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Coal remains a primary fuel for power generation. Herein we present time-of-flight secondary ion mass spectra (ToF-SIMS data) taken with a Ga primary ion beam from ca. 30 coal specimens. These commercially different coal specimens were obtained from coal mining companies and/or power plants. They represent all major coal types used in power generation (bituminous coals, subbituminous coals, and lignites), and include low-rank materials (lignites and subbituminous coals), which are represented as a minor portion of the data. Often, inorganic ions (Na^+, Al^+, Si^+, and K^+) are pronounced in the spectra, overshadowing peaks from organic moieties. This reflects the high sensitivity of SIMS under our analysis conditions for these inorganic species. These results, including a previous, published chemometrics analysis of this data (L. Pei, G. Jiang, B. J. Tyler, L. L. Baxter, and M. R. Linford, Energy & Fuels 2008, 22, 1059), suggest that ToF-SIMS can be a useful method for coal analysis. © *2010 American Vacuum Society*.
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Accession #s 01112, 01113, 01114, 01115, 01116, 01117, 01118, 01119, 01120, 01121, 01122, 01123, 01124, 01125, 01126, 01127, 01128, 01129, 01130, 01131, 01132, 01133, 01134, 01135, 01136, 01137, 01138, 01139, 01140, 01141, 01142, 01143, 01144, 01145, 01146, 01147

Technique: ToF-SIMS

Host Material: #01112: coal SS01; #01113: coal SS02; #01114: coal SS03; #01115: coal SS04; #01116: coal SS05; #01117: coal SS06; #01118: coal SS07; #01119 coal SS08; #01120: coal SS09; #01121: coal SS10; #01122: coal SS11; #01123: coal SS12; #01124: coal SS13; #01125: coal SS14; #01126: coal SS15; #01127: coal SS16; #01128: coal SS17; #01129: coal SS18; #01130: coal SS19; #01131: coal BT; #01132: coal CJR012; #01133: coal GAT034; #01134: coal GAT035; #01135: coal GBJ010; #01136: coal GLJ005; #01137: coal GPB062; #01138: coal HGB011; #01139: coal HNA015; #01140: coal ILL6; #01141: coal JIG014; #01142: coal JIG017; #01143: coal PCT010; #01144: coal PCT012; #01145: coal RBL014; #01146: coal RLL012; #01147: coal RLL014;

Instrument: ION-TOF TOF-SIMS IV

Major Elements in Spectrum: C, H

Minor Elements in Spectrum:

Printed Spectra: 57

Spectra in Electronic Record: 155

Spectral Category: technical

INTRODUCTION

ToF-SIMS (time-of-flight secondary ion mass spectrometry) (Ref. 1) is a highly sophisticated and powerful analytical method that is currently undergoing constant improvements in both its equipment and data analysis. Indeed, SIMS has been applied to numerous interfaces and materials, including coal (Refs. 2–6). ToF-SIMS is conceptually simple; a surface is first irradiated with a primary ion beam. Both the positive and negative secondary ions that are generated as a result of these collisions can then be mass analyzed. The resulting secondary ions are often rich in chemical information about the original surface or material.

Herein we report a ToF-SIMS study of ca. 30 different coal samples. This contribution follows a paper we recently published (L. Pei, G. Jiang, B. J. Tyler, L. L. Baxter, and M. R. Linford, Energy & Fuels 2008, 22, 1059), which presents a chemometrics (statistical) analysis of the raw data presented in this work. For our analysis, both the positive and negative ion spectra were, in general, collected on each sample at three different $500\mu m \times 500\mu m$ spots. For the most part, these replicate analyses were very similar, although in some cases the spectra suggested chemical differences between the analysis regions. This result seems reasonable given the inherent complexity of coal even after our careful grinding/sample preparation. The positive ion spectra of the coal samples often show strong inorganic peaks from Na^+, K^+, Si^+, Al^+, Ca^+, Fe^+, etc., along with other organic/hydrocarbon signals. Some of the spectra also contain a peak at m/z = 180, which may have the formula $C_{14}H_{12}$, and/or $C_{12}H_8N_2$ (Ref. 7). The signal at m/z = 105 is also unknown (it is not labeled in the spectra) and may be due to C_7H_5O and/or C_8H_9. The main peaks in the negative ion spectra are at m/z = 0–20, where H^-, CH^-, O^-, and OH^- are often prominent. Of course, peak intensities do vary somewhat from analysis region to analysis region. Because of the similarity between the negative ion spectra, only one such spectrum (1112-3) is published in this contribution as a representative

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example. (Nevertheless, the remaining negative ion spectra (and similarly positive ion spectra) are archived with this SSS contribution.)

More traditional analyses were also used to characterize coal for the organic (C, H, O, N, S) and inorganic (Si, Al, Fe, Ti, Na, K, Ca, Mg, S, P) ash-forming compounds, the moisture content, the heat of combustion, the softening/melting behavior under oxidizing and reducing conditions, and also the degree of thermal decomposition under standard conditions. Of these measurements, only the moisture is directly tied to a chemical entity and not an element, where this lack of chemical information makes it challenging to predict the thermal decomposition and/or chemical reactions that these fuels experience upon combustion. In other words, such highly complex, and often multiphase reactions are a function of the speciation and/or chemical natures of the fuels, which characteristics cannot typically be predicted solely on elemental analyses. In our work we have found that our ToF-SIMS results often correlate with the results from the more traditional analyses of the coal specimens. As an example, the samples that produce larger amounts of ash have ToF-SIMS spectra with more pronounced inorganic signals. Thus, the purpose of our investigation is to understand the degree to which SIMS can provide additional information regarding coal composition, which will lead to a deeper understanding of its combustion.

SPECIMEN DESCRIPTION (ACCESSION #S 01112, 01113, 01114, 01115, 01116, 01117, 01118, 01119, 01120, 01121, 01122, 01123, 01124, 01125, 01126, 01127, 01128, 01129, 01130, 01131, 01132, 01133, 01134, 01135, 01136, 01137, 01138, 01139, 01140, 01141, 01142, 01143, 01144, 01145, 01146, 01147)

Host Material: Coal

CAS Registry #: N/A

Host Material Characteristics: inhomogeneous, solid, amorphous, composite, powder

Chemical Name: Coal

Source: Alliant Power Systems, Southern Company and Tennessee Valley

Host Composition: C, H, O, Na, K, Si, Al, Ca, Fe

Form: powder

Structure: N/A

History and Significance: Fuel rank is undoubtedly the most common descriptor of coal. Rank increases in the order of lignite, subbituminous coal, bituminous coal, and anthracite, with the middle two ranks representing by far the most significant division in terms of coal. There are subranks within each division. The following shows the rank of each coal sample. SS01: a medium volatile bituminous coal. SS02: a semianthracite coal. SS03: a high volatile B bituminous coal. SS04: a low volatile bituminous coal. SS05: a low volatile bituminous coal. SS06: a medium volatile bituminous coal. SS07: a medium volatile bituminous coal. SS08: a low volatile bituminous coal. SS09: a high volatile A bituminous coal. SS10: a medium volatile bituminous coal. SS11: a subbituminous B coal. SS12: a subbituminous C coal. SS13: a subbituminous C coal. SS14: a subbituminous C coal. SS15: a lignite A coal. SS16: a high volatile B bituminous coal. SS17: a high volatile B bituminous coal. SS17: a high volatile A bituminous coal. SS19: a high volatile B bituminous coal. Blackthunder: a subbituminous coal. CJR012: a high volatile A bituminous coal. GAT034: a medium volatile bituminous coal. GAT035: a medium volatile bituminous coal. GBJ010:a high volatile A bituminous coal. GLJ005: a high volatile A bituminous coal. GPB062: a high volatile B bituminous coal. HGB011: a high volatile B bituminous coal. HNA015: a high volatile A bituminous coal. ILL6: a bituminous coal. JIG014: a high volatile A bituminous coal. JIG017: a medium volatile bituminous coal. PCT010: a high volatile A bituminous coal. PCT012: a medium volatile bituminous coal. RBL014: a high volatile A bituminous coal. RLL012: a medium volatile bituminous coal. RLL014: a high volatile A bituminous coal.

As Received Condition: powder in a sealed bottle

Analyzed Region: same as host material

***Ex Situ* Preparation/Mounting:** ground into fine powder with a mortar and pestle, then mounted onto a silicon substrate with double-sided tape

***In Situ* Preparation:** N/A

Charge Control: A charge control flood gun was used. Anode voltage 300 V; Wehnelt voltage 73 V; current 2.2 A; no target bias or metal screen. The same charge control conditions are used for all non-conductive samples.

Temp. During Analysis: 298 K

Pressure During Analysis: $< 2.0 \times 10^{6}$ Pa

INSTRUMENT DESCRIPTION

Manufacturer and Model: ION-TOF TOF-SIMS IV

Analyzer Type: time-of-flight, reflectron

Experiment Type: static

Charge Control/conditions and Procedures: A charge control flood gun was used. Anode voltage 300 V; Wehnelt voltage 73 V; current 2.2 A; no target bias or metal screen. The same charge control conditions are used for all non-conductive samples.

Sample Voltage Offset Range: sample was grounded

Energy Acceptance Window: n/a

Detector Description: electron multiplier

Detected Sample Dimensions: 500 μm $\times$ 500 μm

Live Time: 100%

Analyzer Mass Resolution: $\sim$5000 m/Δm

Mass Used to Determine Resolution: 28 Da

Sample Bias: 0 V

Specimen Normal to Analyzer (Θe): 0°

***ION GUNS*:**

Number of Ion Guns Used: 1

Ion Gun No.: 1

Purpose: primary beam

Manufacturer and Model: ION-TOF 2 lens Ga gun

Beam Mass Filter: none

Beam Species: Ga^{+}

Beam Gating Used: yes

Beam Comment: blanked and then bunched

Beam Voltage: 25,000 V

Net Beam Voltage: 25,000 V

Ion Pulse Length: 25×10^{-9} sec

Ion Pulse Rate: 10,000 Hz

Beam Current: 1.5 nA

Current Measurement Method: Faraday Cup

Beam Diameter: 0.1 μm

Beam Raster Size: 500 μm $\times$ 500 μm

Beam Incident Angle: 45°

Effective Beam Incident Angle: 45°

Source to Analyzer Angle: 45°

Specimen Azimuthal Angle: 45°

CALIBRATION

Mass Range Calibration: Calibration was based on the peaks H^+, C^+, CH^+, CH_2^+, CH_3^+, Na^+, Si^+, K^+, Ga^+ for positive spectra; H^-, C^-, CH^-, O^-, OH^-, C_2^-, $^{35}Cl^-$, C_3^-, $^{37}Cl^-$ for negative spectra

