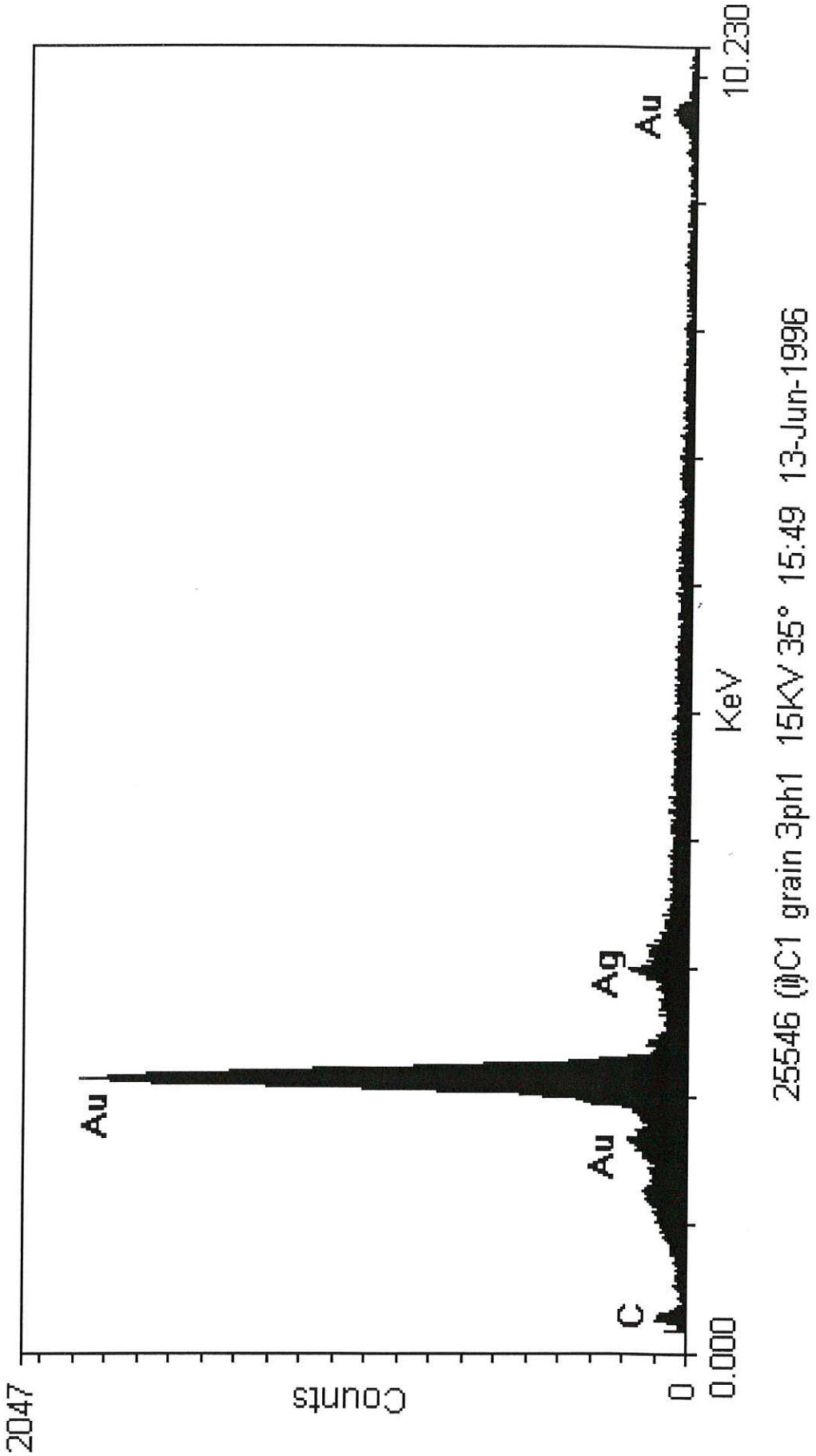
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Fig 24

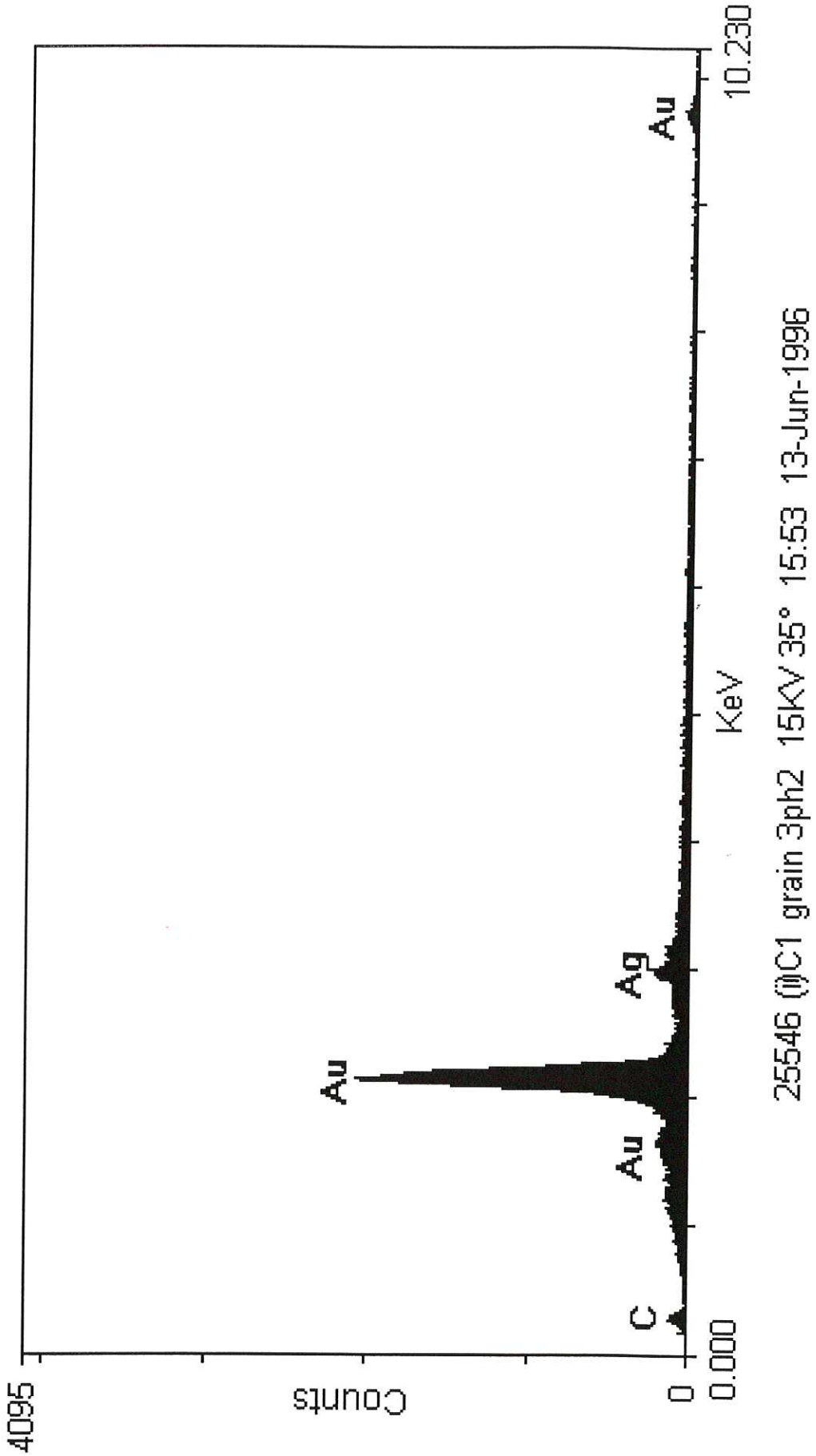
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Fig 25

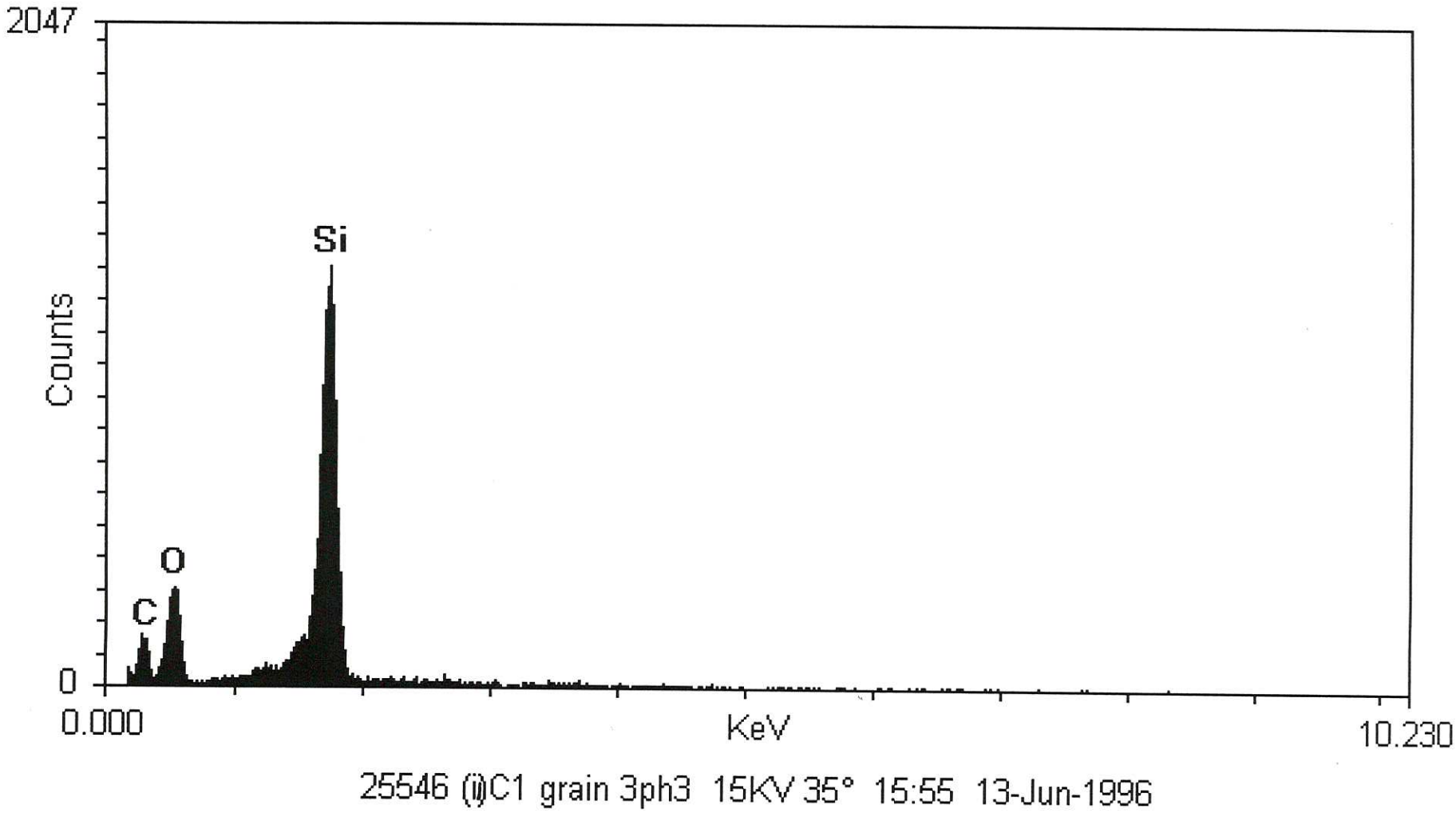
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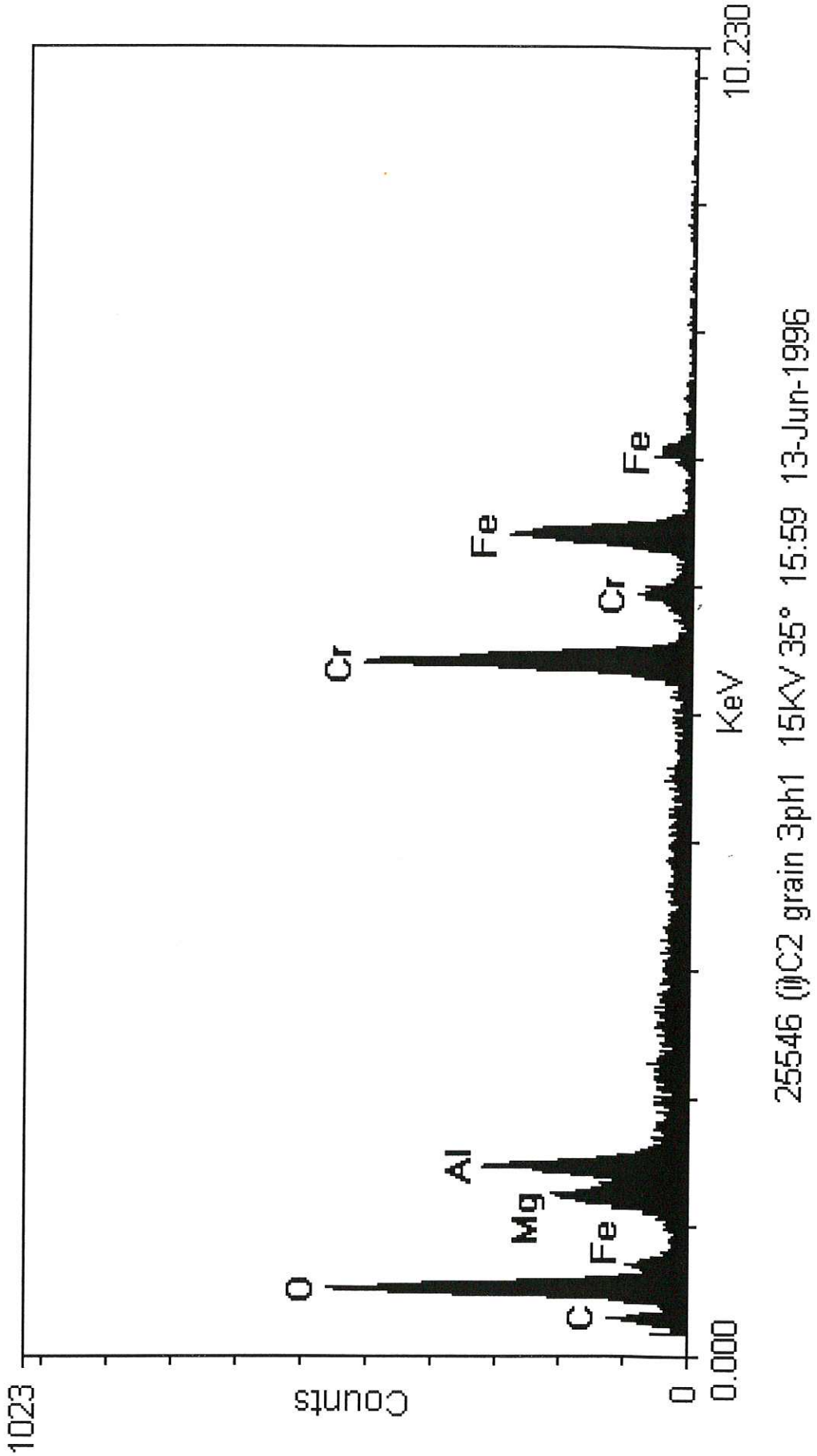
Fig 26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10.230
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Fe
Cr
Fe
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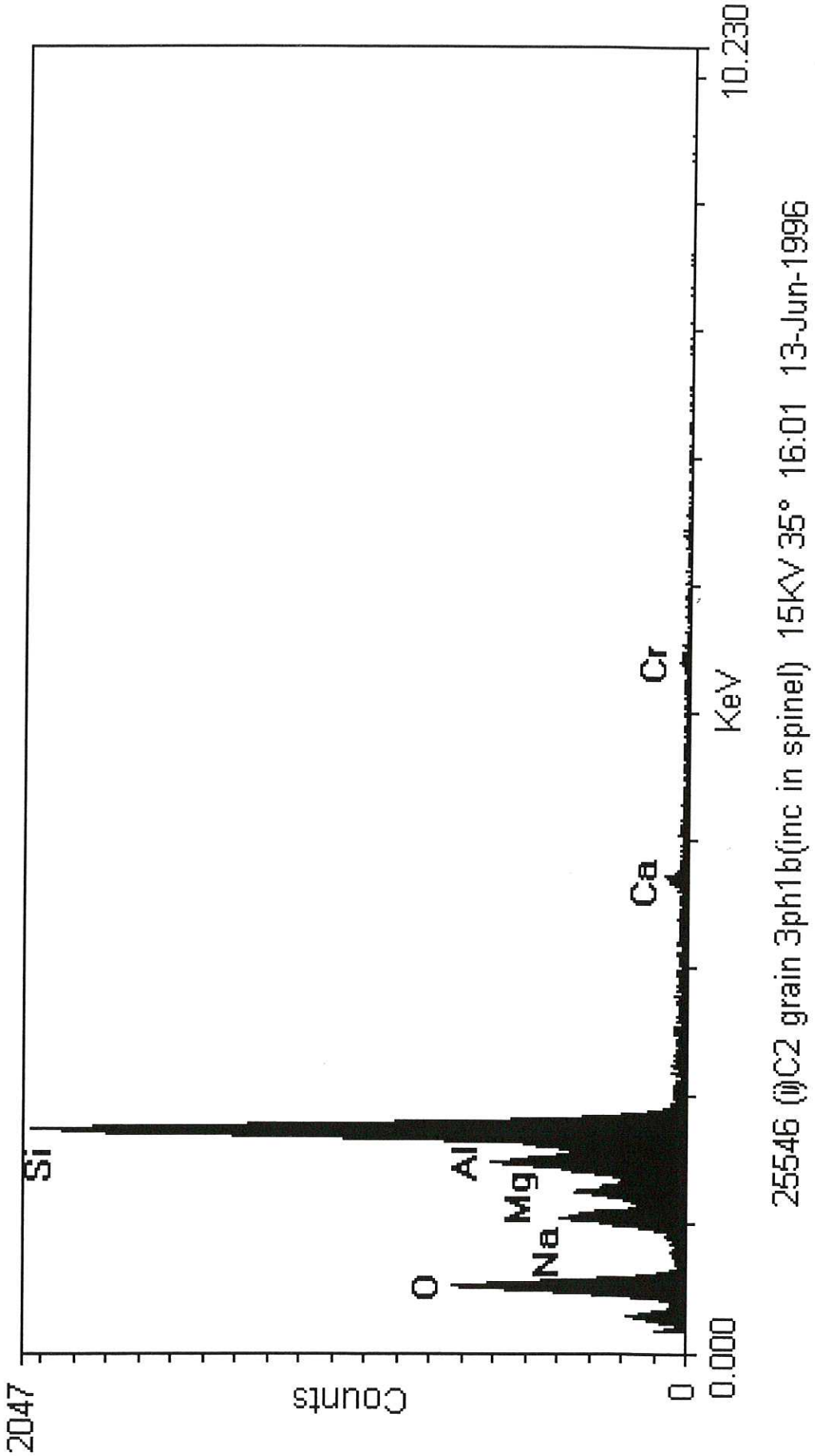
Fig 27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Cr
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Fig 28

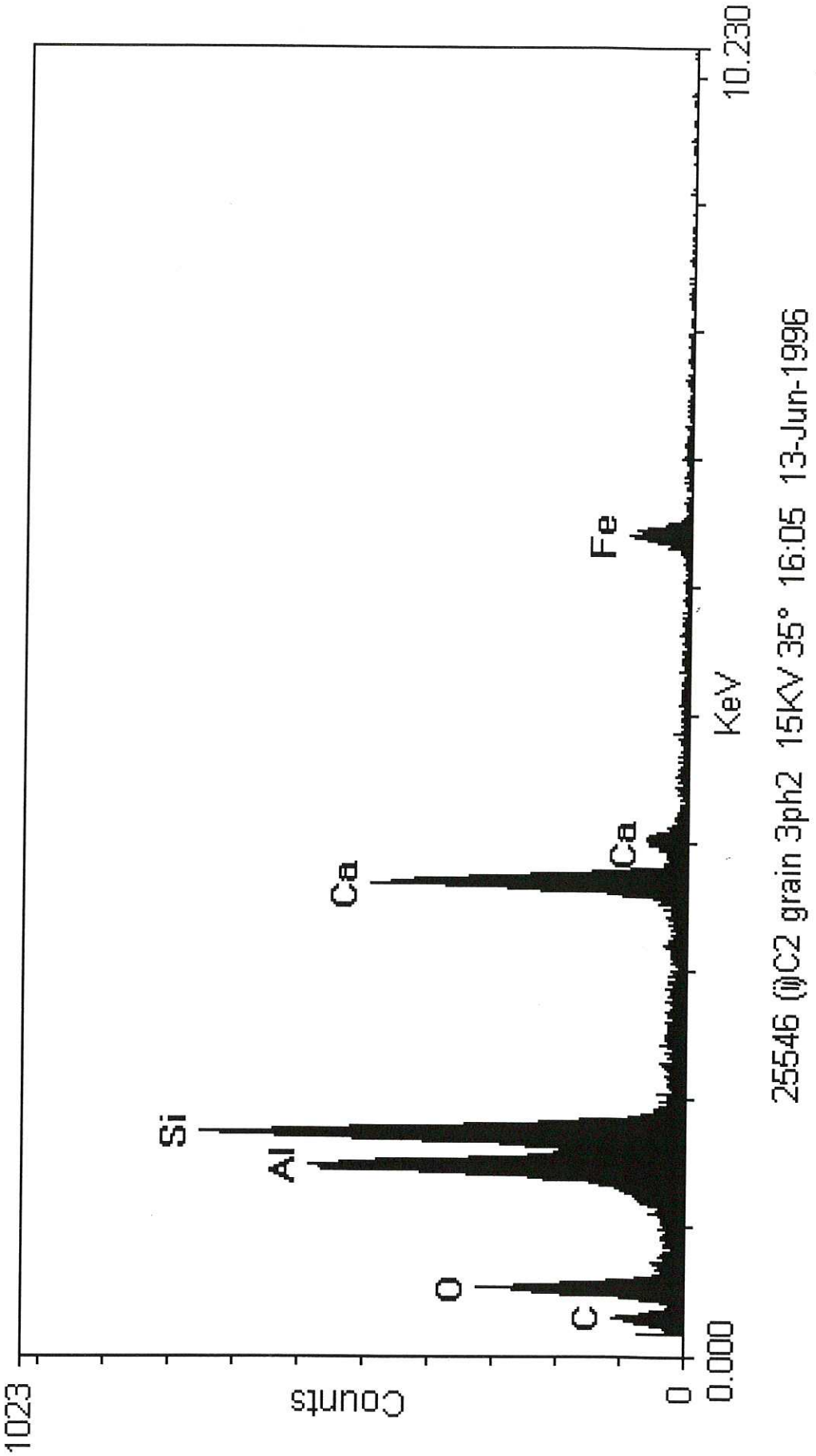
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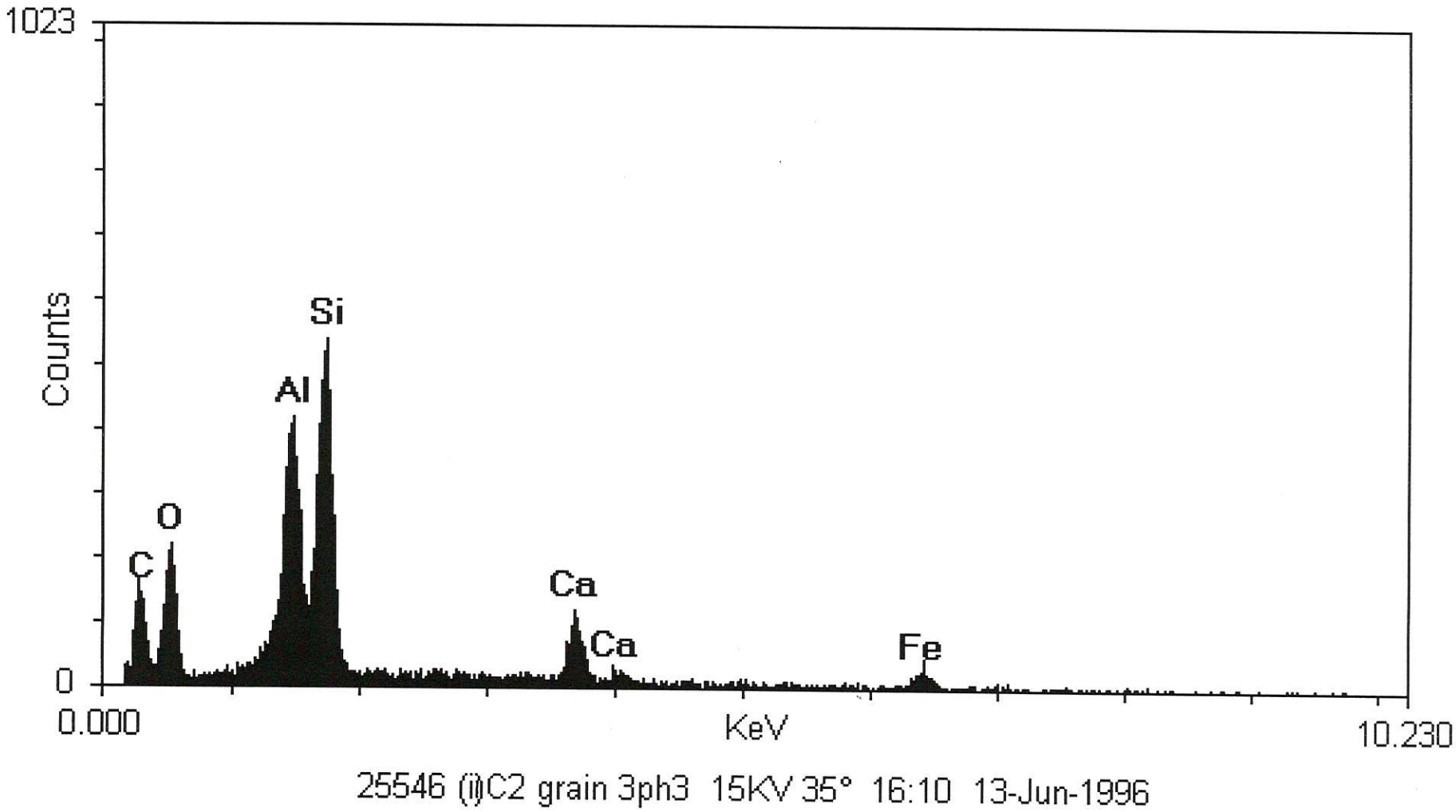
Fig 29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C
Ca
Ca
Fe
0.000
KeV
10.230
25546 (ii)C2 grain 3ph3 15KV 35° 16:10 13-Jun-1996

Fig 30

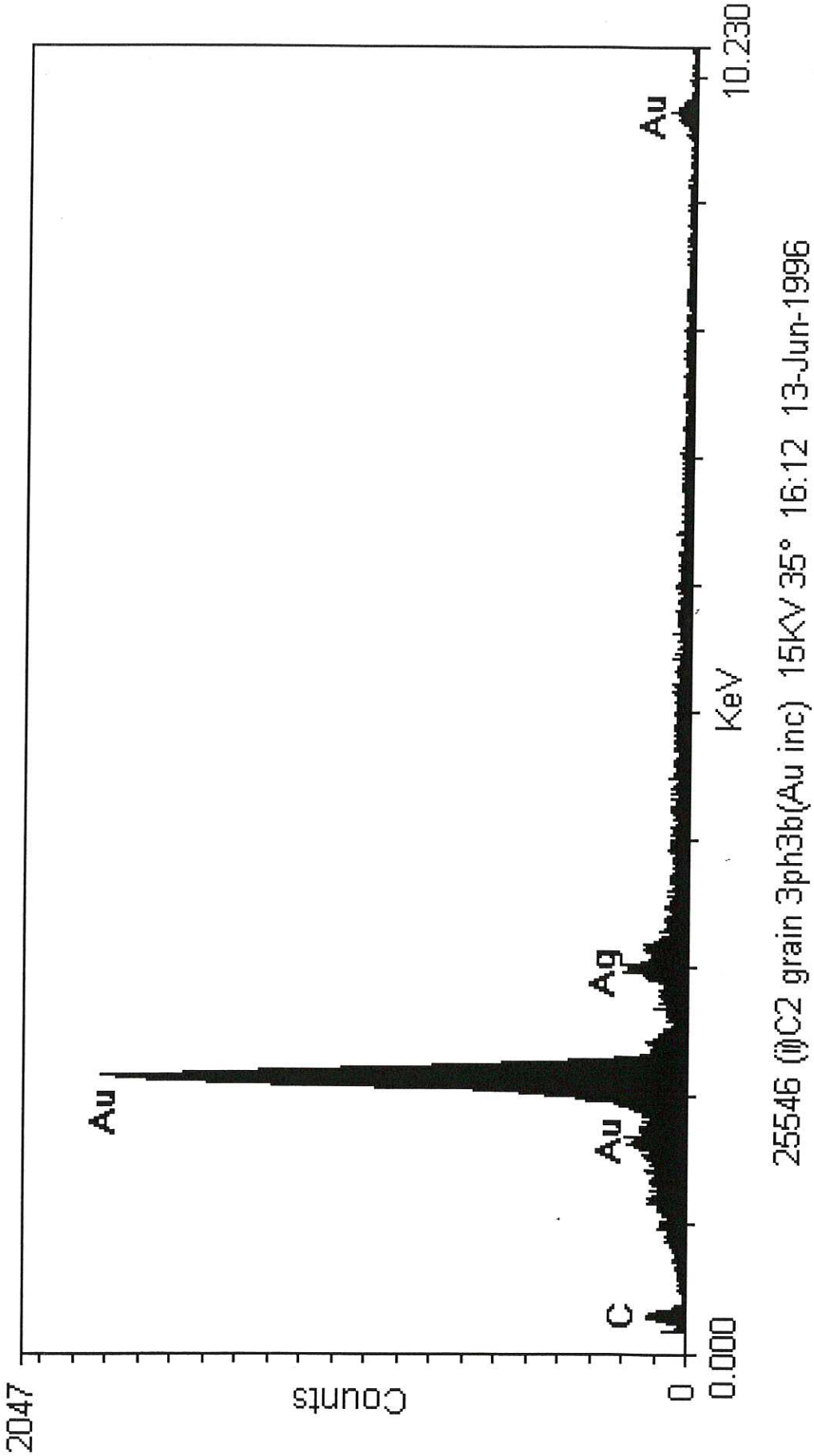

2047
Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546 (ii)C2 grain 3ph3b(Au inc) 15KV 35° 16:12 13-Jun-1996