Detector Saturation: n/a

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SPECTRAL FEATURES TABLE

Spectrum ID #	Species	Source	Mass	Label
1112-1	Al	SS01	26.98	Al
1112-1	Si	SS01	27.98	Si
1112-1	K	SS01	38.96	K
1112-1	C_3H_5	SS01	41.04	C_3H_5
1112-1	Fe	SS01	55.94	Fe
1112-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS01	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1112-2	Al	SS01	26.98	Al
1112-2	Si	SS01	27.98	Si
1112-2	K	SS01	38.96	K
1112-2	C_3H_5	SS01	41.04	C_3H_5
1112-2	Fe	SS01	55.94	Fe
1112-2	C_4H_9	SS01	57.06	C_4H_9
1112-2	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS01	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1112-3	H	SS01	1.01	H
1112-3	CH	SS01	13.01	CH
1112-3	O	SS01	15.99	O
1112-3	OH	SS01	17.00	OH
1113-1	Na	SS02	22.99	Na
1113-1	Al	SS02	26.98	Al
1113-1	Si	SS02	27.98	Si
1113-1	K	SS02	38.96	K
1114-1	Al	SS03	26.98	Al
1114-1	Si	SS03	27.98	Si
1114-1	K	SS03	38.96	K
1114-1	C_3H_5	SS03	41.04	C_3H_5
1114-1	Fe	SS03	55.94	Fe
1114-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS03	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1114-2	Al	SS03	26.98	Al
1114-2	Si	SS03	27.98	Si
1114-2	K	SS03	38.96	K
1114-2	C_3H_5	SS03	41.04	C_3H_5
1114-2	C_3H_7	SS03	43.05	C_3H_7
1114-2	Fe	SS03	55.94	Fe
1114-2	C_6H_5	SS03	77.03	C_6H_5
1114-2	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS03	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1114-3	Al	SS03	26.98	Al
1114-3	Si	SS03	27.98	Si
1114-3	C_2H_5	SS03	29.04	C_2H_5
1114-3	K	SS03	38.96	K
1114-3	C_3H_5	SS03	41.04	C_3H_5
1114-3	C_3H_7	SS03	43.05	C_3H_7
1114-3	C_4H_7	SS03	55.05	C_4H_7
1114-3	Fe	SS03	55.94	Fe
1114-3	C_4H_9	SS03	57.07	C_4H_9
1114-3	C_6H_5	SS03	77.03	C_6H_5

SPECTRAL FEATURES TABLE (CONT.)

Spectrum ID #	Species	Source	Mass	Label
1114-3	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS03	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1115-1	Na	SS04	22.99	Na
1115-1	Al	SS04	26.98	Al
1115-1	Si	SS04	27.98	Si
1115-1	K	SS04	38.96	K
1115-1	Fe	SS04	55.94	Fe
1116-1	Al	SS05	26.98	Al
1116-1	Si	SS05	27.98	Si
1116-1	C_2H_5	SS05	29.04	C_2H_5
1116-1	K	SS05	38.96	K
1116-1	C_3H_5	SS05	41.04	C_3H_5
1116-1	C_3H_7	SS05	43.05	C_3H_7
1116-1	Fe	SS05	55.94	Fe
1116-1	C_4H_9	SS05	57.07	C_4H_9
1116-1	C_6H_5	SS05	77.03	C_6H_5
1116-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS05	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1116-2	Al	SS05	26.98	Al
1116-2	Si	SS05	27.98	Si
1116-2	C_2H_5	SS05	29.04	C_2H_5
1116-2	K	SS05	38.96	K
1116-2	C_3H_5	SS05	41.04	C_3H_5
1116-2	Fe	SS05	55.94	Fe
1116-2	C_6H_5	SS05	77.03	C_6H_5
1116-2	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS05	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1117-1	Al	SS06	26.98	Al
1117-1	Si	SS06	27.98	Si
1117-1	C_2H_5	SS06	29.04	C_2H_5
1117-1	K	SS06	38.96	K
1117-1	Fe	SS06	55.94	Fe
1117-1	$C_4H_{12}N$	SS06	74.10	$C_4H_{12}N$
1117-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS06	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1118-1	Na	SS07	22.99	Na
1118-1	Al	SS07	26.98	Al
1118-1	Si	SS07	27.98	Si
1118-1	K	SS07	38.96	K
1118-1	C_3H_5	SS07	41.04	C_3H_5
1118-1	C_3H_7	SS07	43.05	C_3H_7
1118-1	C_4H_7	SS07	55.05	C_4H_7
1118-1	Fe	SS07	55.94	Fe
1118-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS07	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1118-2	Na	SS07	22.99	Na
1118-2	Al	SS07	26.98	Al
1118-2	Si	SS07	27.98	Si
1118-2	K	SS07	38.96	K
1118-2	Fe	SS07	55.94	Fe

SPECTRAL FEATURES TABLE (CONT.)

Spectrum ID #	Species	Source	Mass	Label
1119-1	Na	SS08	22.99	Na
1119-1	Al	SS08	26.98	Al
1119-1	Si	SS08	27.98	Si
1119-1	K	SS08	38.96	K
1119-1	Fe	SS08	55.94	Fe
1119-1	C_6H_5	SS08	77.03	C_6H_5
1120-1	Na	SS09	22.99	Na
1120-1	Al	SS09	26.98	Al
1120-1	Si	SS09	27.98	Si
1120-1	K	SS09	38.96	K
1121-1	Na	SS10	22.99	Na
1121-1	Al	SS10	26.98	Al
1121-1	Si	SS10	27.98	Si
1121-1	K	SS10	38.96	K
1121-1	Fe	SS10	55.94	Fe
1121-2	Na	SS10	22.99	Na
1121-2	Al	SS10	26.98	Al
1121-2	Si	SS10	27.98	Si
1121-2	K	SS10	38.96	K
1121-2	Fe	SS10	55.94	Fe
1122-1	C_2H_3	SS11	27.02	C_2H_3
1122-1	C_3H_5	SS11	41.04	C_3H_5
1122-1	C_3H_7	SS11	43.05	C_3H_7
1122-1	C_4H_9	SS11	57.07	C_4H_9
1122-2	C_2H_3	SS11	27.02	C_2H_3
1122-2	C_3H_5	SS11	41.04	C_3H_5
1122-2	C_3H_7	SS11	43.05	C_3H_7
1122-2	C_4H_9	SS11	57.07	C_4H_9
1122-2	C_6H_5	SS11	77.03	C_6H_5
1122-3	Na	SS11	22.99	Na
1122-3	Al	SS11	26.98	Al
1122-3	Si	SS11	27.98	Si
1122-3	K	SS11	38.96	K
1123-1	Na	SS12	22.99	Na
1123-1	Al	SS12	26.98	Al
1123-1	Si	SS12	27.98	Si
1123-1	K	SS12	38.96	K
1124-1	C_2H_3	SS13	27.03	C_2H_3
1124-1	C_3H_5	SS13	41.04	C_3H_5
1124-1	C_3H_7	SS13	43.05	C_3H_7
1124-1	C_4H_9	SS13	57.07	C_4H_9
1125-1	Na	SS14	22.99	Na
1125-1	C_2H_3	SS14	27.03	C_2H_3
1125-1	C_3H_5	SS14	41.04	C_3H_5
1125-1	C_3H_7	SS14	43.05	C_3H_7

SPECTRAL FEATURES TABLE (CONT.)

Spectrum ID #	Species	Source	Mass	Label
1125-1	C_4H_9	SS14	57.07	C_4H_9
1125-2	C_2H_3	SS14	27.03	C_2H_3
1125-2	C_3H_5	SS14	41.04	C_3H_5
1125-2	C_3H_7	SS14	43.05	C_3H_7
1125-2	C_4H_9	SS14	57.07	C_4H_9
1126-1	C_2H_5	SS15	29.04	C_2H_5
1126-1	C_3H_5	SS15	41.04	C_3H_5
1126-1	C_3H_7	SS15	43.05	C_3H_7
1126-1	C_4H_9	SS15	57.07	C_4H_9
1127-1	Na	SS16	22.99	Na
1127-1	Al	SS16	26.98	Al
1127-1	Si	SS16	27.98	Si
1127-1	K	SS16	38.96	K
1127-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS16	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1128-1	Na	SS17	22.99	Na
1128-1	Al	SS17	26.98	Al
1128-1	Si	SS17	27.98	Si
1128-1	K	SS17	38.96	K
1128-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS17	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1129-1	Na	SS18	22.99	Na
1129-1	Al	SS18	26.98	Al
1129-1	Si	SS18	27.98	Si
1129-1	K	SS18	38.96	K
1129-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS18	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1129-2	Na	SS18	22.99	Na
1129-2	Al	SS18	26.98	Al
1129-2	K	SS18	38.96	K
1129-2	C_3H_5	SS18	41.04	C_3H_5
1129-2	C_4H_9	SS18	57.07	C_4H_9
1129-2	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS18	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1130-1	Na	SS19	22.99	Na
1130-1	Al	SS19	26.98	Al
1130-1	Si	SS19	27.98	Si
1130-1	K	SS19	38.96	K
1130-1	$C_{14}H_{12}$ or $C_{12}H_8N_2$	SS19	180.08	$C_{14}H_{12}$ or $C_{12}H_8N_2$
1131-1	Na	blackthunder	22.99	Na
1131-1	Al	blackthunder	26.98	Al
1131-1	Si	blackthunder	27.98	Si
1131-1	K	blackthunder	38.96	K
1131-1	Fe	blackthunder	55.94	Fe
1132-1	Na	CJR012	22.99	Na
1132-1	Al	CJR012	26.98	Al
1132-1	Si	CJR012	27.98	Si
1132-1	K	CJR012	38.96	K
1132-1	Fe	CJR012	55.94	Fe

SPECTRAL FEATURES TABLE (CONT.)