Fig 31

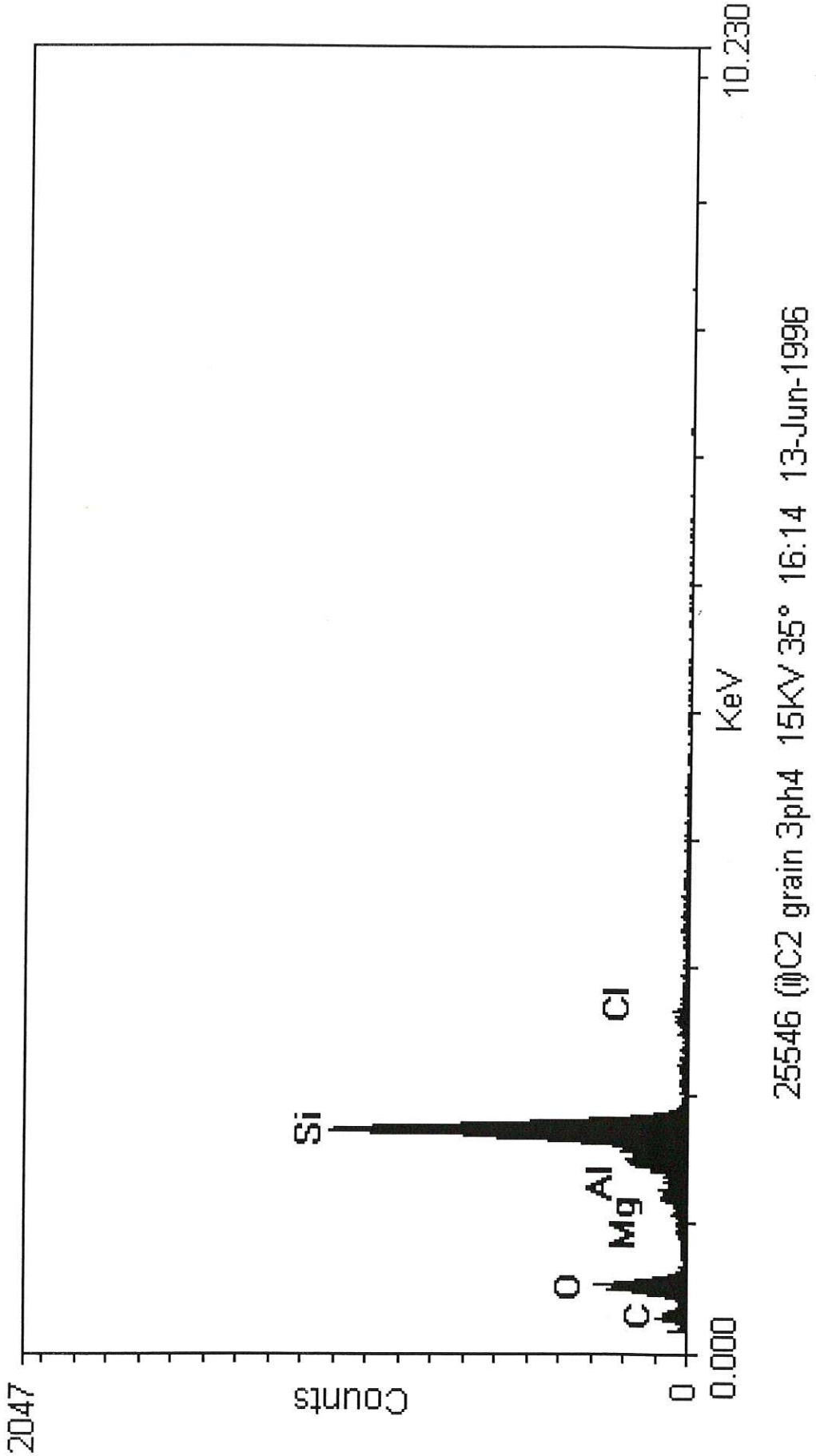
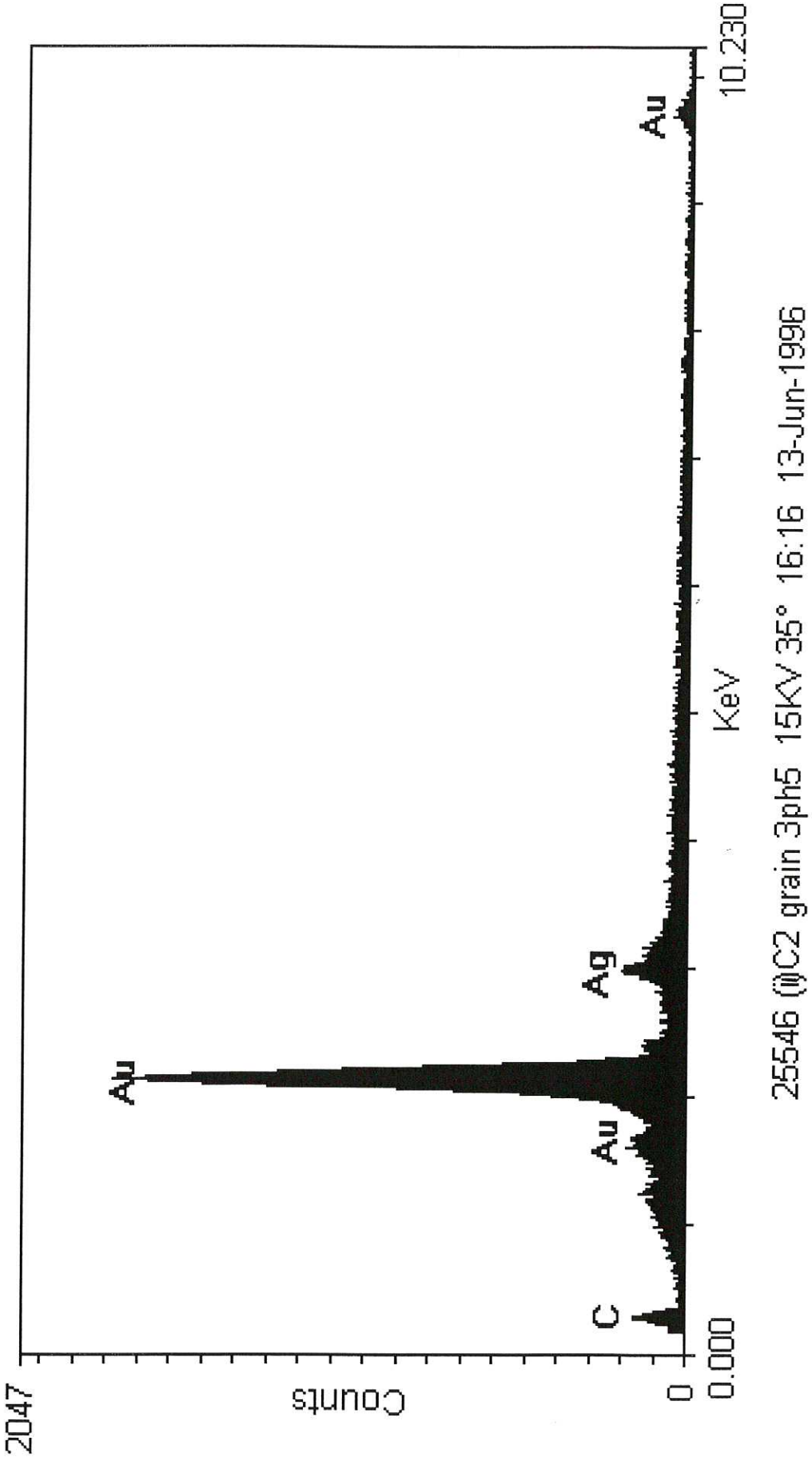

2047
Counts
0
0.000
C
O
Mg
Al
Si
Cl
KeV
10.230
25546 (i)C2 grain 3ph4 15KV 35° 16:14 13-Jun-1996

Fig 32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Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546 (i)C2 grain 3ph5 15KV 35° 16:16 13-Jun-1996

Fig 33

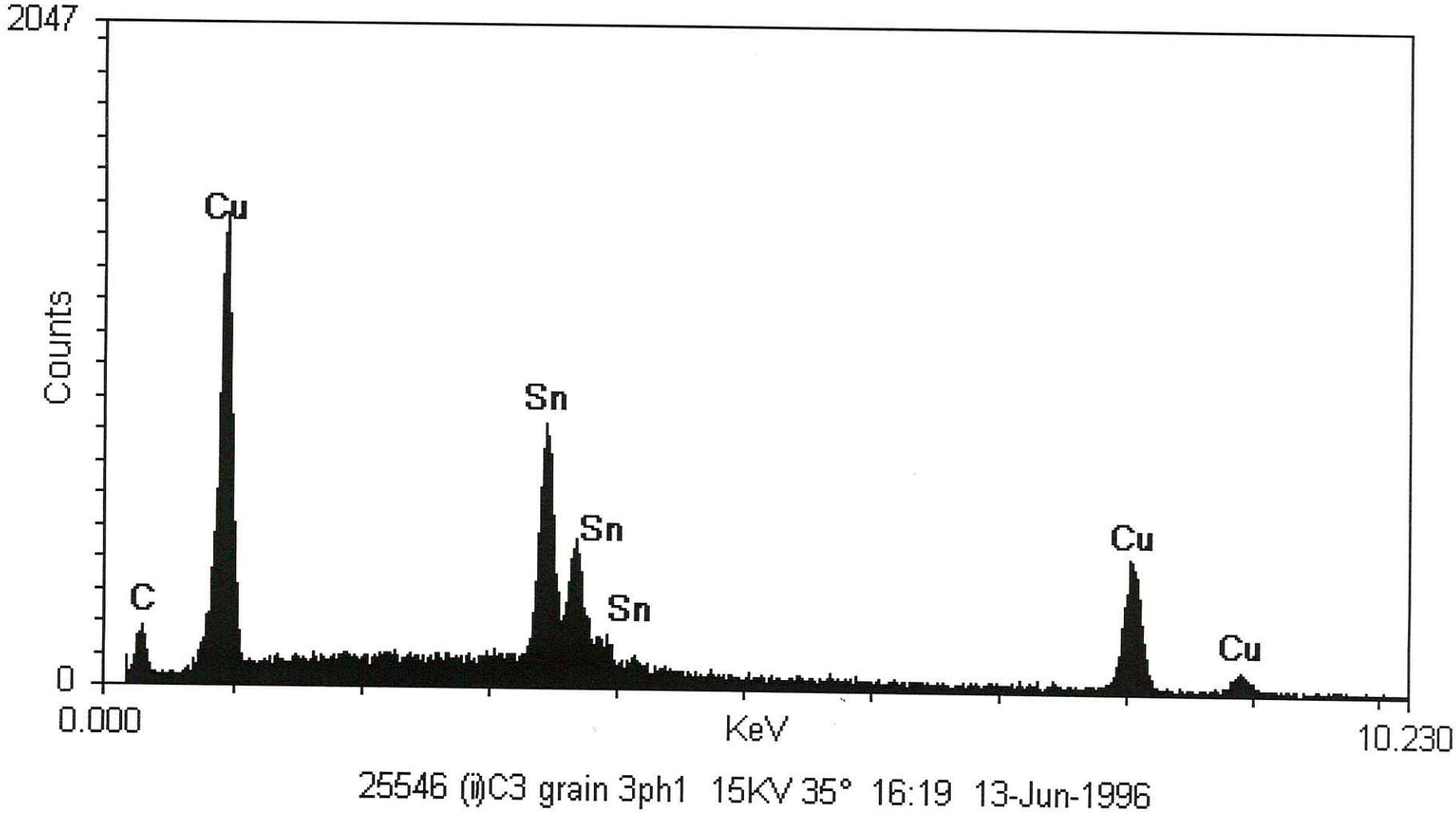

2047
Counts
0
0.000
KeV
10.230
C
Cu
Sn
Sn
Sn
Cu
Cu
25546 (ii)C3 grain 3ph1 15KV 35° 16:19 13-Jun-1996

Fig 34

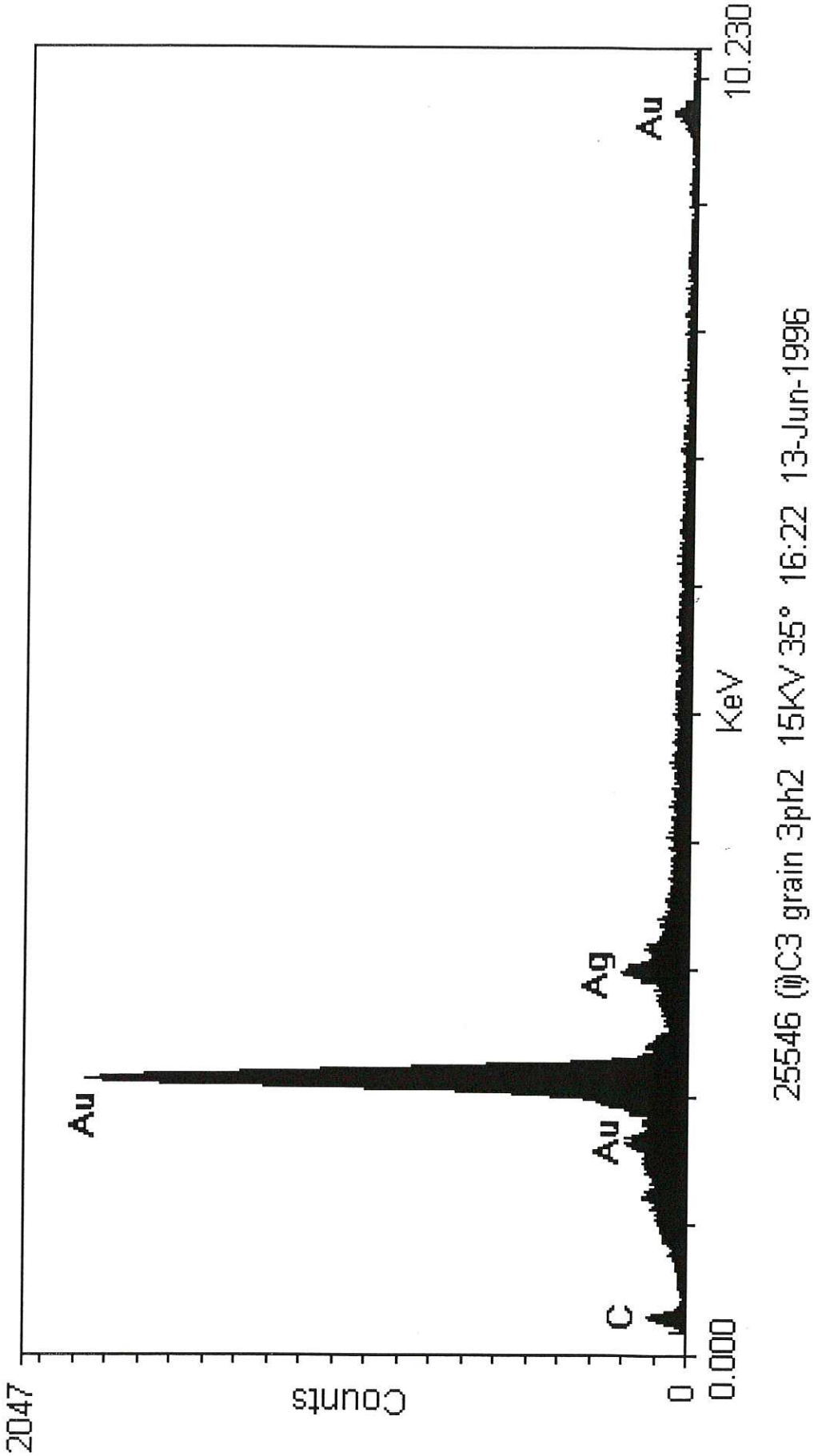

2047
Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546 (I)C3 grain 3ph2 15KV 35° 16:22 13-Jun-1996