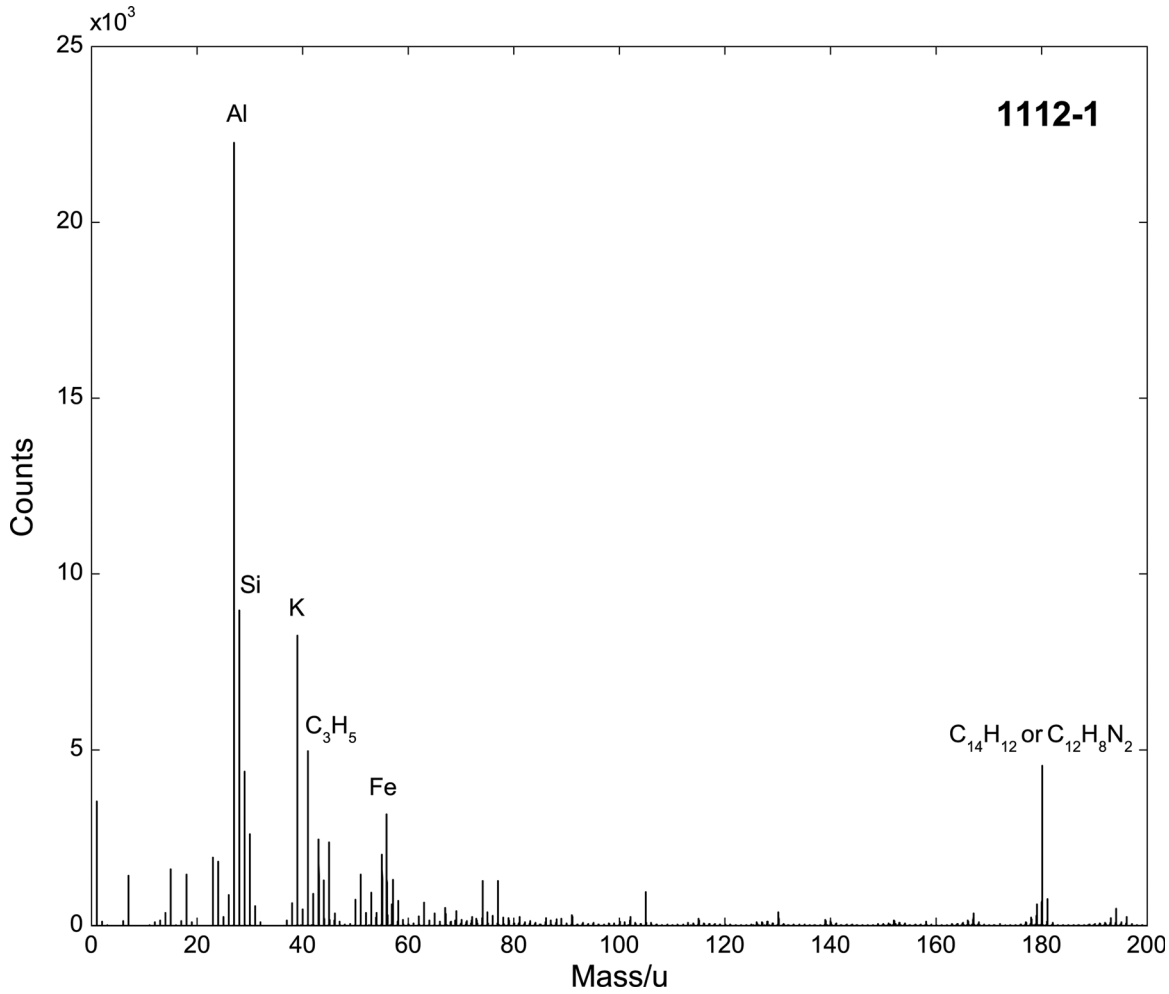
Spectrum ID #	Species	Source	Mass	Label
1133-1	Al	GAT034	26.98	Al
1133-1	Si	GAT034	27.98	Si
1133-1	K	GAT034	38.96	K
1133-1	Fe	GAT034	55.94	Fe
1133-2	Na	GAT034	22.99	Na
1133-2	Al	GAT034	26.98	Al
1133-2	Si	GAT034	27.98	Si
1133-2	K	GAT034	38.96	K
1133-2	Fe	GAT034	55.94	Fe
1134-1	Al	GAT035	26.98	Al
1134-1	Si	GAT035	27.98	Si
1134-1	K	GAT035	38.96	K
1134-2	Na	GAT035	22.99	Na
1134-2	Al	GAT035	26.98	Al
1134-2	Si	GAT035	27.98	Si
1134-2	K	GAT035	38.96	K
1135-1	Na	GBJ010	22.99	Na
1135-1	Al	GBJ010	26.98	Al
1135-1	Si	GBJ010	27.98	Si
1135-1	K	GBJ010	38.96	K
1136-1	Na	GLJ005	22.99	Na
1136-1	Al	GLJ005	26.98	Al
1136-1	Si	GLJ005	27.98	Si
1136-1	K	GLJ005	38.96	K
1136-1	Fe	GLJ005	55.94	Fe
1136-2	Na	GLJ005	22.99	Na
1136-2	Al	GLJ005	26.98	Al
1136-2	Si	GLJ005	27.98	Si
1136-2	K	GLJ005	38.96	K
1136-2	Fe	GLJ005	55.94	Fe
1137-1	Al	GPB062	26.98	Al
1137-1	Si	GPB062	27.98	Si
1137-1	K	GPB062	38.96	K
1137-1	Fe	GPB062	55.94	Fe
1137-2	Al	GPB062	26.98	Al
1137-2	Si	GPB062	27.98	Si
1137-2	C_2H_5	GPB062	29.04	C_2H_5
1137-2	K	GPB062	38.96	K
1137-2	C_3H_5	GPB062	41.04	C_3H_5
1137-2	Fe	GPB062	55.94	Fe
1138-1	Al	HGB011	26.98	Al
1138-1	Si	HGB011	27.98	Si
1138-1	K	HGB011	38.96	K
1138-1	Fe	HGB011	55.94	Fe
1139-1	Al	HNA015	26.98	Al

SPECTRAL FEATURES TABLE (CONT.)

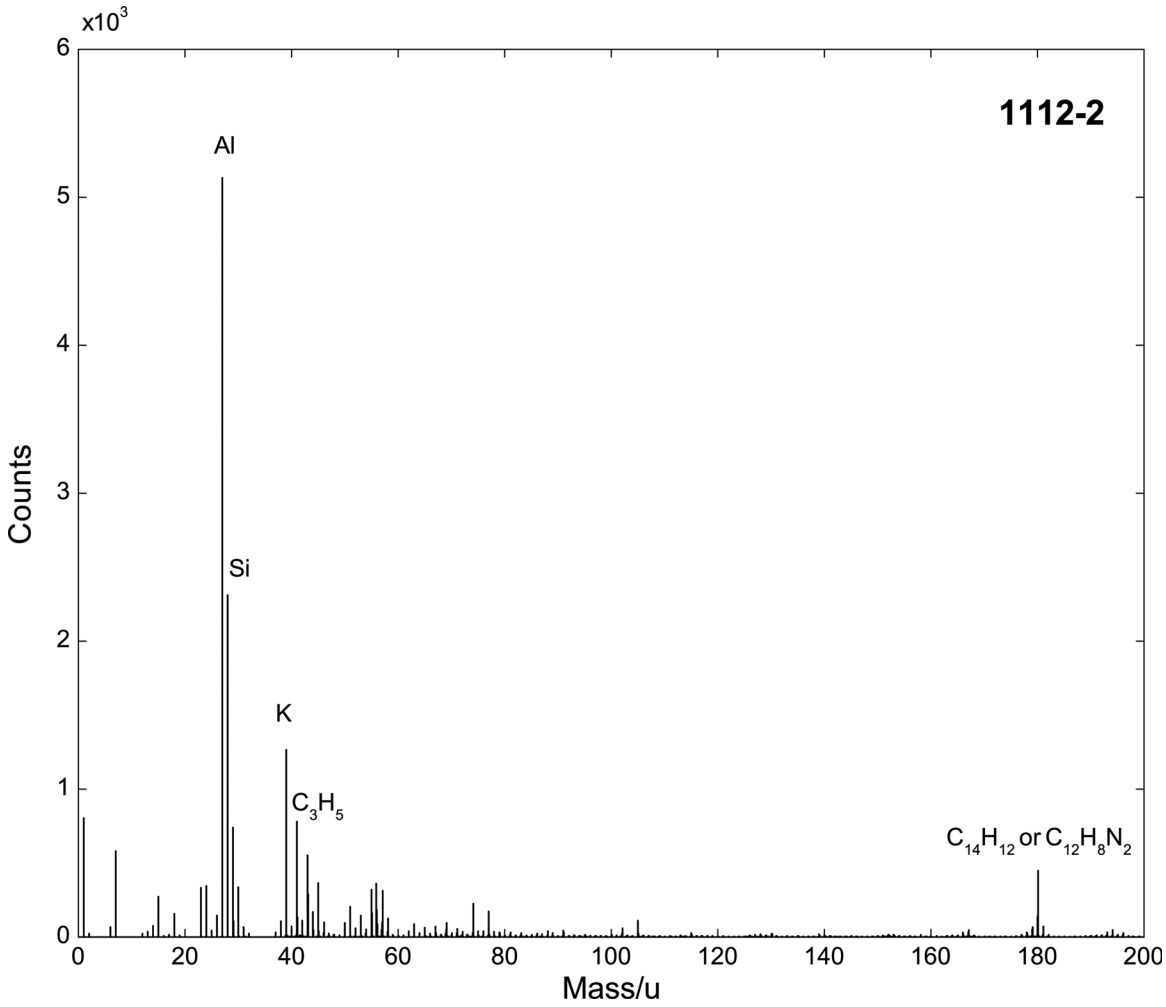
Spectrum ID #	Species	Source	Mass	Label
1139-1	Si	HNA015	27.98	Si
1139-1	K	HNA015	38.96	K
1139-1	Fe	HNA015	55.94	Fe
1140-1	Na	ILL6	22.99	Na
1140-1	Al	ILL6	26.98	Al
1140-1	Si	ILL6	27.98	Si
1140-1	K	ILL6	38.96	K
1140-1	Fe	ILL6	55.94	Fe
1140-2	Na	ILL6	22.99	Na
1140-2	Al	ILL6	26.98	Al
1140-2	Si	ILL6	27.98	Si
1140-2	K	ILL6	38.96	K
1140-2	Fe	ILL6	55.94	Fe
1141-1	Na	JIG014	22.99	Na
1141-1	Al	JIG014	26.98	Al
1141-1	Si	JIG014	27.98	Si
1141-1	K	JIG014	38.96	K
1141-1	Fe	JIG014	55.94	Fe
1141-2	Na	JIG014	22.99	Na
1141-2	Al	JIG014	26.98	Al
1141-2	Si	JIG014	27.98	Si
1141-2	K	JIG014	38.96	K
1141-2	Fe	JIG014	55.94	Fe
1142-1	Na	JIG017	22.99	Na
1142-1	Al	JIG017	26.98	Al
1142-1	Si	JIG017	27.98	Si
1142-1	K	JIG017	38.96	K
1142-1	Fe	JIG017	55.94	Fe
1143-1	Al	PCT010	26.98	Al
1143-1	Si	PCT010	27.98	Si
1143-1	K	PCT010	38.96	K
1143-1	Fe	PCT010	55.94	Fe
1143-2	Al	PCT010	26.98	Al, C_2H_3
1143-2	C_2H_3	PCT010	27.03	Al, C_2H_3
1143-2	Si	PCT010	27.98	Si
1143-2	C_2H_5	PCT010	29.04	C_2H_5
1143-2	K	PCT010	38.96	K
1143-2	C_3H_5	PCT010	41.04	C_3H_5
1143-2	C_4H_7	PCT010	55.05	C_4H_7
1144-1	Al	PCT012	26.98	Al
1144-1	Si	PCT012	27.98	Si
1144-1	K	PCT012	38.96	K
1144-1	Fe	PCT012	55.94	Fe
1144-2	Na	PCT012	22.99	Na
1144-2	Al	PCT012	26.98	Al

SPECTRAL FEATURES TABLE (CONT.)