Fig 35

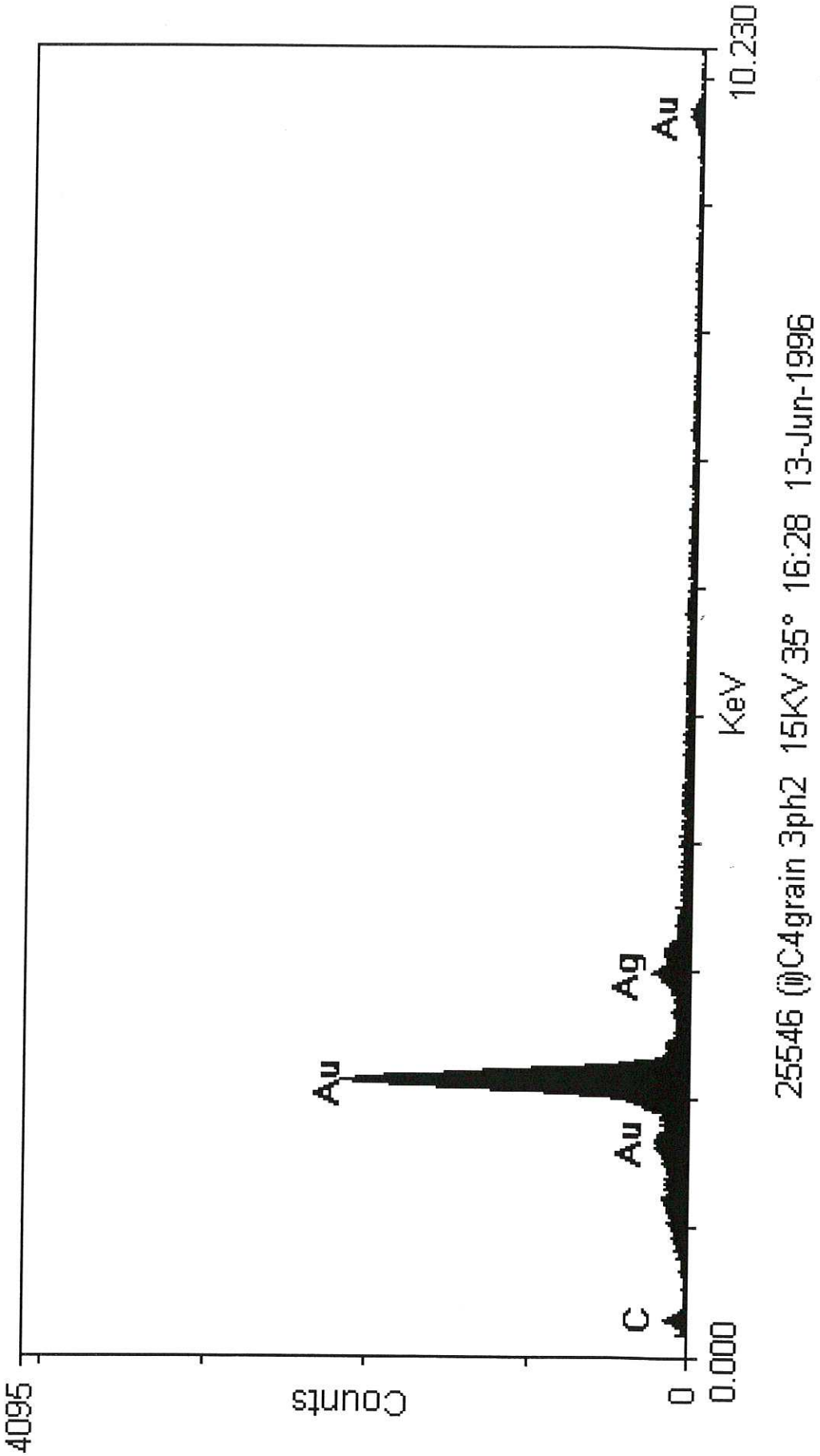

4095
Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546 (@C4grain 3ph2 15KV 35° 16:28 13-Jun-1996

Fig 36

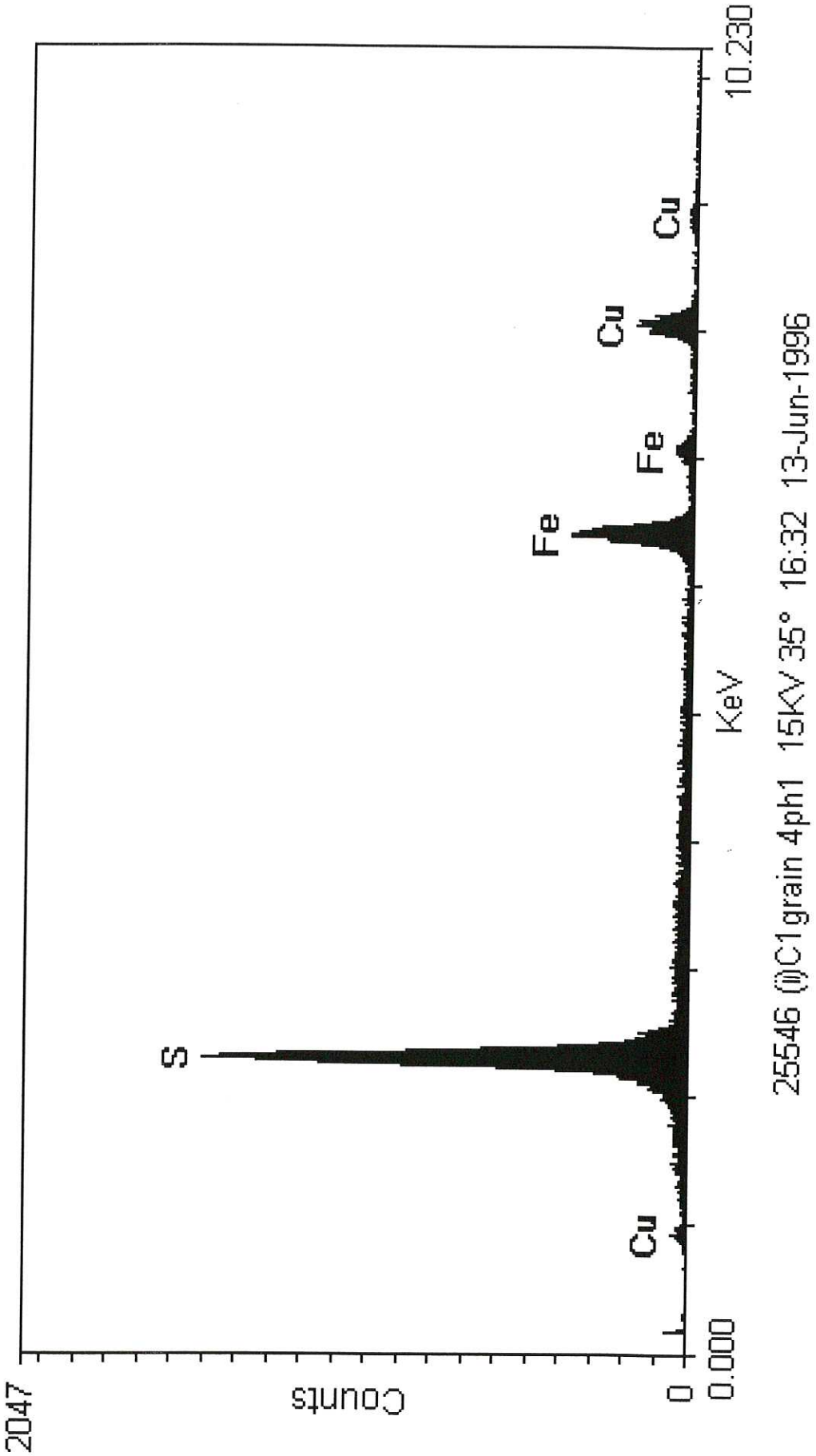

2047
Counts
0
0.000
Cu
S
Fe
Fe
Cu
Cu
KeV
10.230
25546 (ii)C1grain 4ph1 15KV 35° 16:32 13-Jun-1996

Fig 37

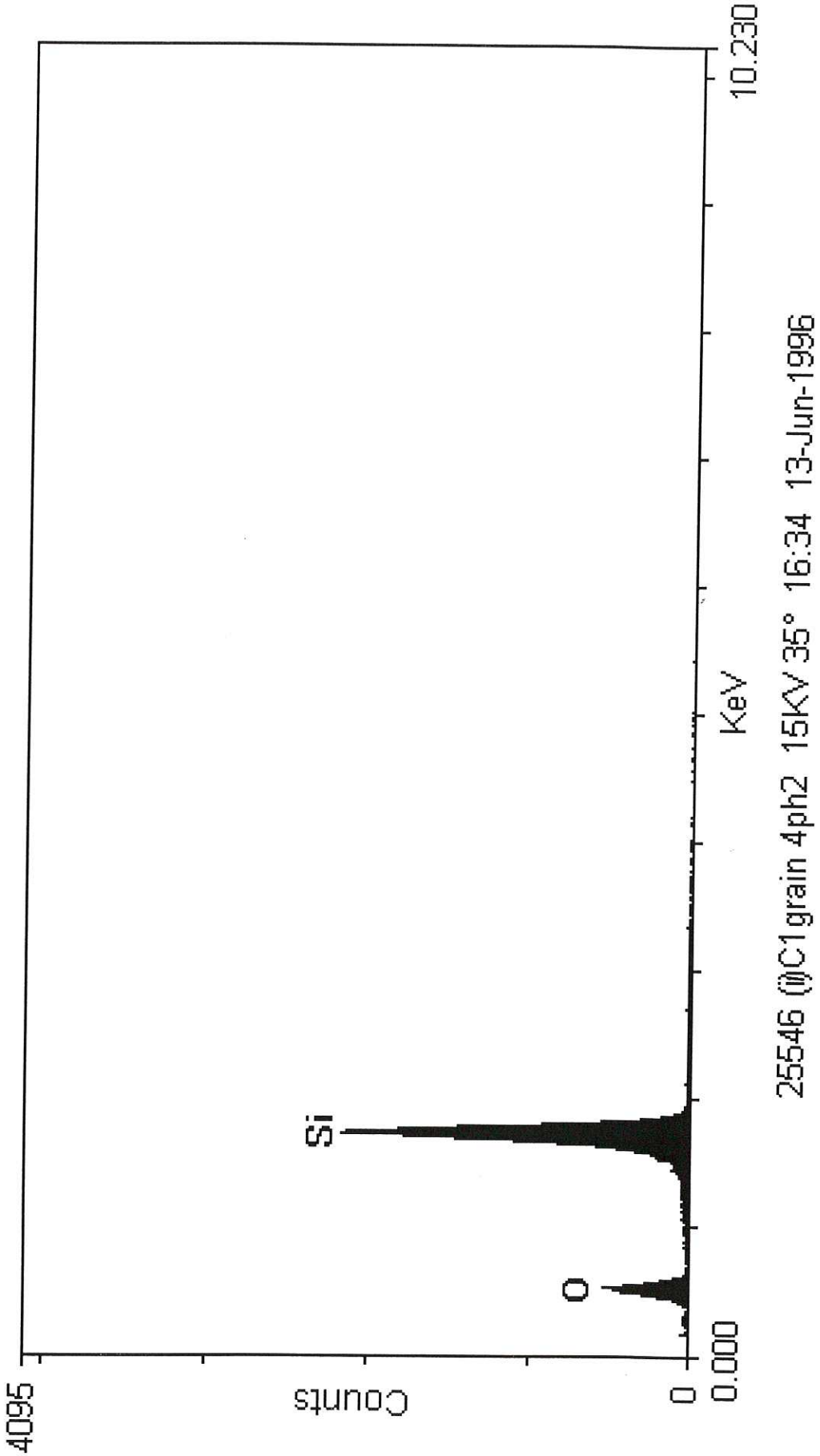

4095
Counts
0
0.000
O
Si
KeV
10.230
25546 (@C1grain 4ph2 15KV 35° 16:34 13-Jun-1996

Fig 38

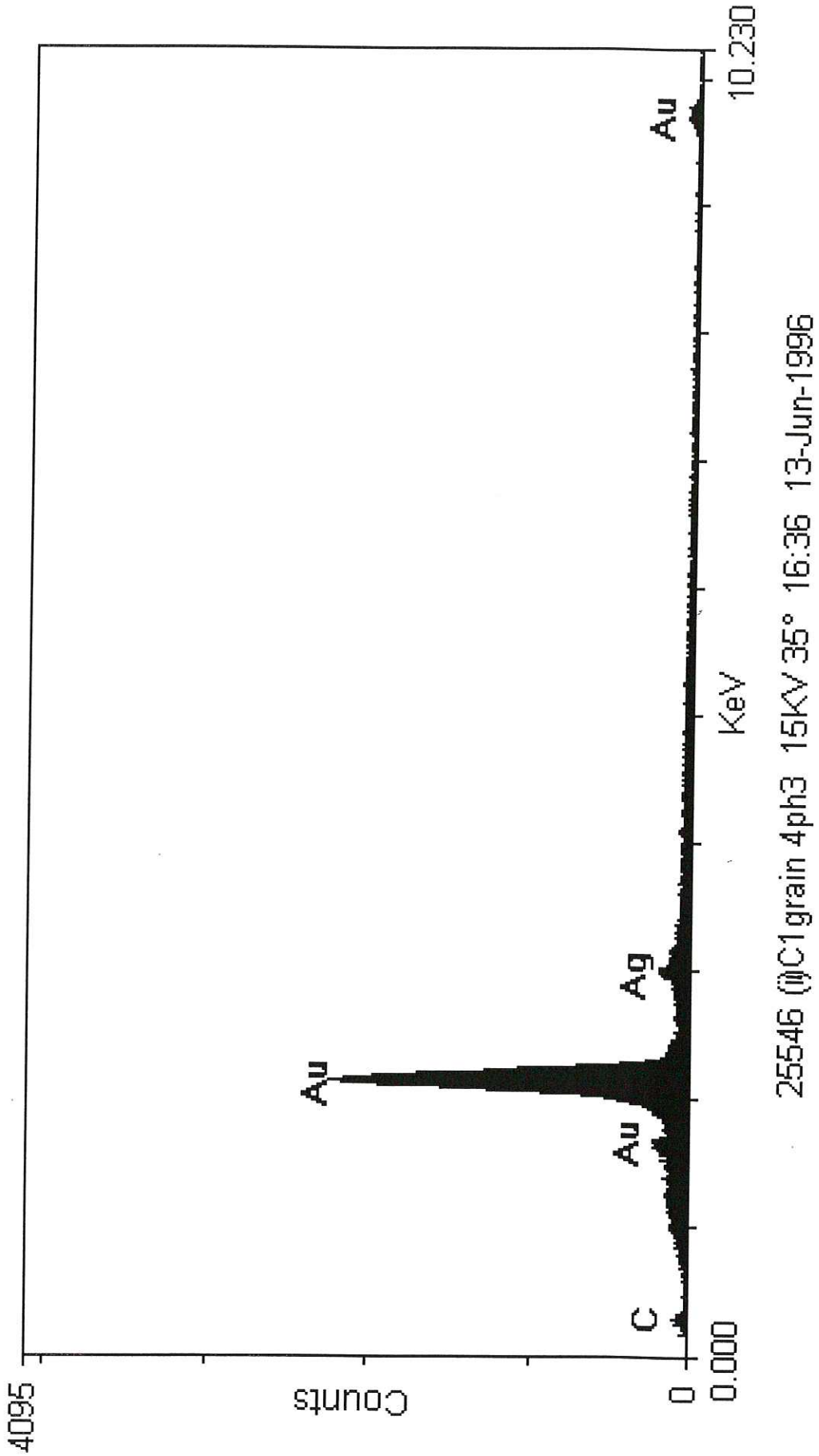

4095
Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546 (i)C1grain 4ph3 15KV 35° 16:36 13-Jun-1996

Fig 39

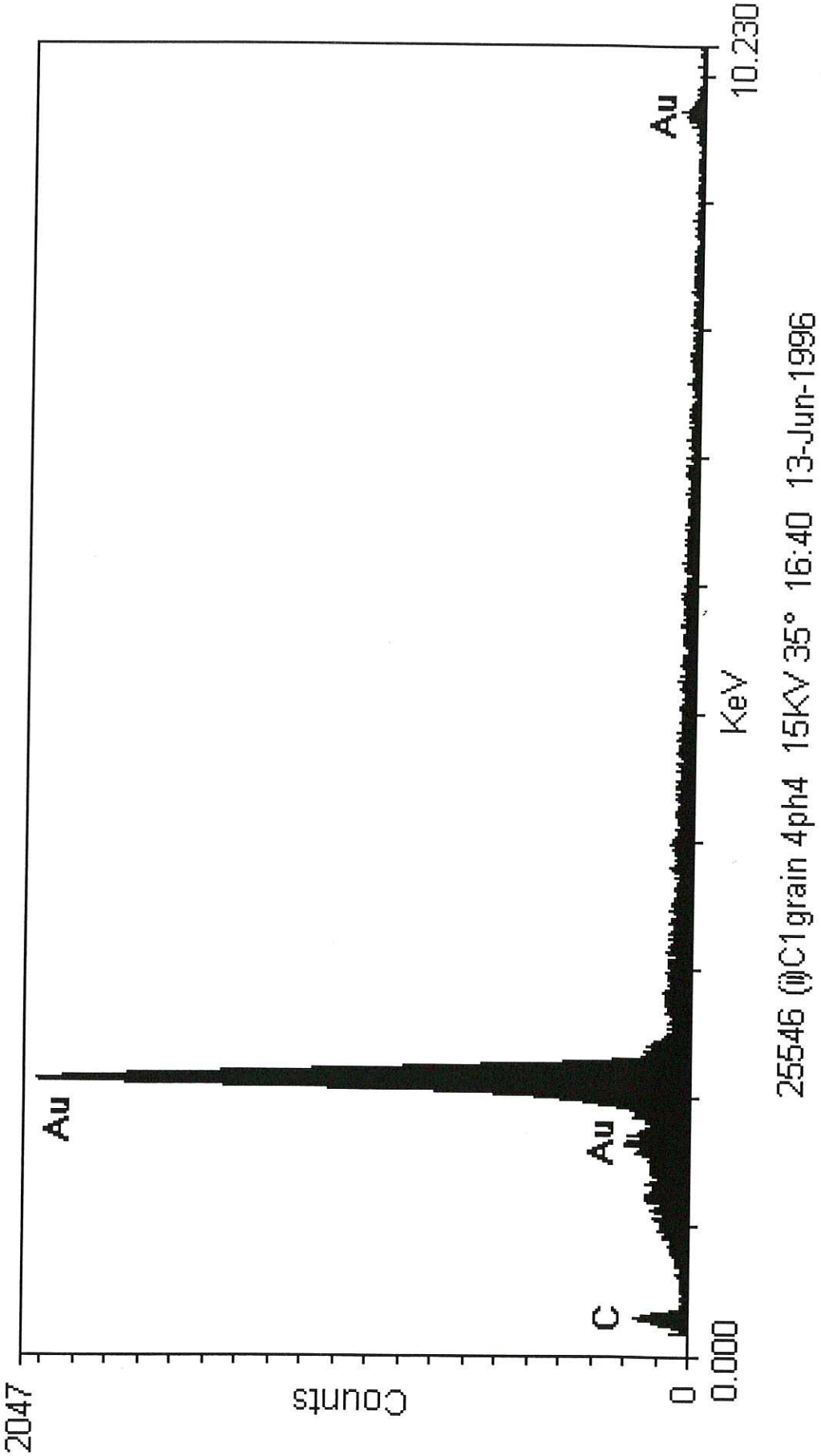

2047
Counts
0
0.000
C
Au
Au
Au
KeV
10.230
25546 (i)C1grain 4ph4 15KV 35° 16:40 13-Jun-1996

Fig 40

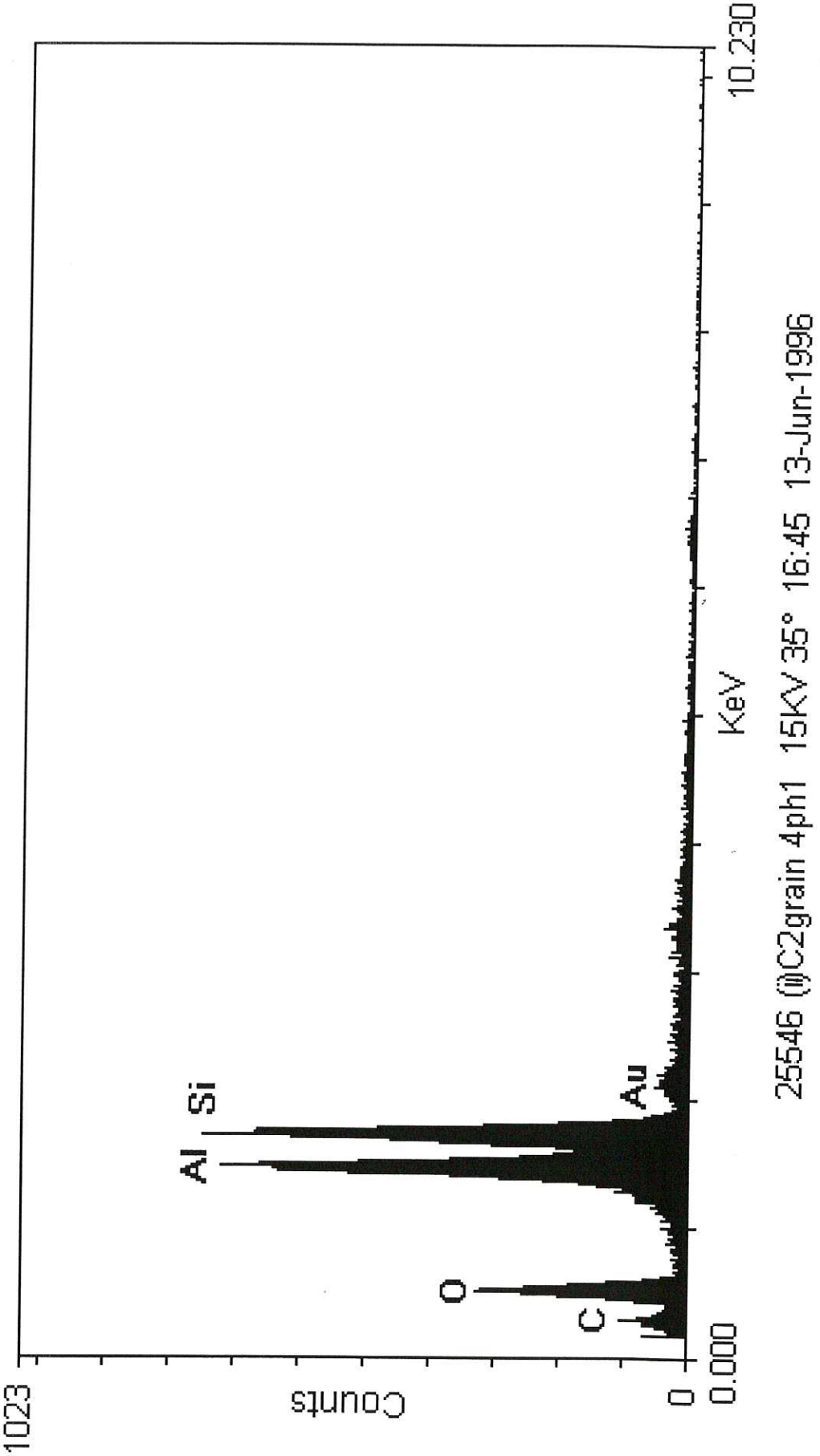

1023
Counts
0
0.000
C
O
Al
Si
Au
KeV
10.230
25546 (ii)C2grain 4ph1 15KV 35° 16:45 13-Jun-1996

Fig 41

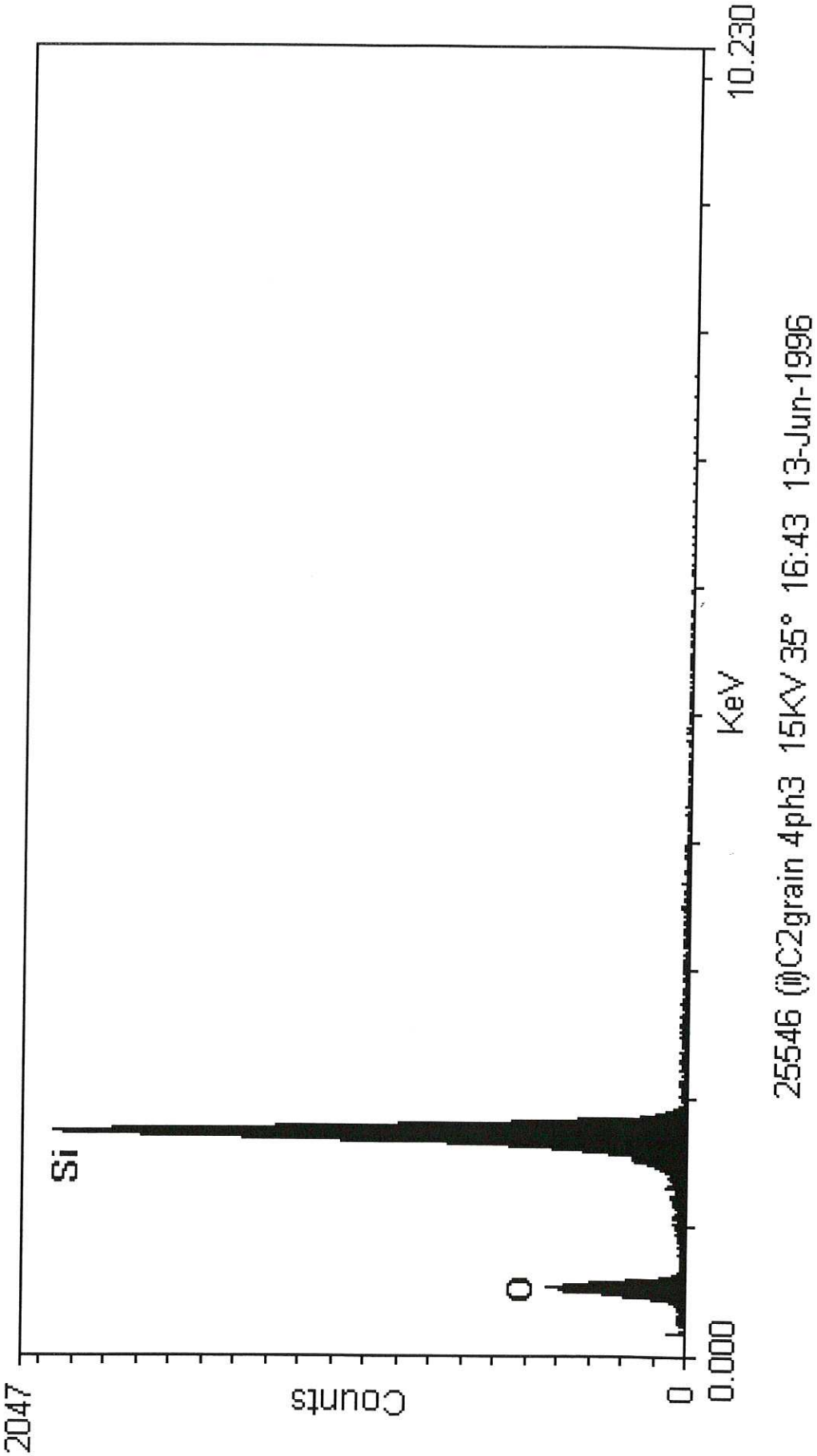

2047
Counts
0
0.000
O
Si
KeV
10.230
25546 (#)C2grain 4ph3 15KV 35° 16:43 13-Jun-1996

Fig 42

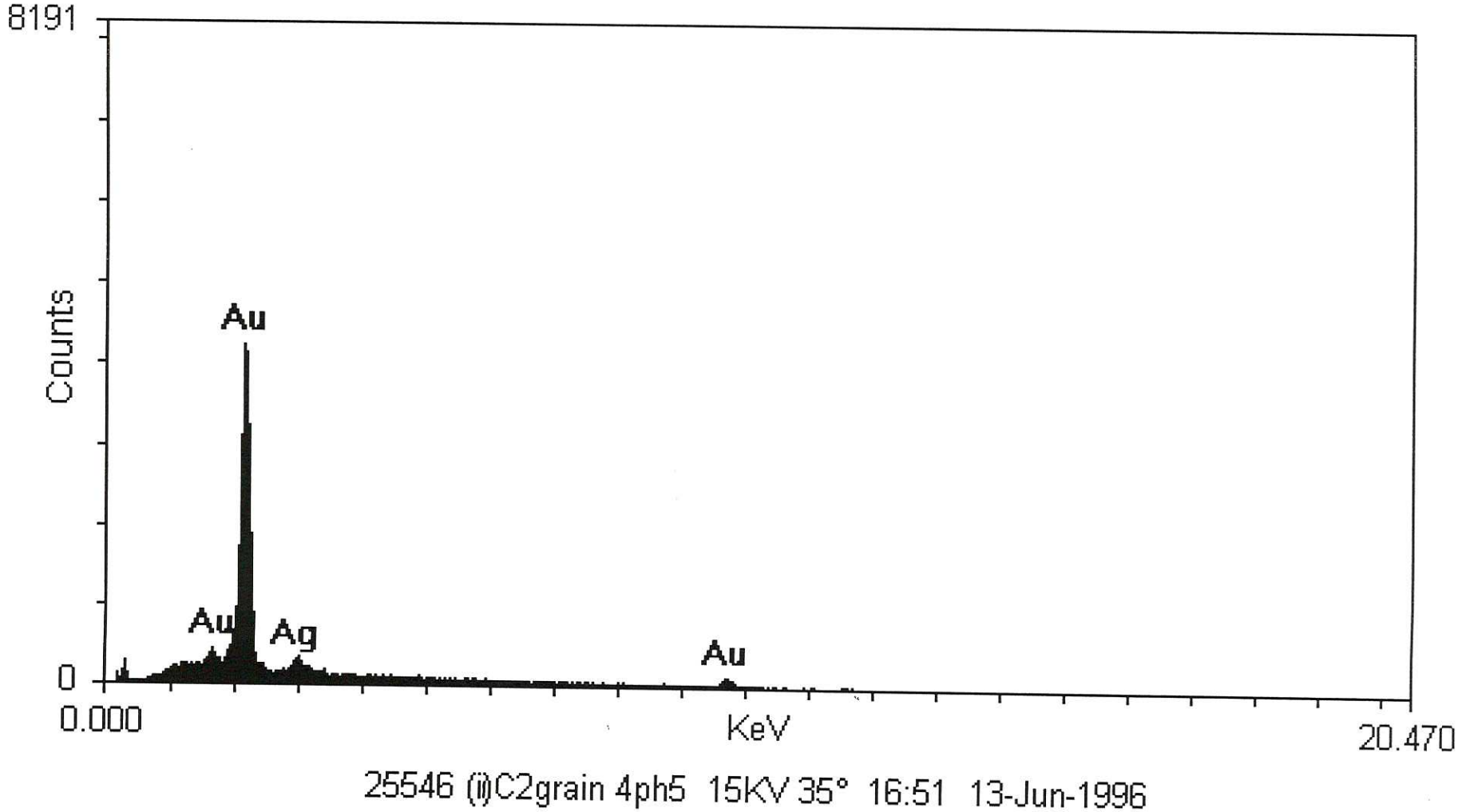

8191
Counts
0
Au
Au
Ag
Au
0.000
KeV
20.470
25546 (i)C2grain 4ph5 15KV 35° 16:51 13-Jun-1996

Fig 43