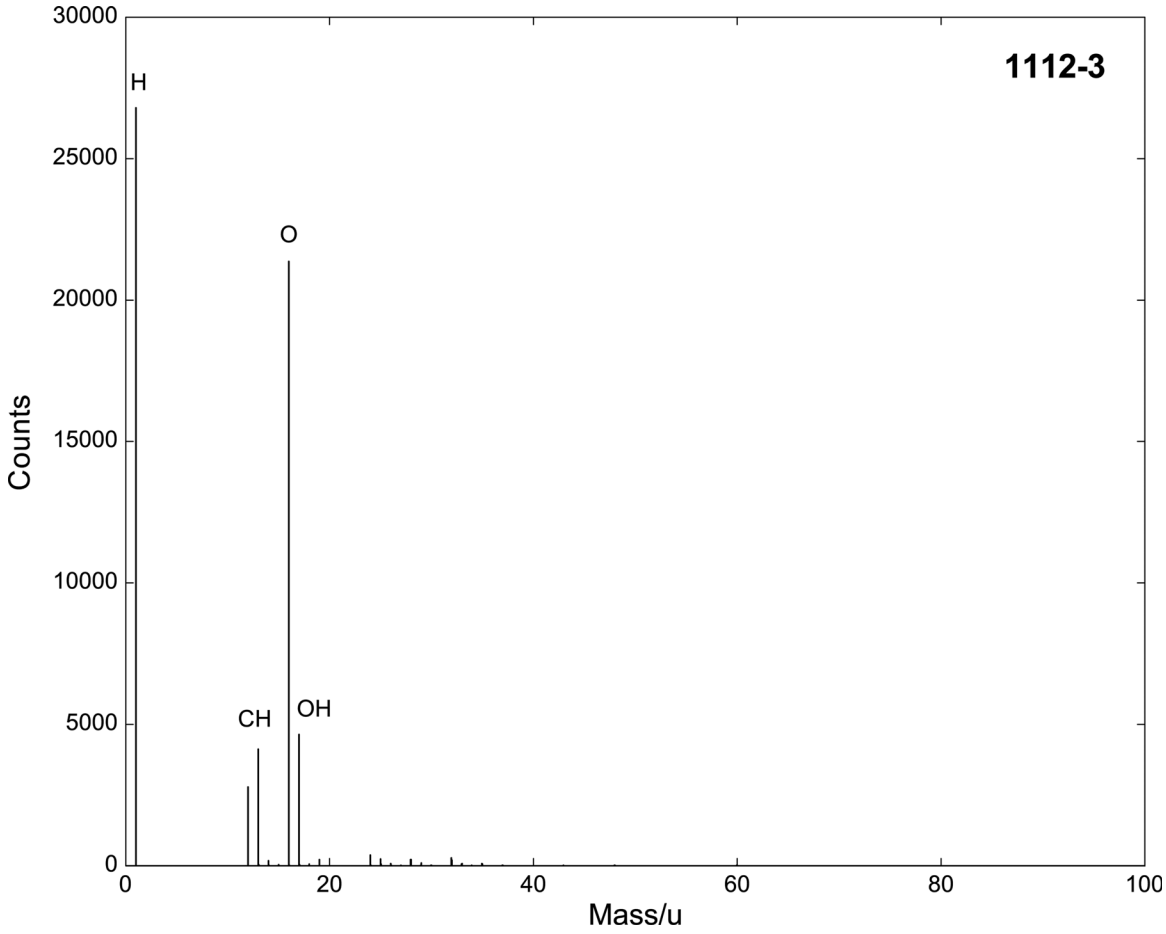
Spectrum ID #	Species	Source	Mass	Label
1144-2	Si	PCT012	27.98	Si
1144-2	K	PCT012	38.96	K
1144-2	Fe	PCT012	55.94	Fe
1145-1	Na	RBL014	22.99	Na
1145-1	Al	RBL014	26.98	Al
1145-1	Si	RBL014	27.98	Si
1145-1	K	RBL014	38.96	K
1145-1	Fe	RBL014	55.94	Fe
1146-1	Na	RLL012	22.99	Na
1146-1	Al	RLL012	26.98	Al
1146-1	Si	RLL012	27.98	Si
1146-1	K	RLL012	38.96	K
1146-1	Fe	RLL012	55.94	Fe
1146-2	Na	RLL012	22.99	Na
1146-2	Al	RLL012	26.98	Al
1146-2	Si	RLL012	27.98	Si
1146-2	K	RLL012	38.96	K
1146-2	Fe	RLL012	55.94	Fe
1147-1	Na	RLL014	22.99	Na
1147-1	Al	RLL014	26.98	Al
1147-1	Si	RLL014	27.98	Si
1147-1	K	RLL014	38.96	K
1147-1	Fe	RLL014	55.94	Fe
1147-2	Na	RLL014	22.99	Na
1147-2	Al	RLL014	26.98	Al
1147-2	Si	RLL014	27.98	Si
1147-2	K	RLL014	38.96	K



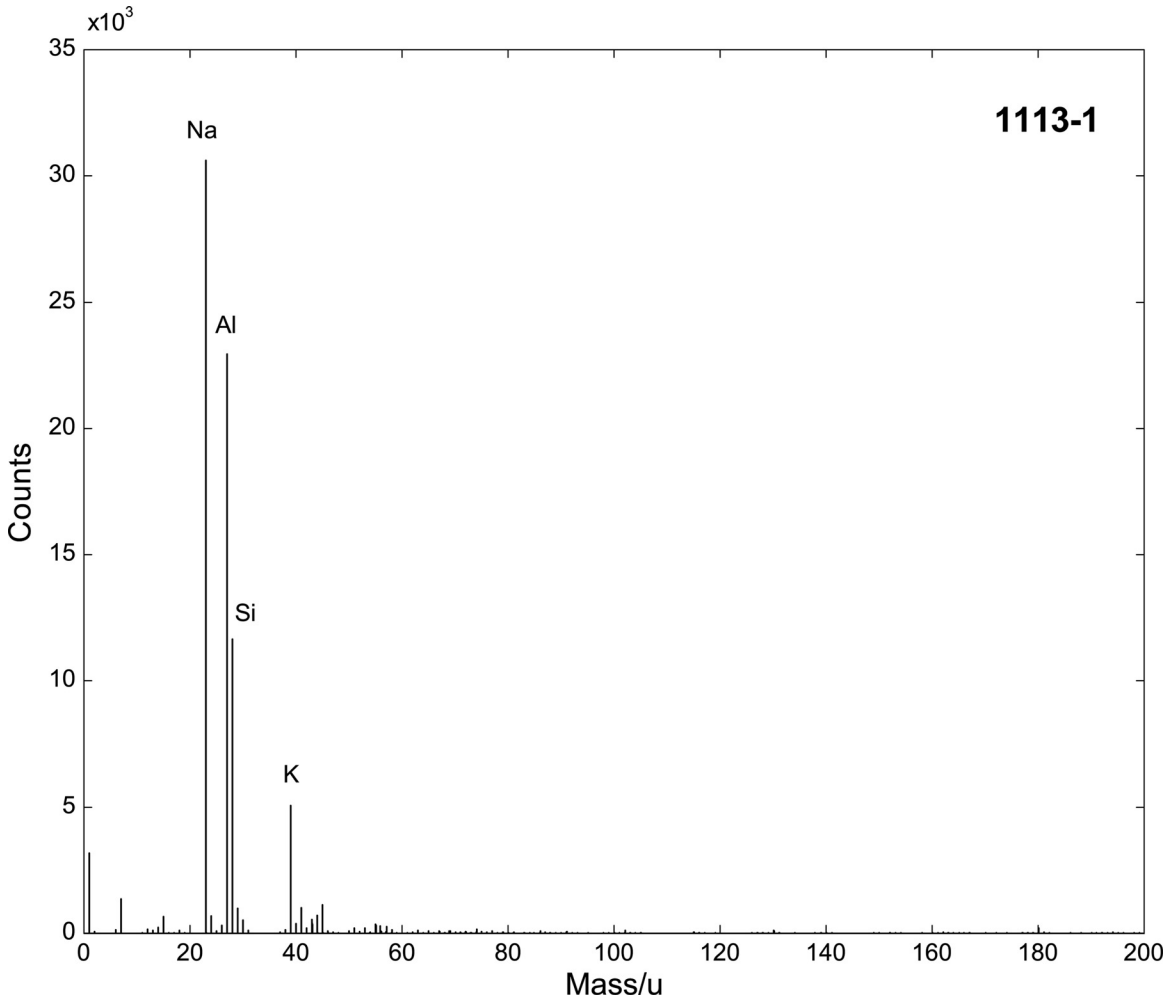
Accession #	01112–01
Host Material	Coal SS01
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



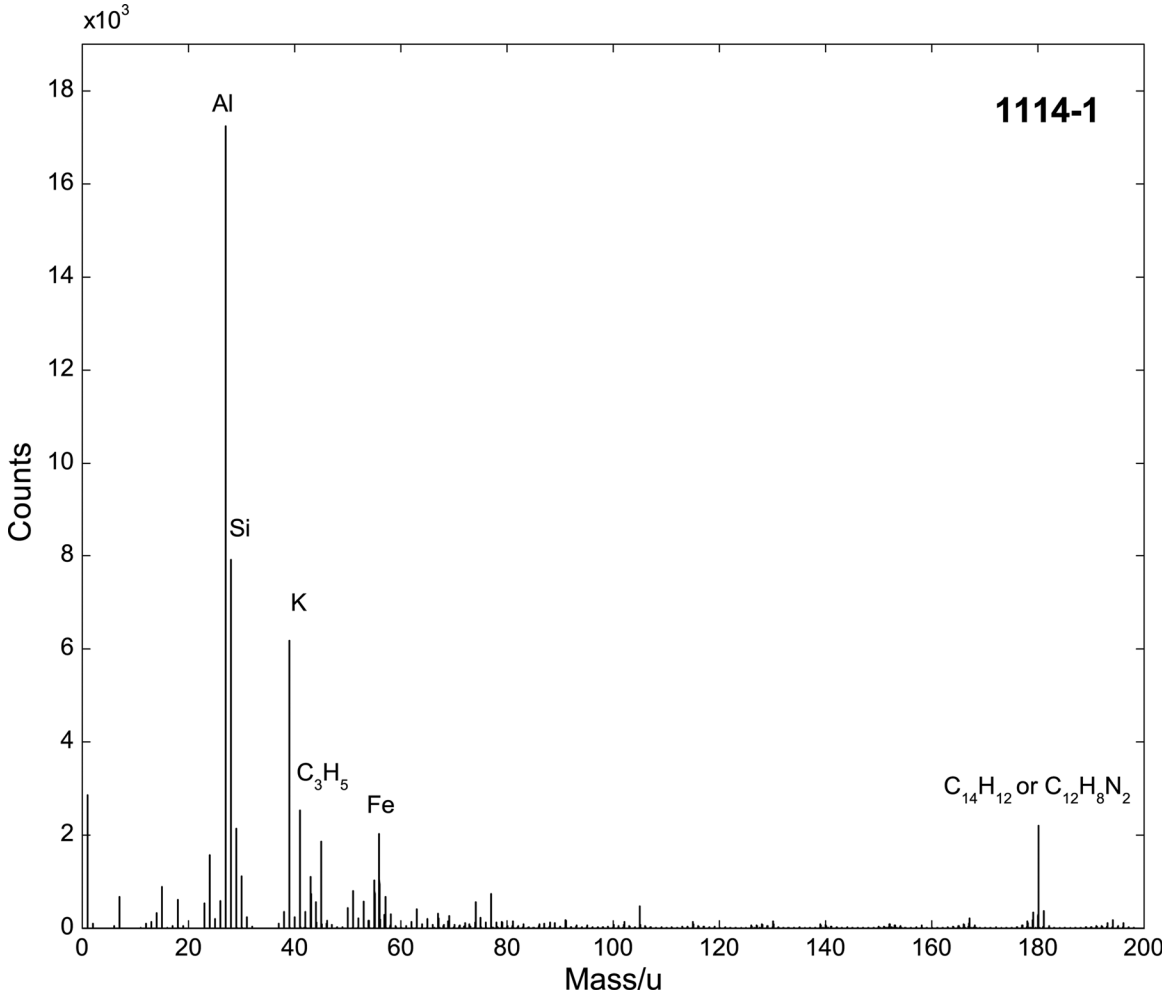
Accession #	01112–02
Host Material	Coal SS01
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