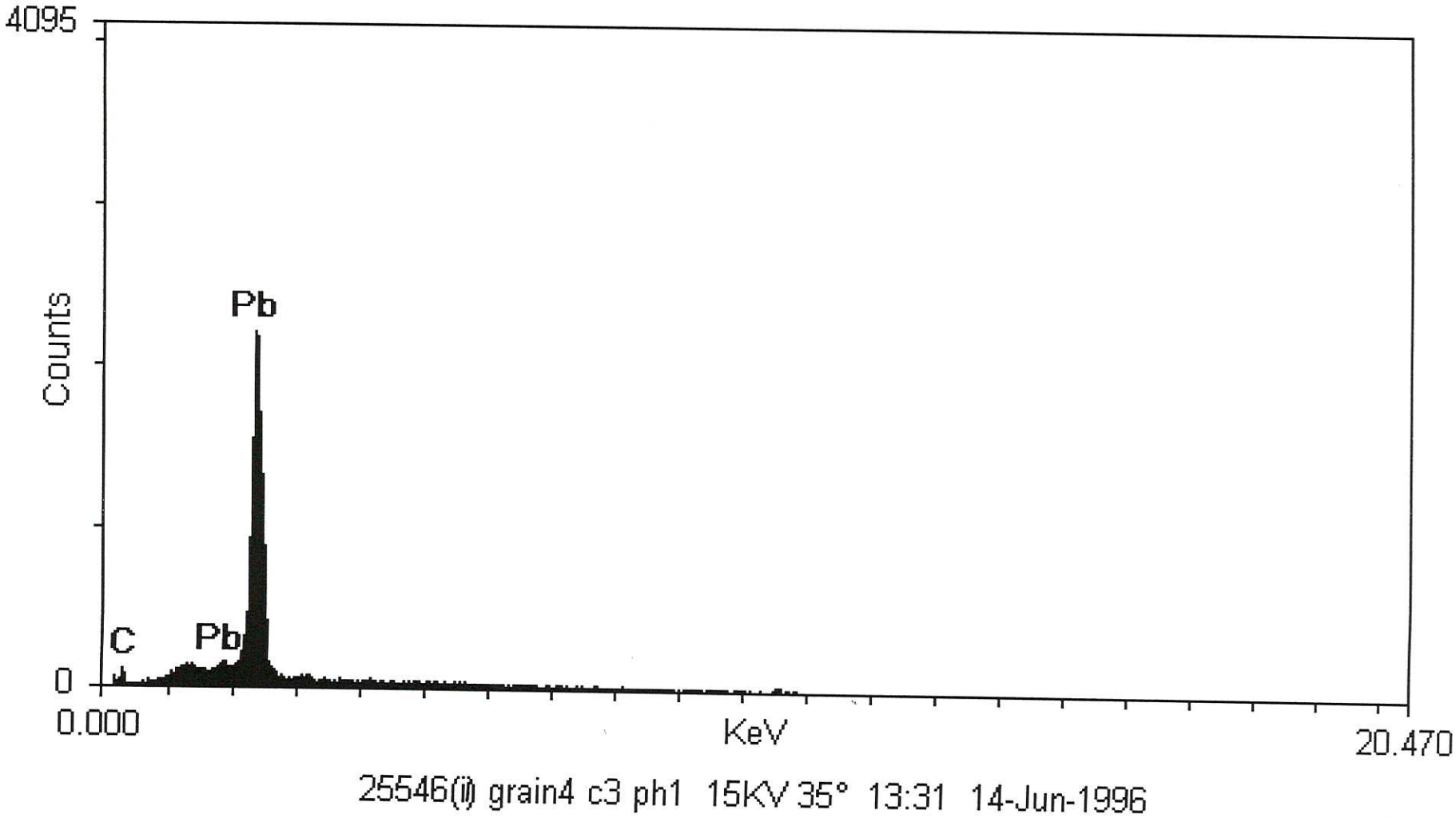

4095
Counts
0
Pb
C
Pb
0.000
KeV
20.470
25546(ii) grain4 c3 ph1 15KV 35° 13:31 14-Jun-1996

Fig 44

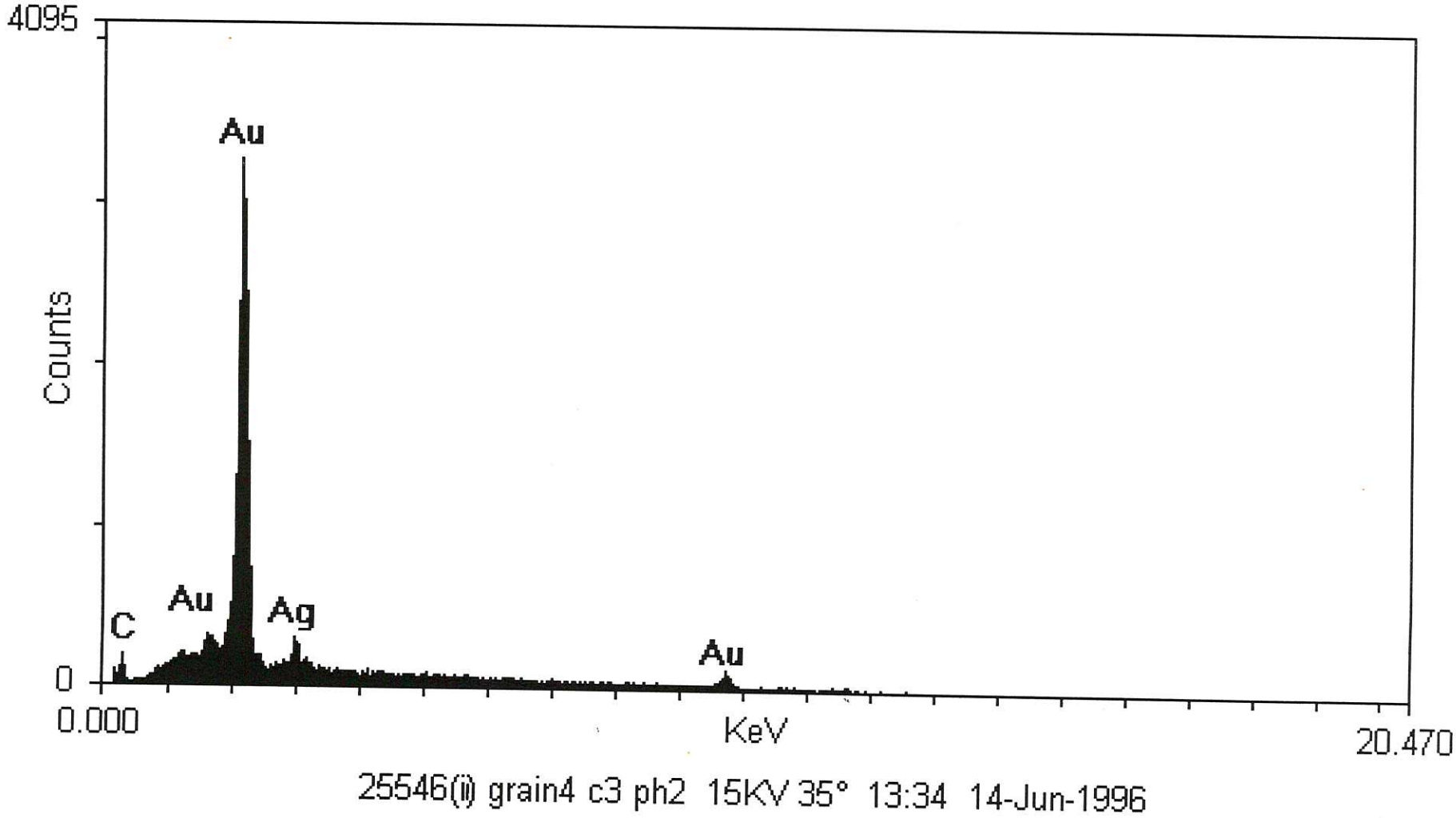

4095
Counts
0
Au
Au
C
Ag
Au
0.000
KeV
20.470
25546(ii) grain4 c3 ph2 15KV 35° 13:34 14-Jun-1996

Fig 45

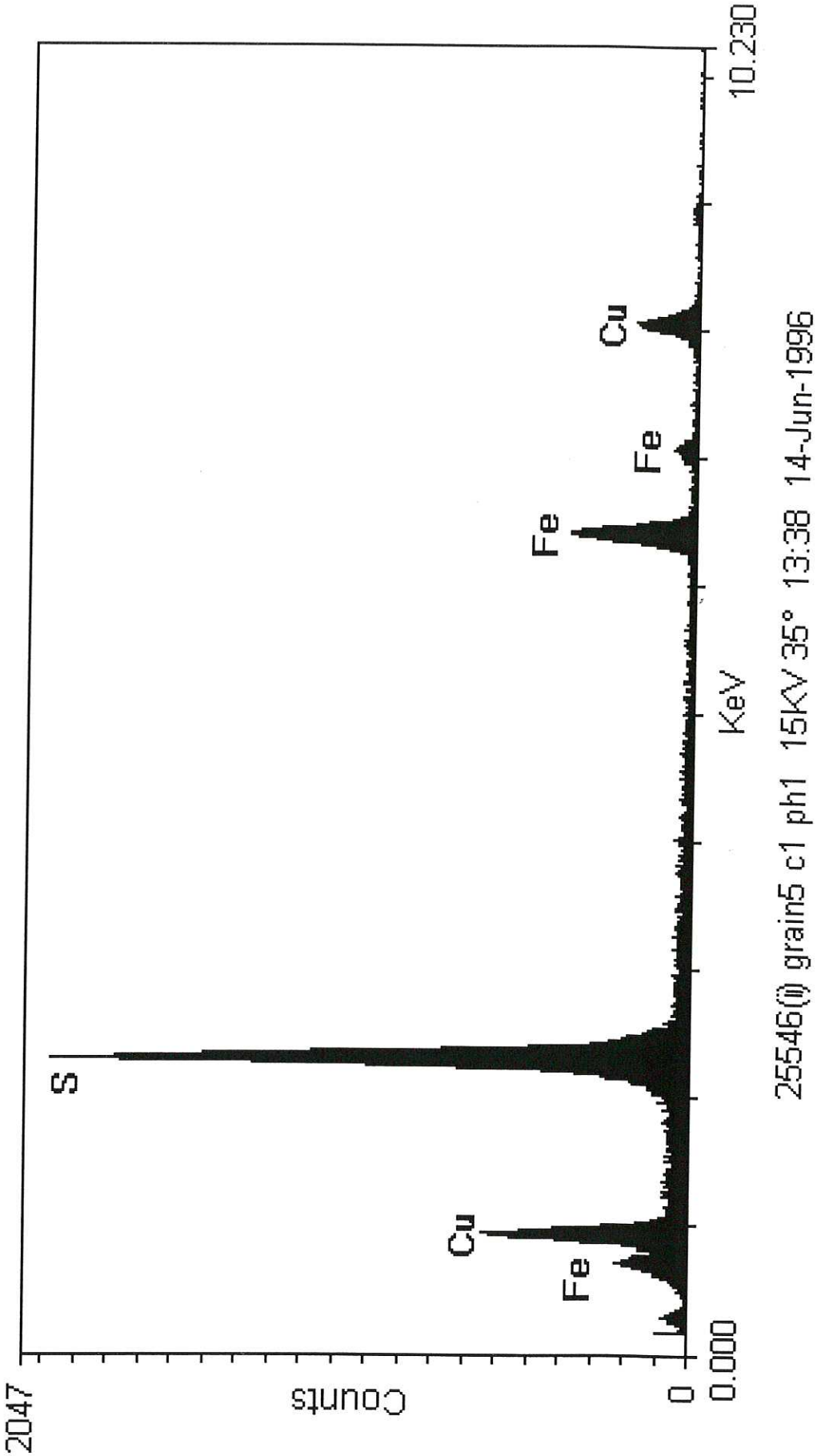

2047
Counts
0
0.000
S
Cu
Fe
Fe
Fe
Cu
KeV
10.230
25546(0) grain5 c1 ph1 15KV 35° 13:38 14-Jun-1996

Fig 46

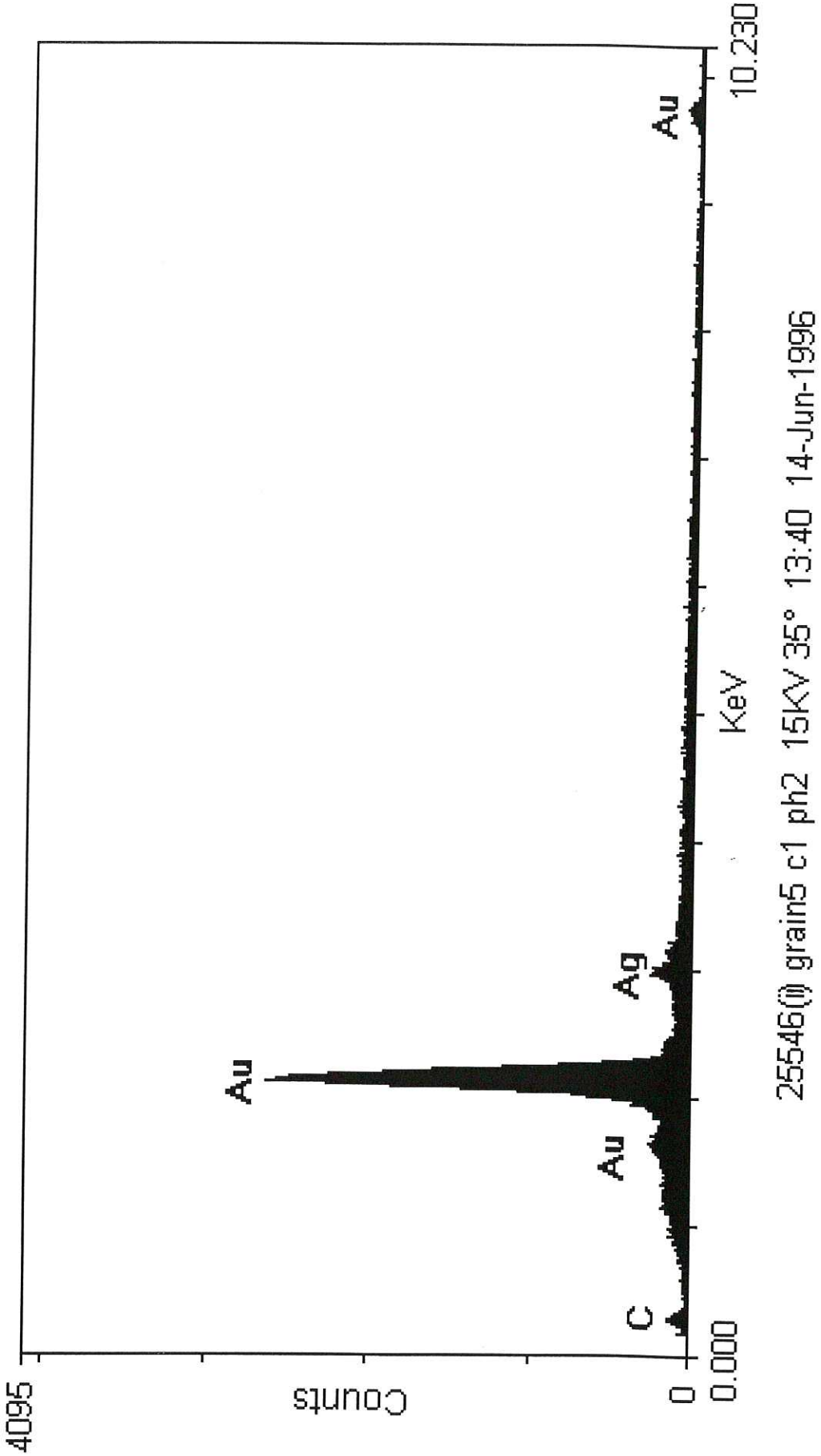

4095
Counts
0
0.000
C
Au
Au
Ag
KeV
Au
10.230
25546(0) grain5 c1 ph2 15KV 35° 13:40 14-Jun-1996

Fig 47

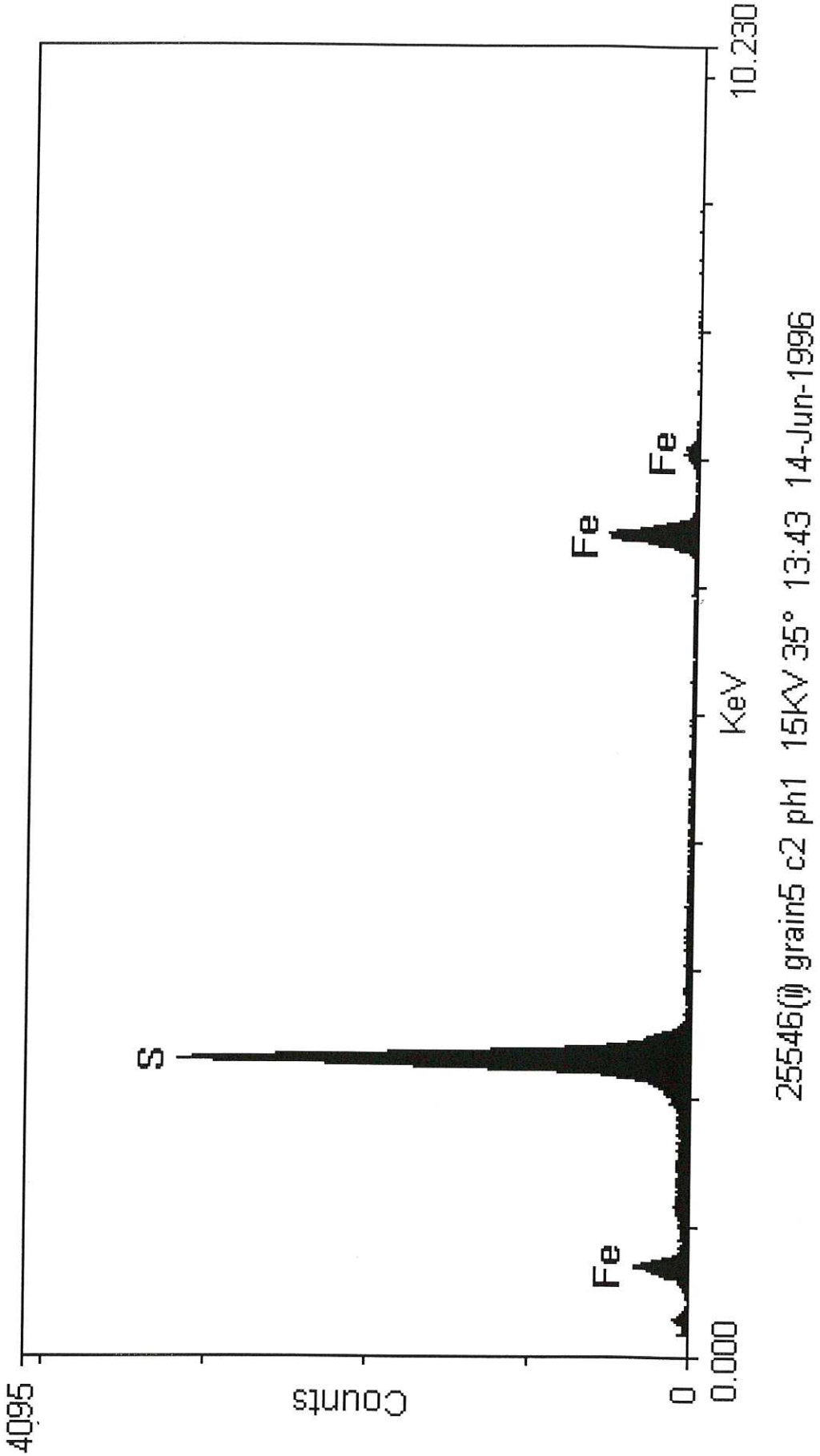

4095
Counts
0
0.000
Fe
S
Fe
Fe
KeV
10.230
25546(0) grain5 c2 ph1 15KV 35° 13:43 14-Jun-1996

Fig 48

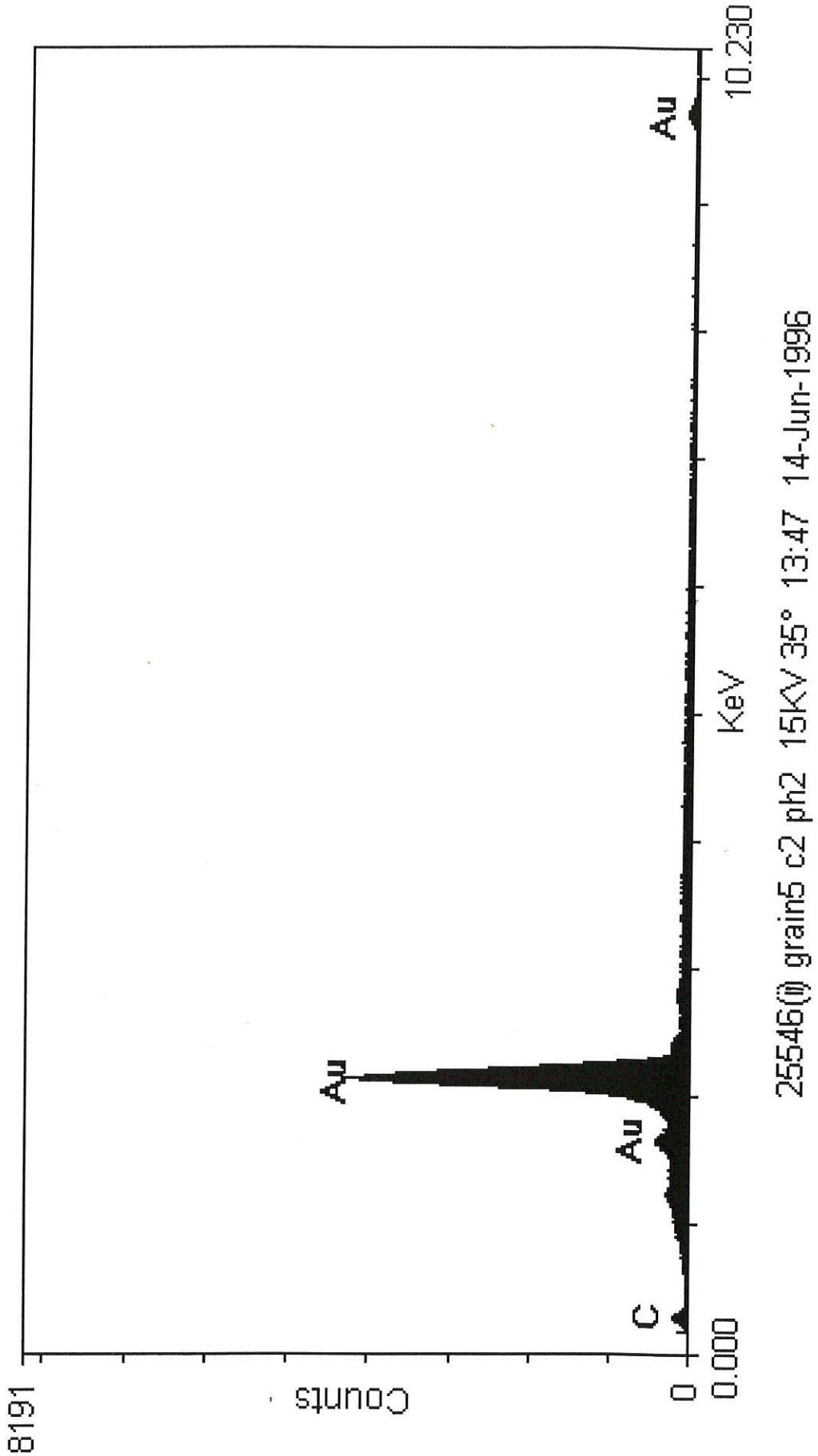

8191
Counts
0
0.000
C
Au
Au
Au
10.230
KeV
25546(ii) grain5 c2 ph2 15KV 35° 13:47 14-Jun-1996

Fig 49

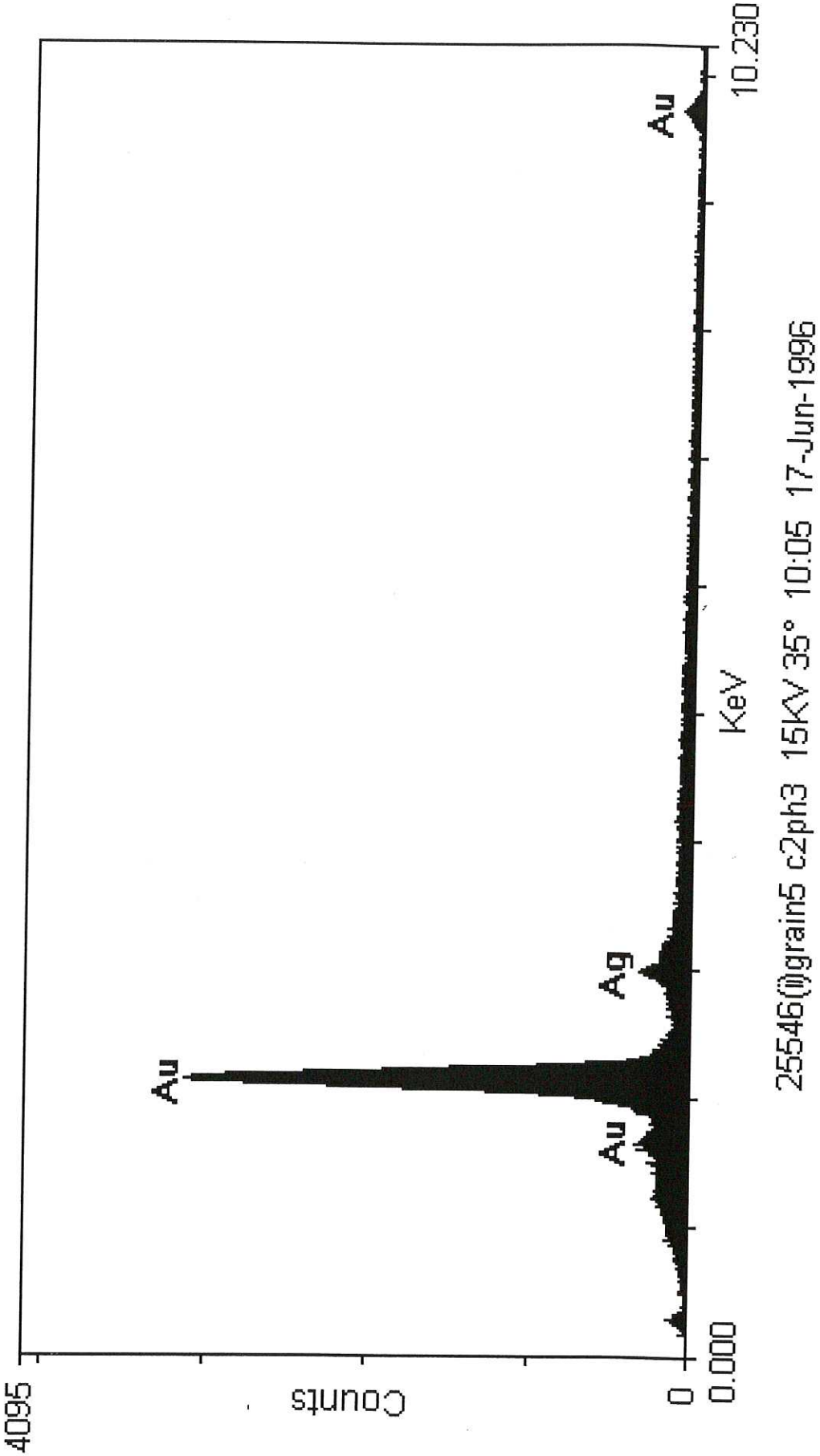

4095
Counts
0
0.000
Au
Au
Ag
Au
KeV
10.230
25546(i)grain5 c2ph3 15KV 35° 10:05 17-Jun-1996

Fig 50

Plate 1

SEM photomicrographs of inclusions within sectioned gold nuggets, Comet Conglomerate, Bamboo Creek Area, Pilbara, W.A.