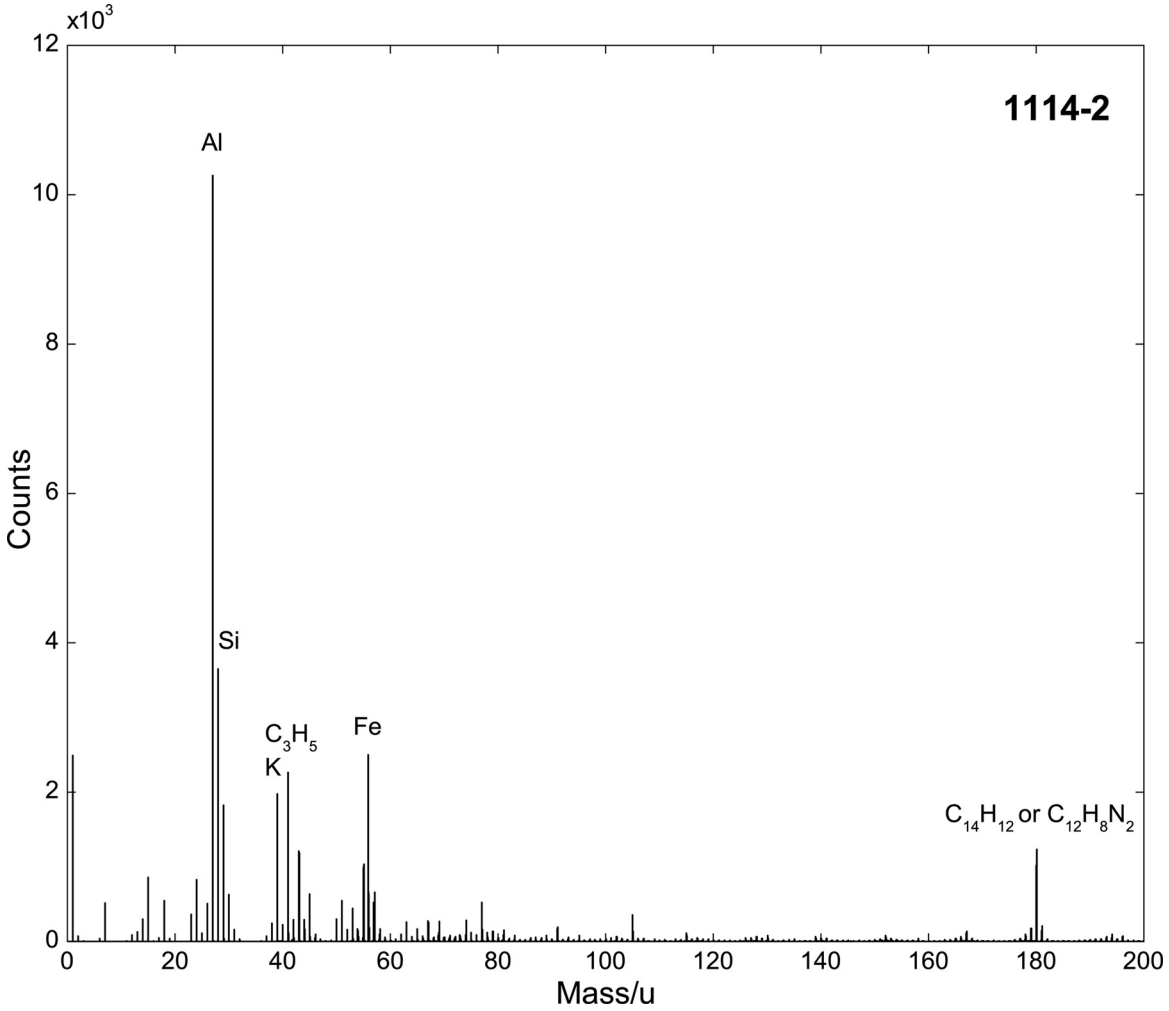
Accession #	01112–03
Host Material	Coal SS01
Technique	ToF-SIMS
Mass Range	100 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



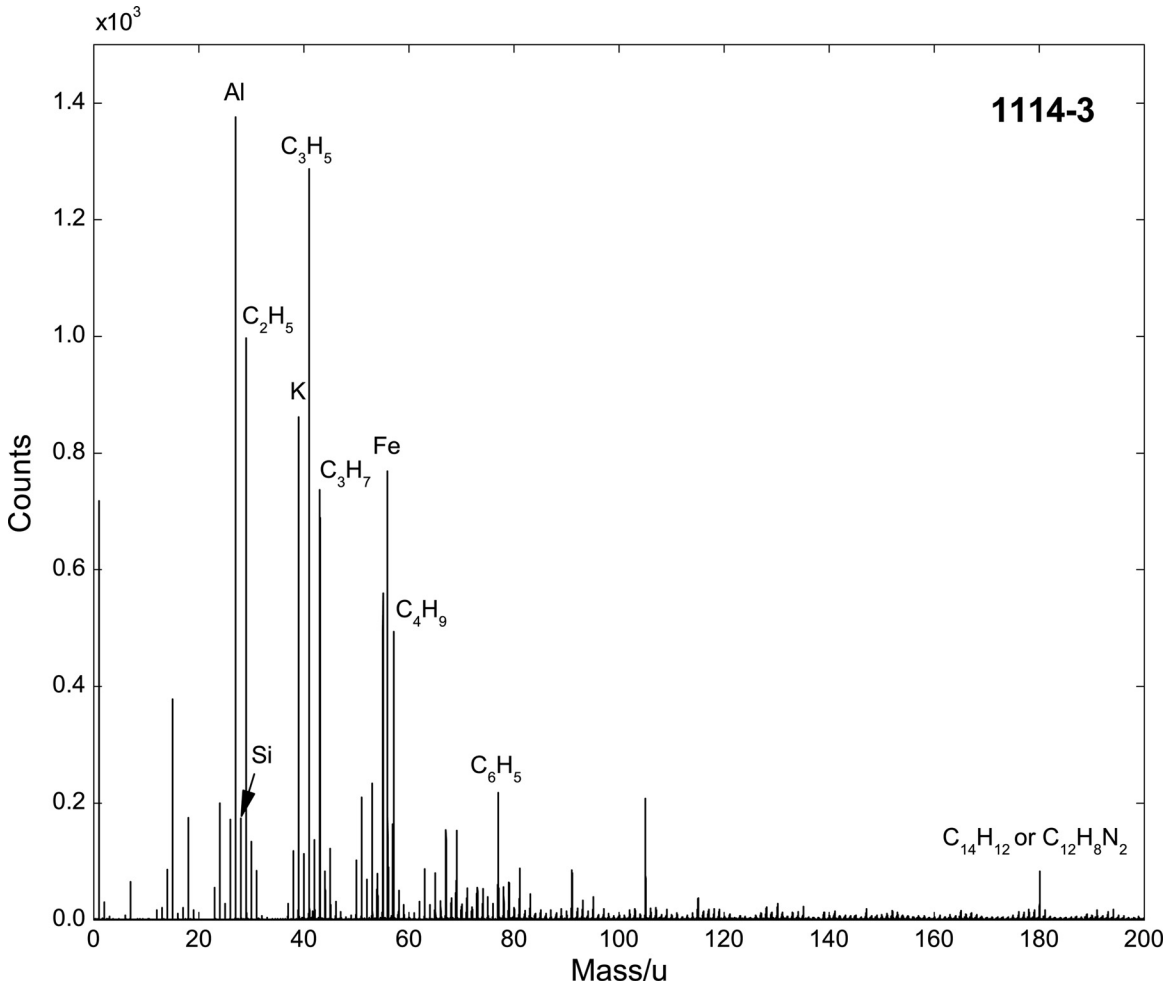
Accession #	01113–01
Host Material	Coal SS02
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



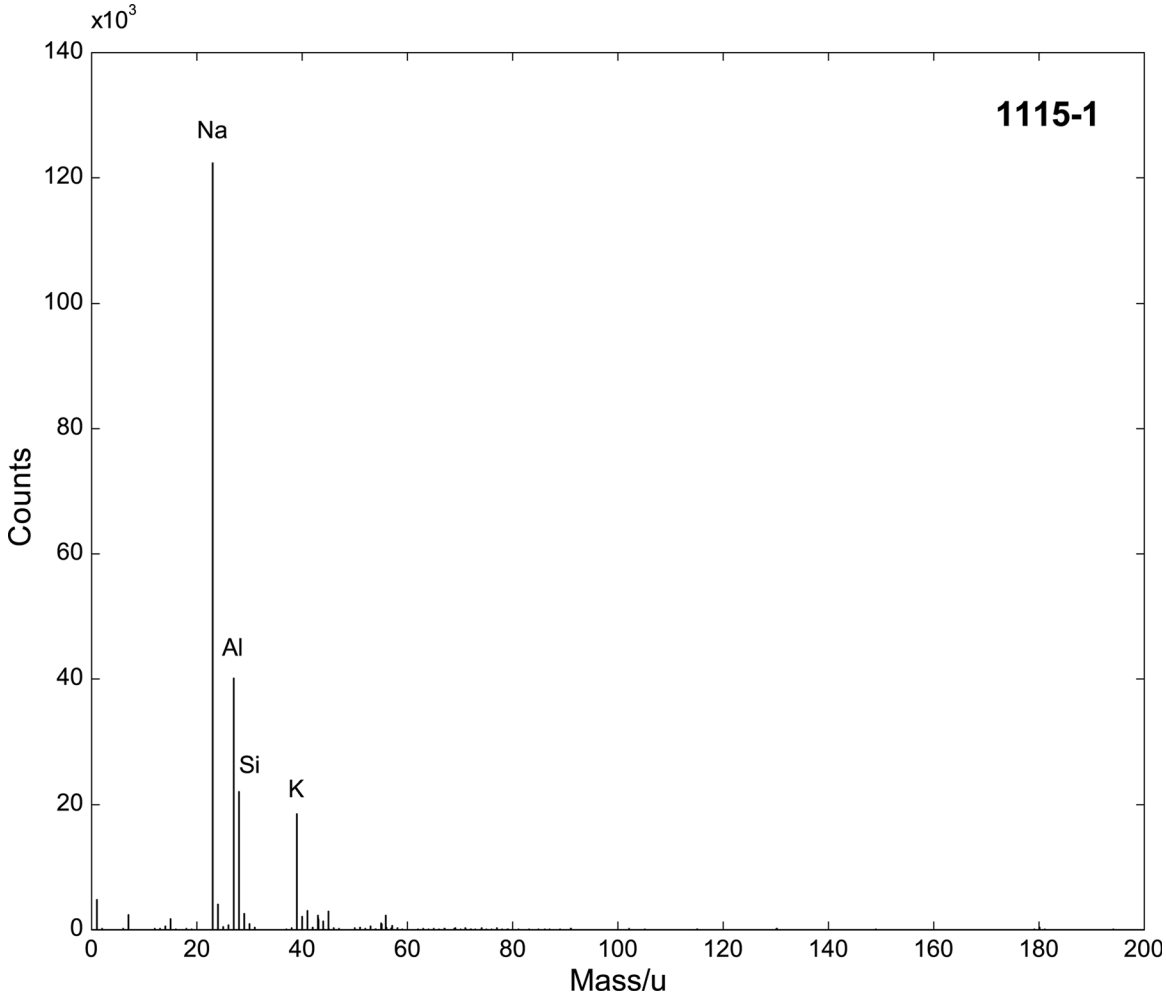
Accession #	01114–01
Host Material	Coal SS03
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



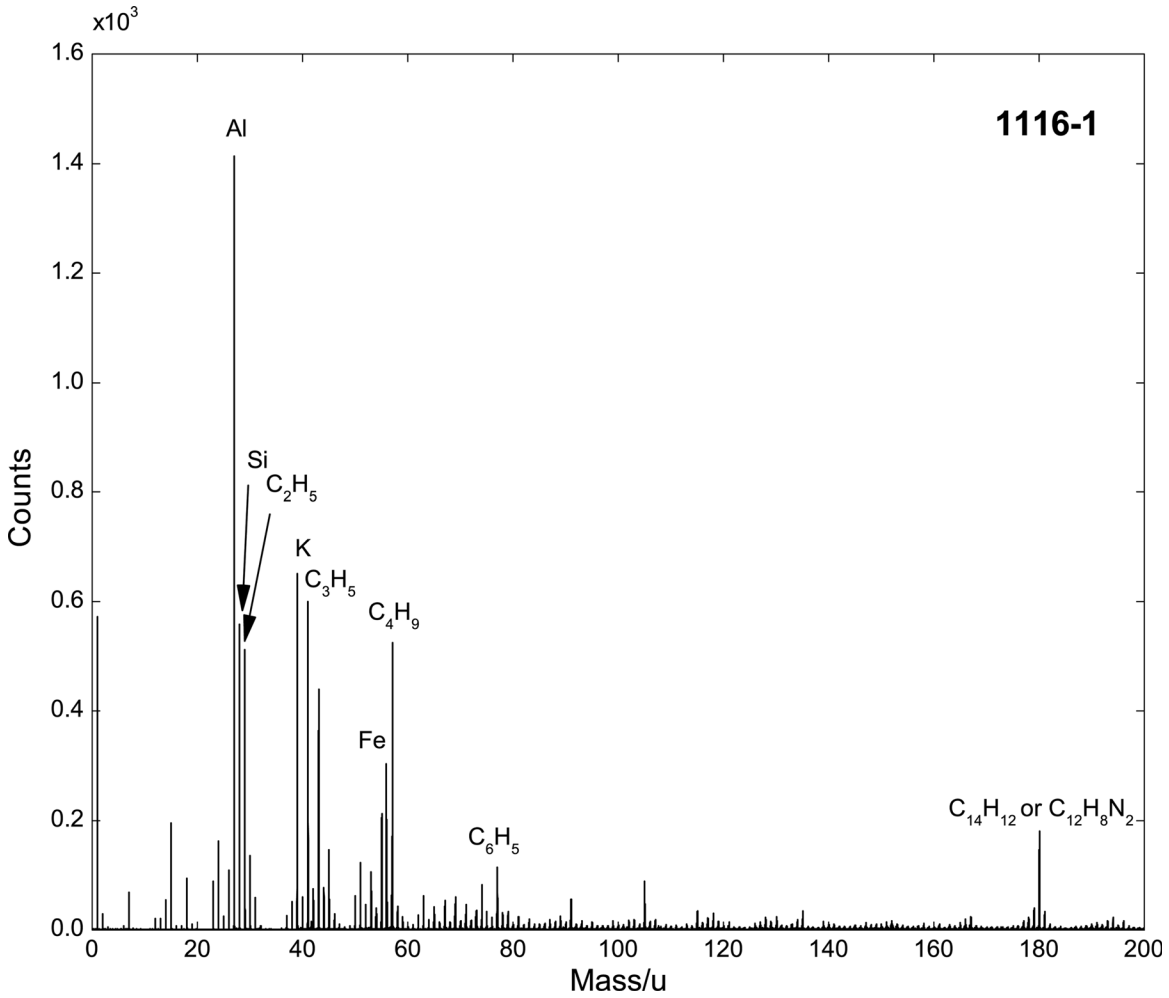
Accession #	01114–02
Host Material	Coal SS03
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



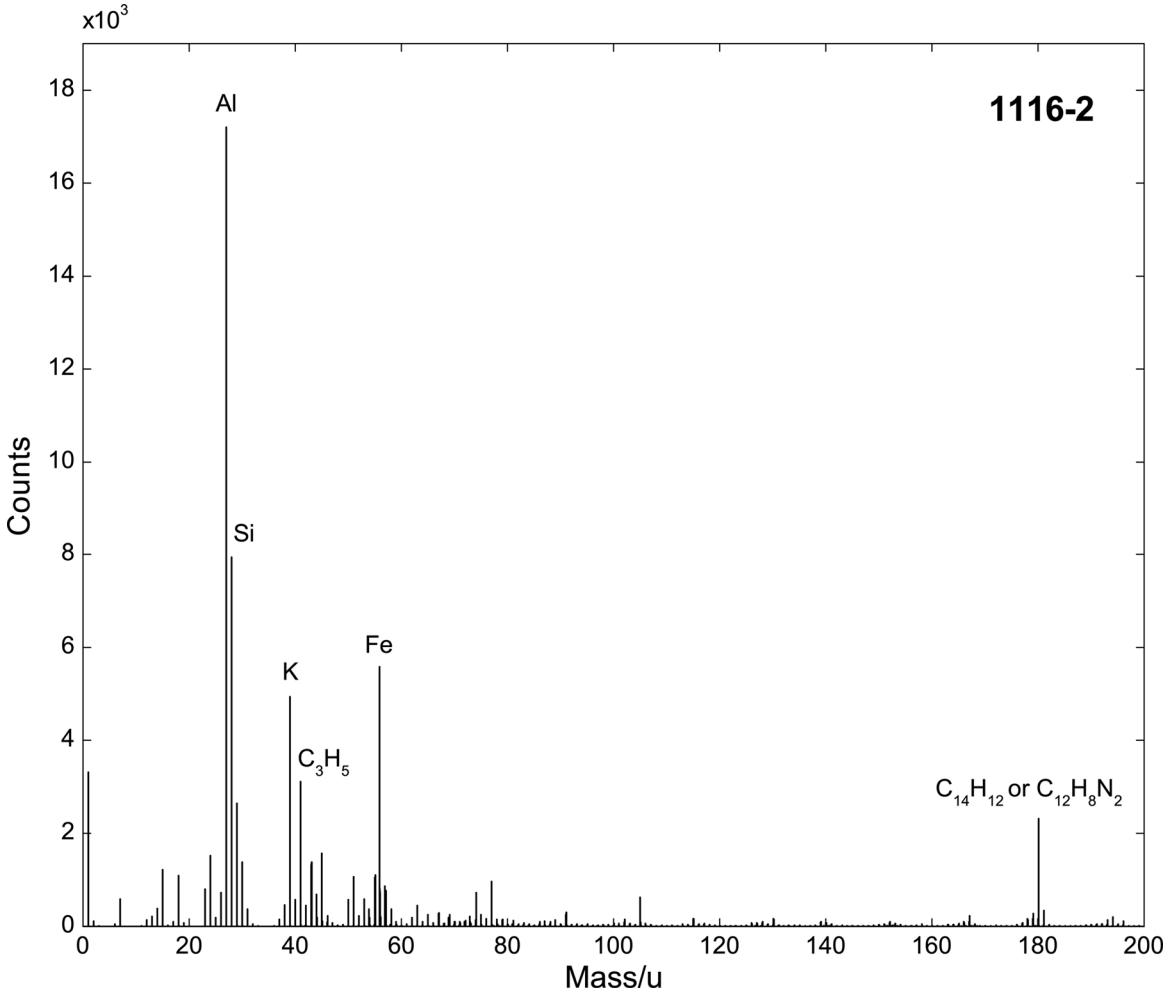
Accession #	01114–03
Host Material	Coal SS03
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



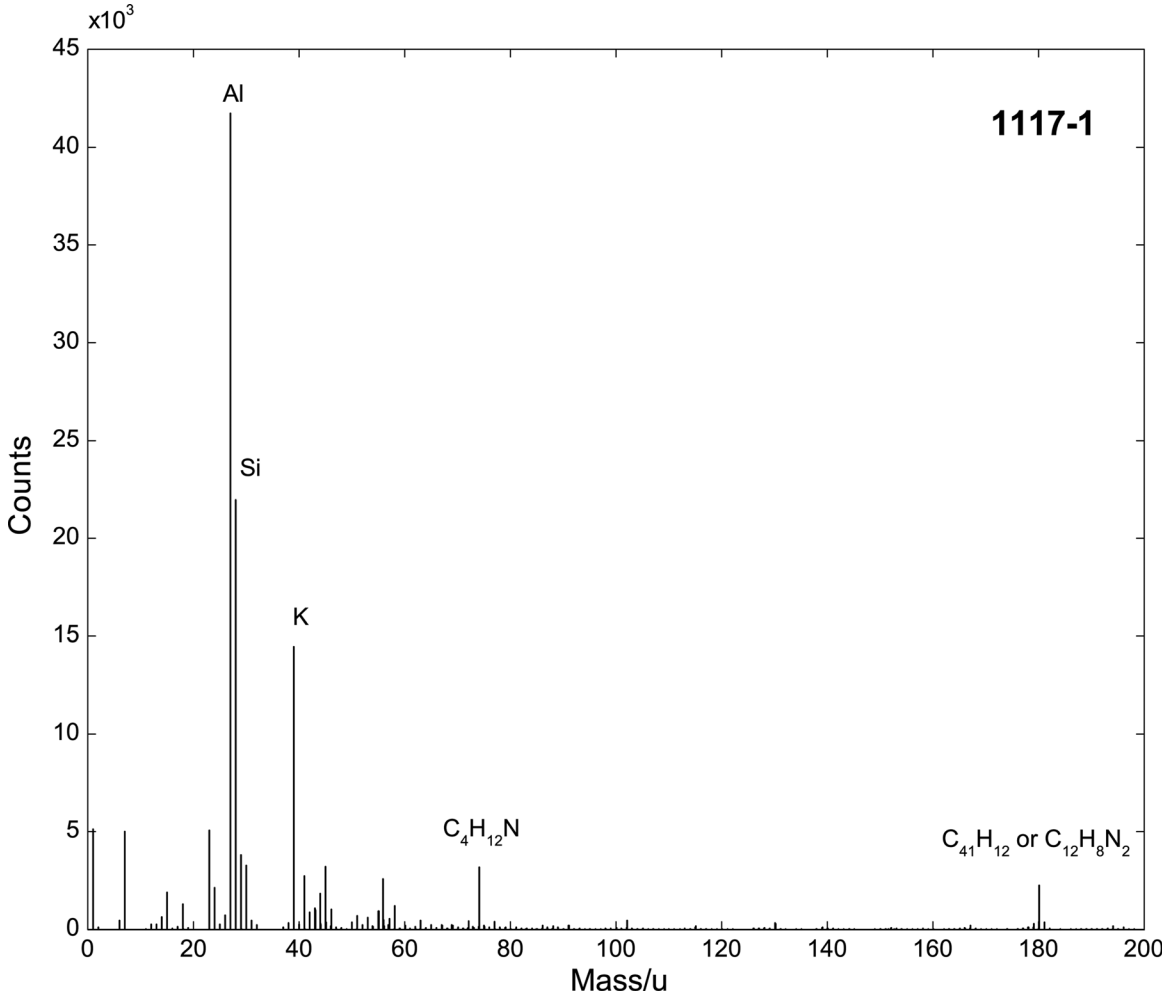
Accession #	01115–01
Host Material	Coal SS04
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