[MRL25546 (i)]

Bar scales shown in microns; individual photomicrographs arranged left to right:

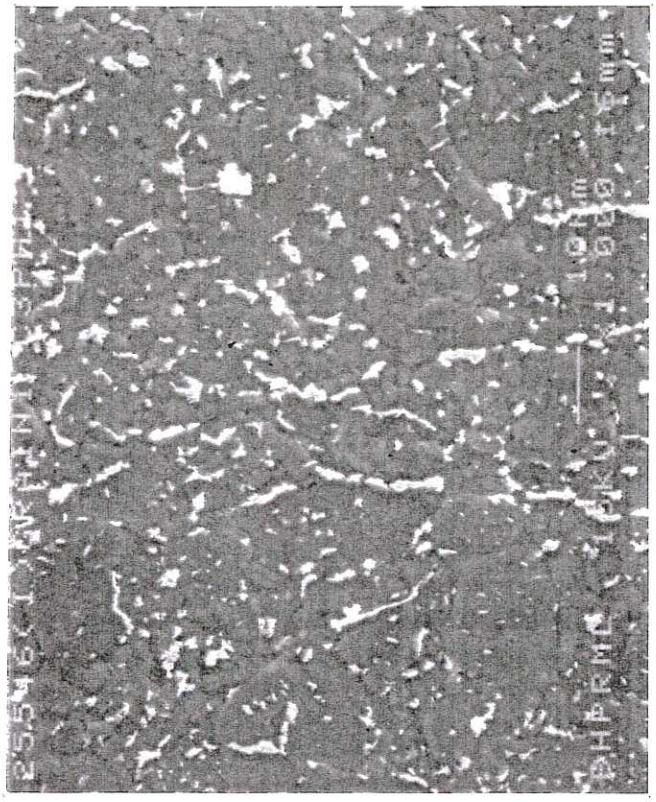
a Minute inclusions of supergene pure gold (white) within kaolinitic clay (grey). This intergrowth is located within a nugget of silver-bearing gold. Grain 1, C3, phases 1, 1b.

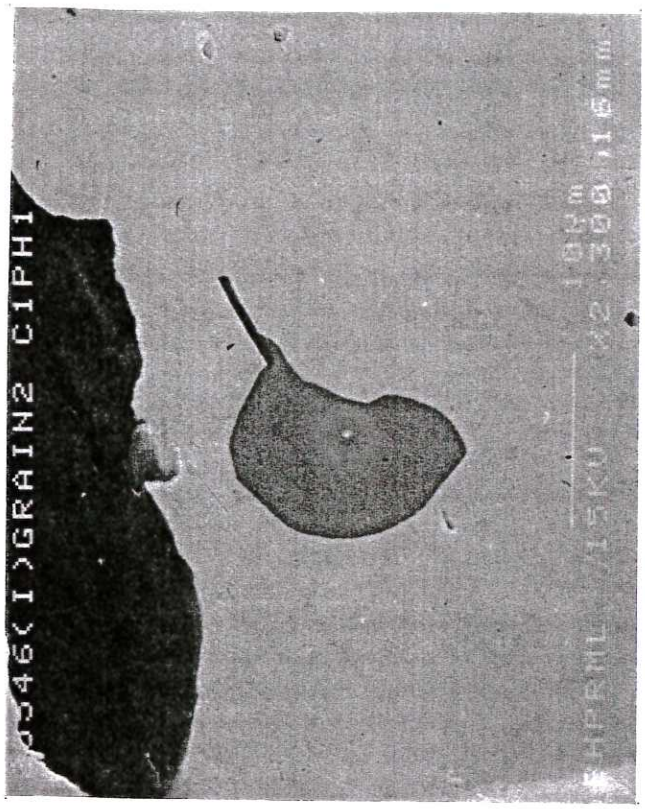
b Inclusion of chalcopyrite (centre, medium grey) within pure gold (light grey) Grain 2, C1, phase 1.

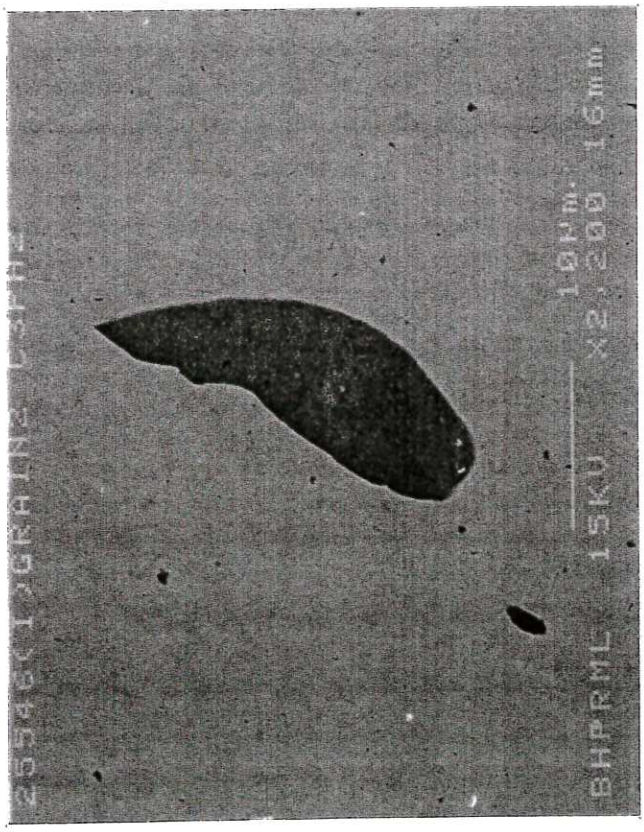
c Inclusion of chalcopyrite (medium grey) in pure gold (light grey). Grain 2, C3, phase 2.

d Euhedral orthorhombic crystal of cobaltite (Co As S) within pure gold. Grain 2, C4, phase 1.

1


BHPRML 15KU 10µm


GRAIN2 C1PH1
BHPRML 15KU X2,300 10µm 16mm


BHPRML 15KU X2,200 10µm 16mm

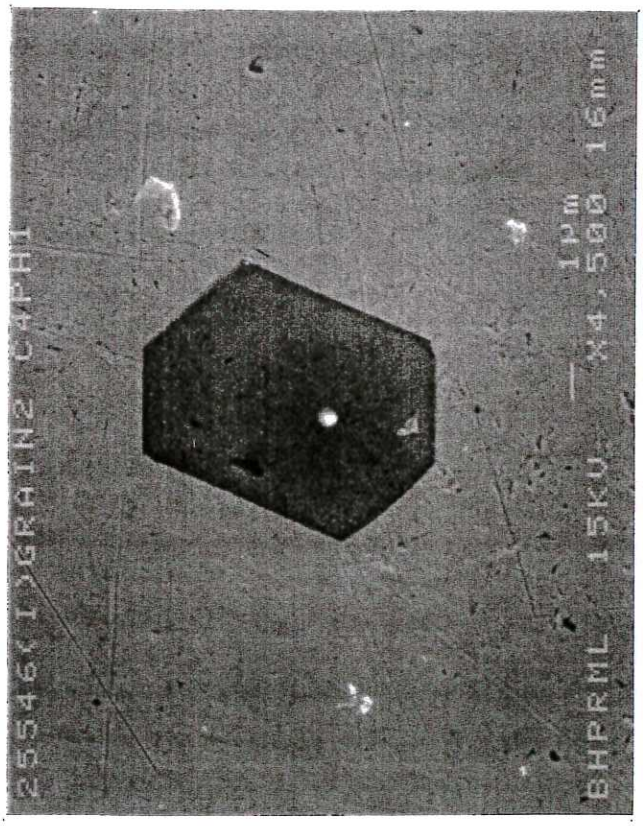

GRAIN2 C4PH1
BHPRML 15KU X4,500 1µm 16mm

Plate 2

SEM photomicrographs of inclusions and associated gangue minerals, sectioned gold nuggets, Comet Conglomerate, Bamboo Creek Area, Pilbara, W.A.

[MRL25546 (ii)]

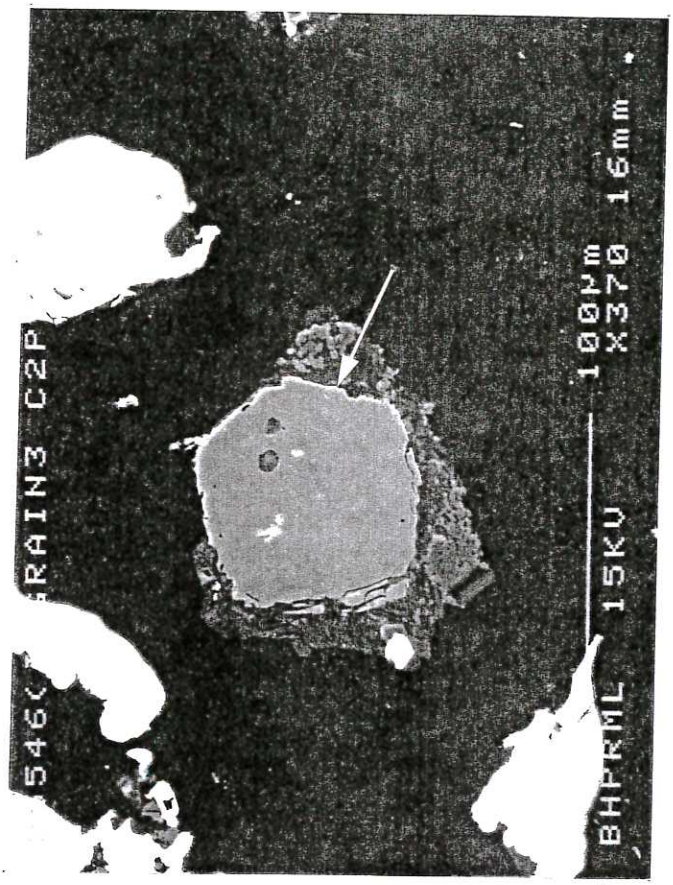
Bar scales shown in microns; individual photomicrographs arranged left to right:

a Detrital grain of chrome spinel (see arrow) with two minute inclusions of a sodium magnesium aluminium silicate phase (? dravite) adjacent to silver-bearing gold (white). Grain 3, C2, phase 1, 1b.

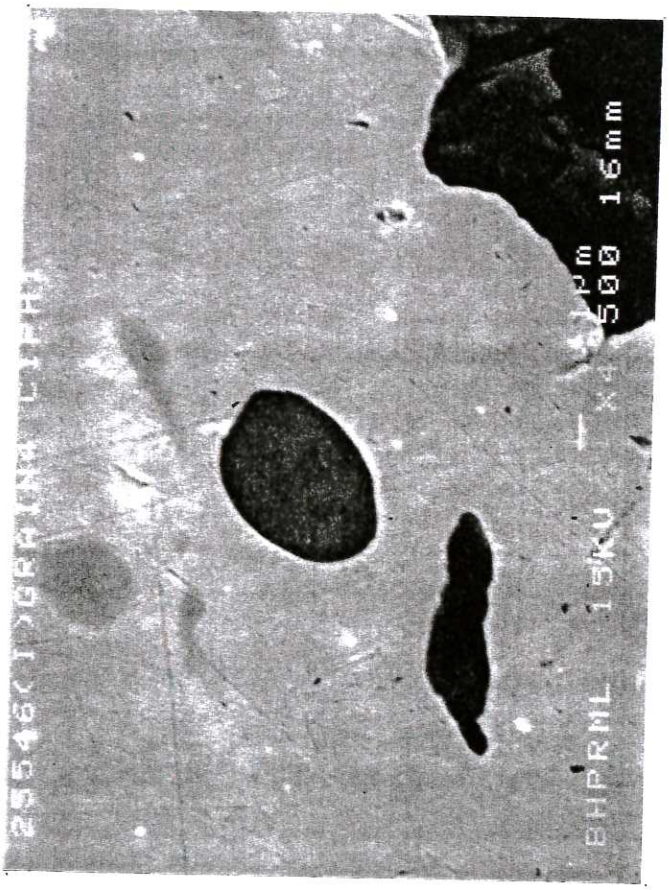
b Inclusions of a copper-tin phase of uncertain origin (medium grey) within silver-bearing gold (light grey). Grain 3, C3, phase 1.

c Subrounded inclusion of chalcopyrite (dark grey) in silver-bearing gold (light-grey). Grain 4, C1, phase 1.

d Inclusion of galena (medium grey) in silver-bearing gold (light grey). Grain 4, C3, phase 1.


546C
RAIN3 C2P
100µm
X370 16mm
BHPRML 15KV


BHPRML


BHPRML 15KV
16mm

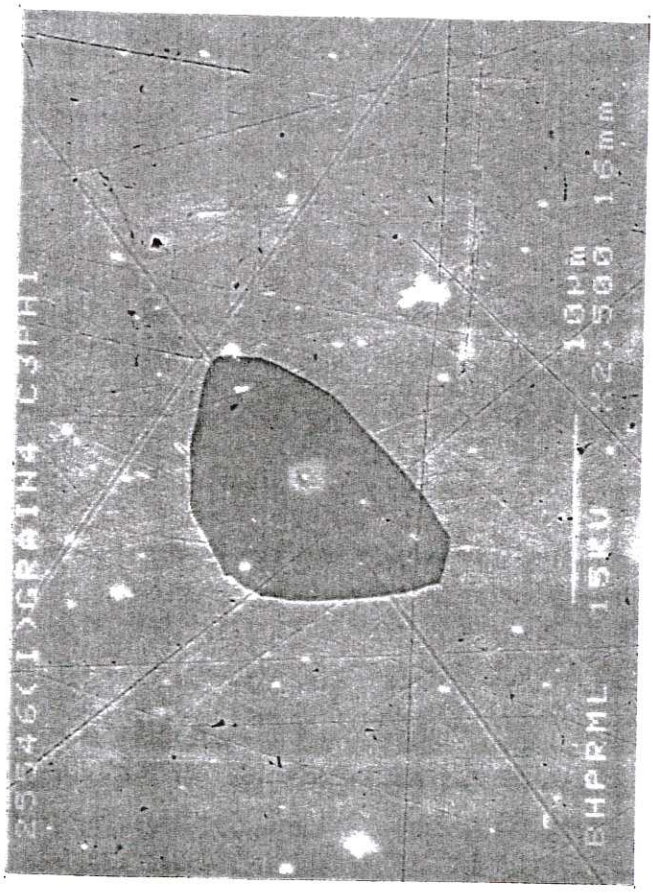

BHPRML 15KV
10µm
2,500 16mm

Plate 3

SEM photomicrographs of inclusions within a sectioned gold nugget, Comet Conglomerate, Bamboo Creek Area, Pilbara, W.A.

[MRL25546 (ii)]

Bar scales shown in microns.

a Inclusion of chalcopyrite (darker grey) within silver-bearing gold (lighter grey). Grain 5, C1, phase 1.

b Inclusion of pyrite (darker grey) in silver-bearing gold (lighter grey). Grain 5, C2, phase 1.