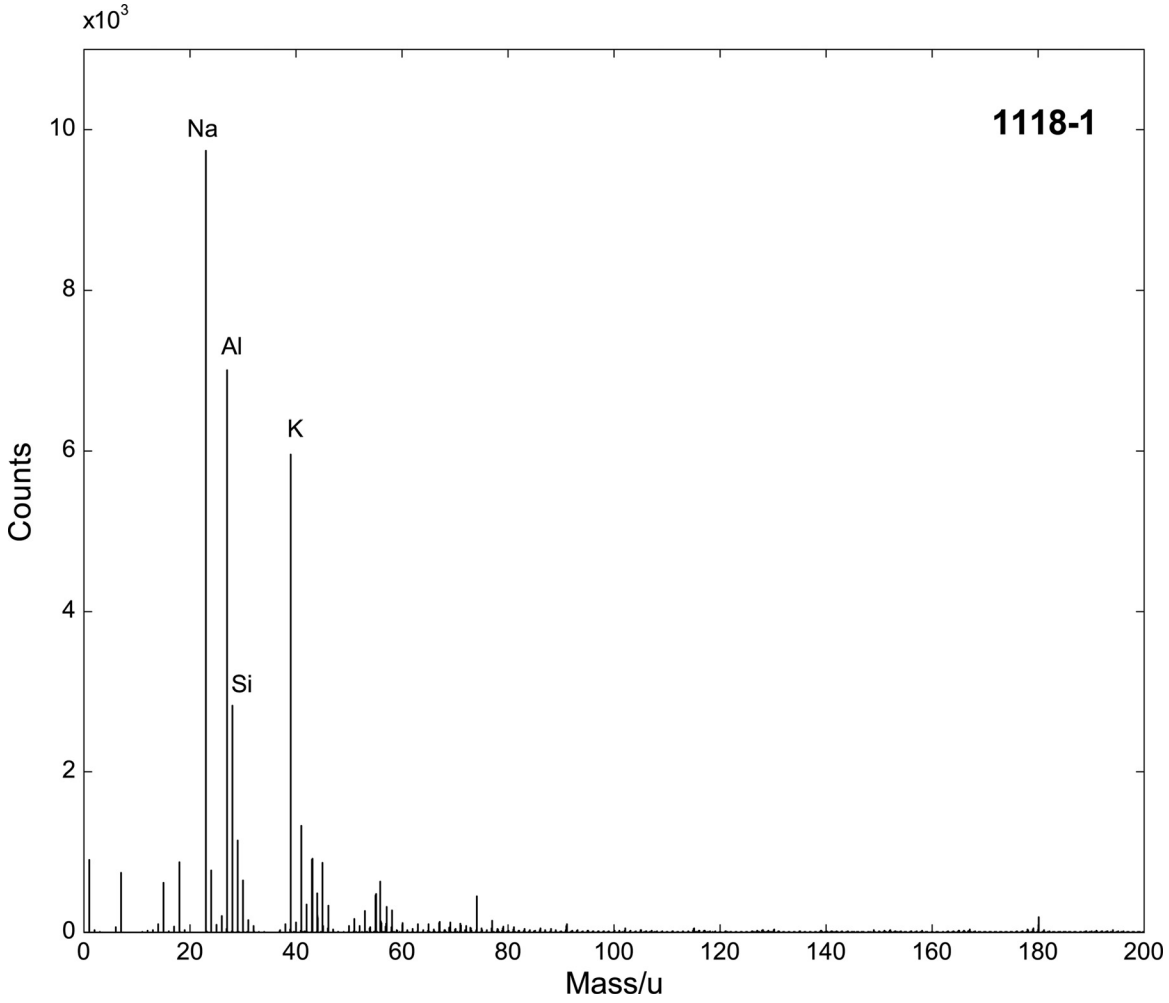
Accession #	01116–01
Host Material	Coal SS05
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



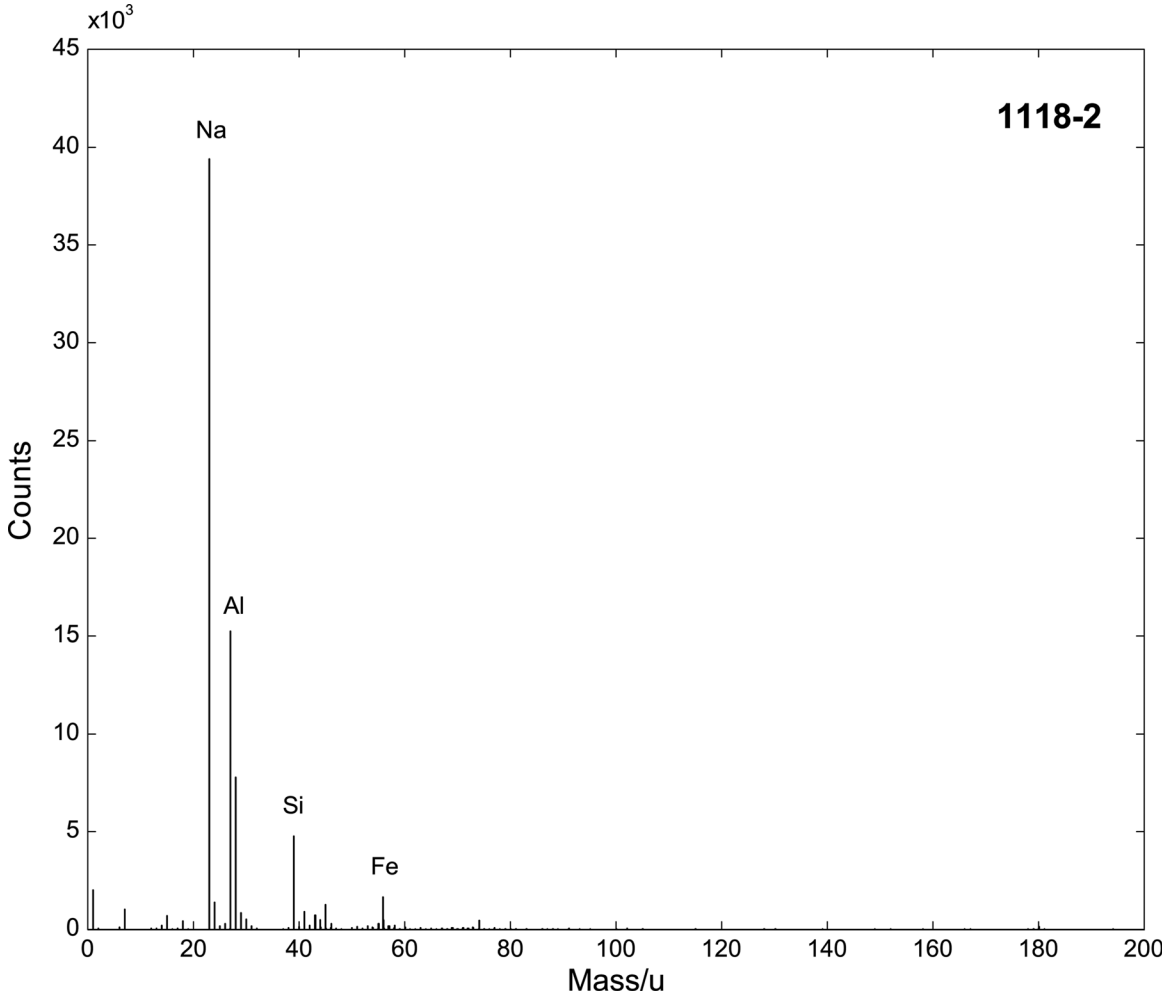
Accession #	01116–02
Host Material	Coal SS05
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



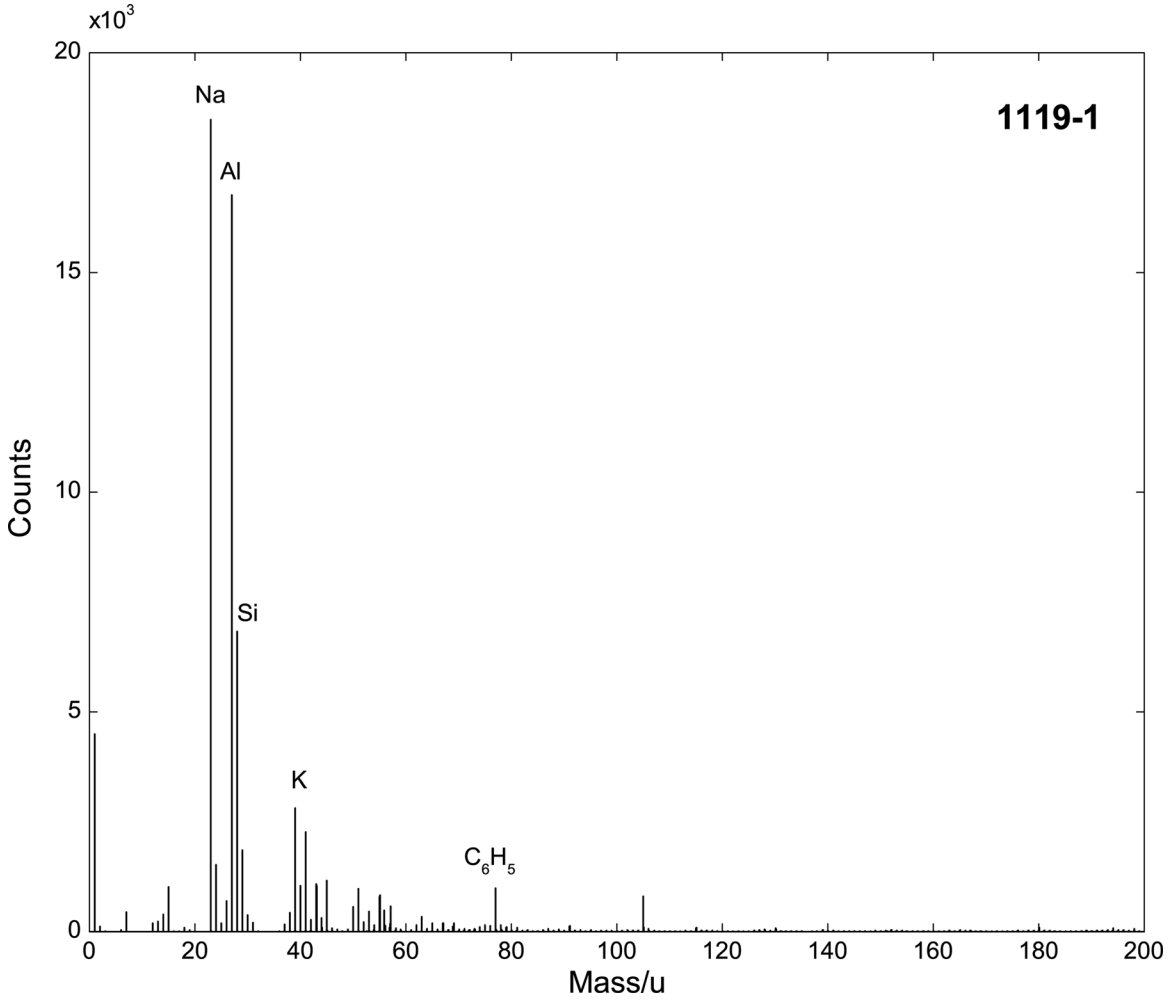
Accession #	01117–01
Host Material	Coal SS06
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



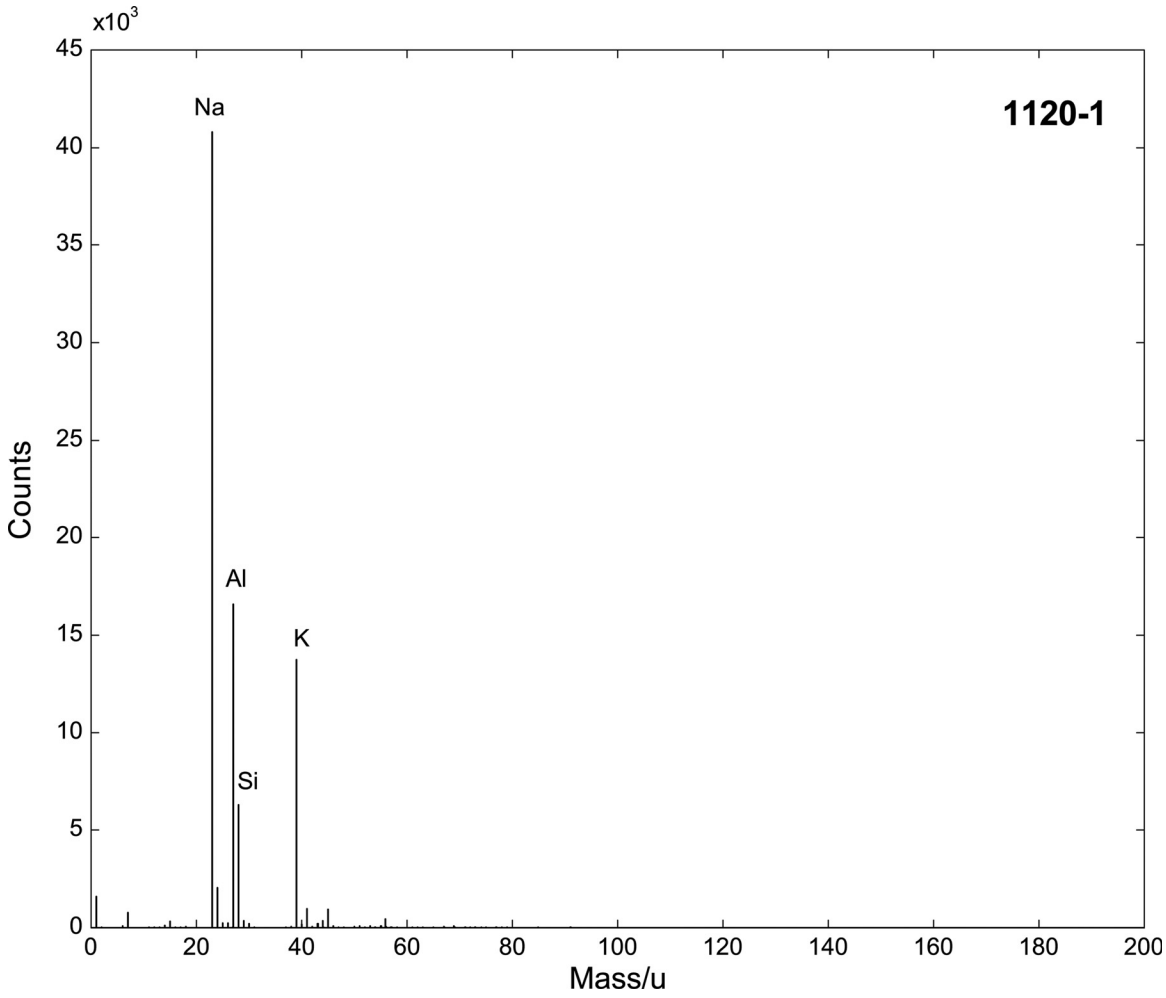
Accession #	01118–01
Host Material	Coal SS07
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



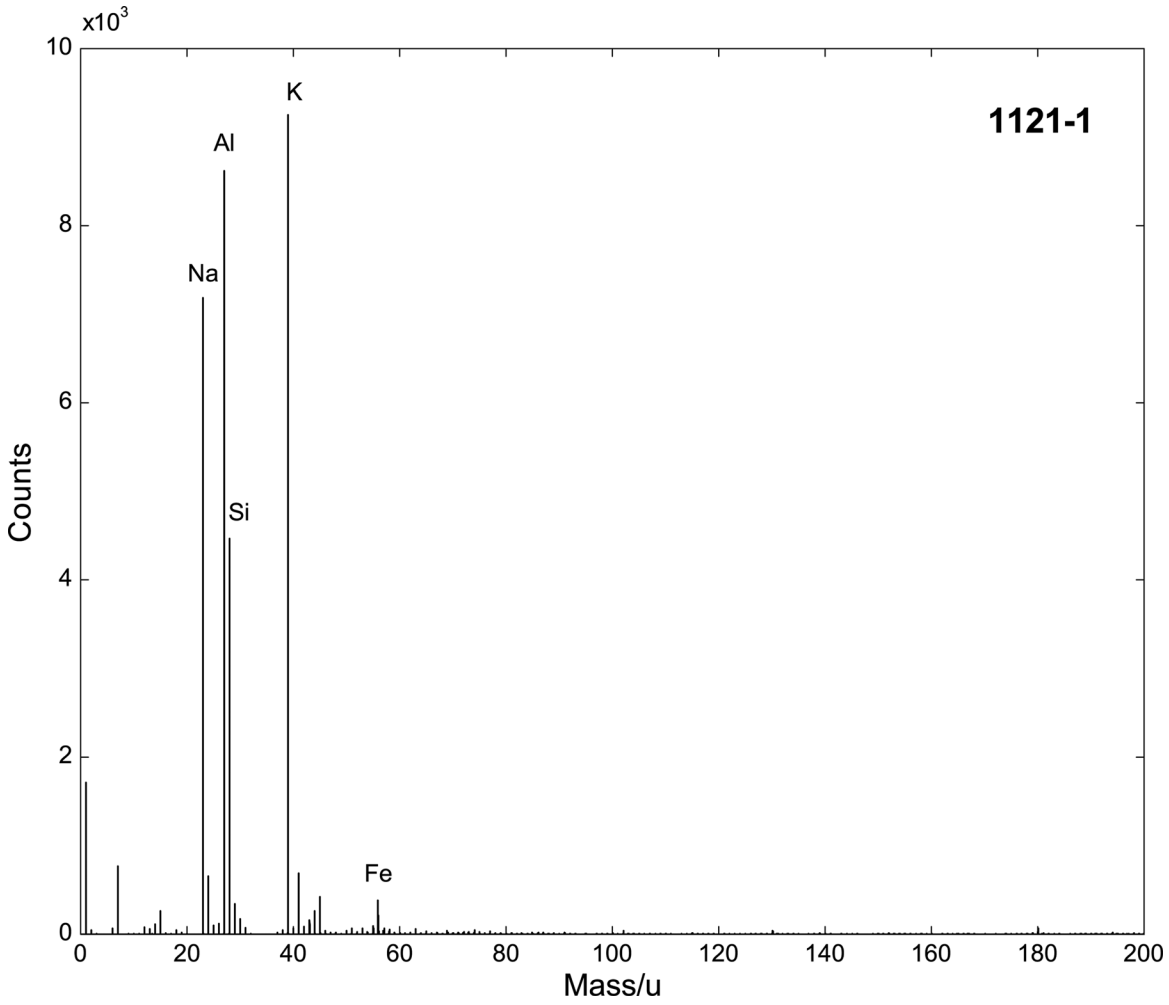
Accession #	01118–02
Host Material	Coal SS07
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



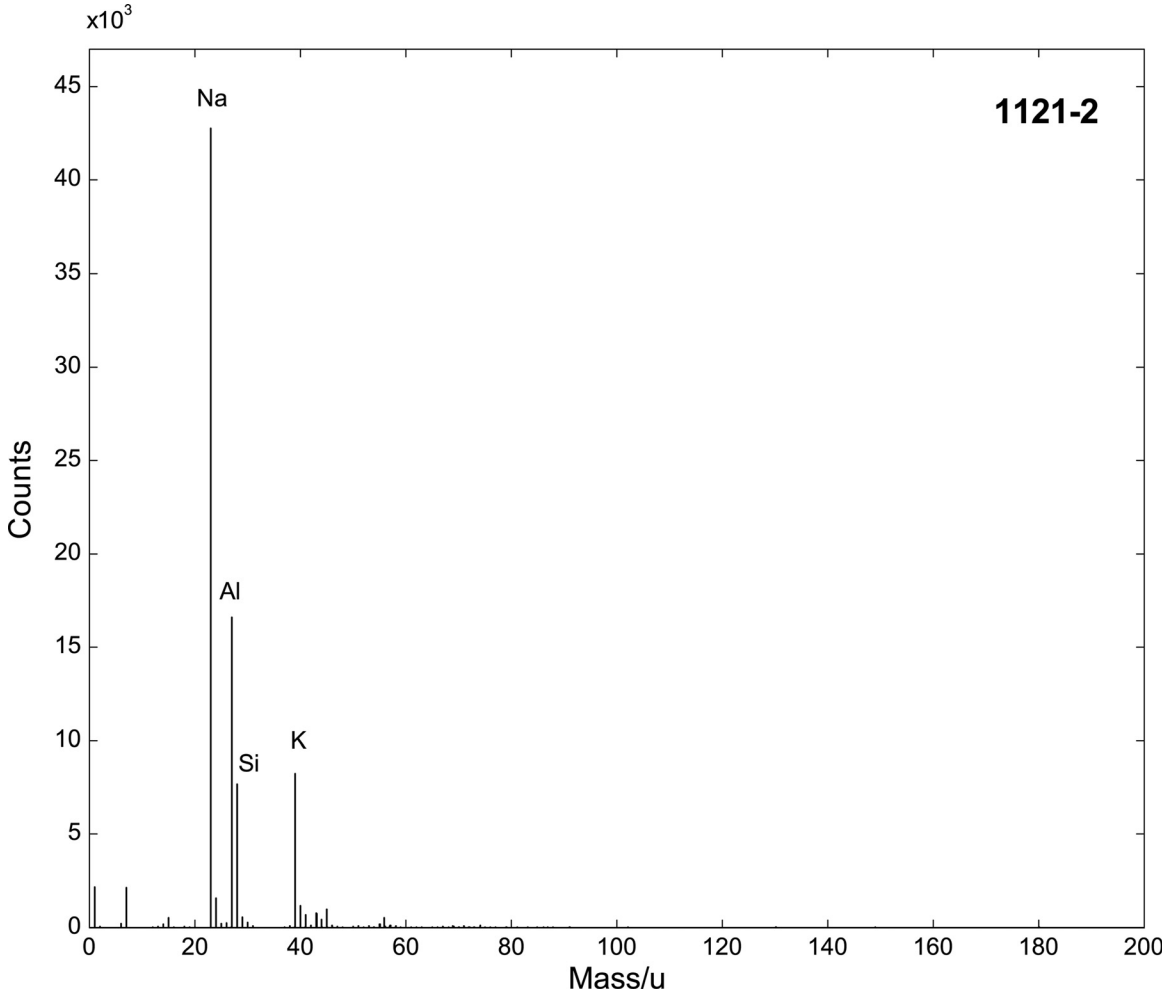
Accession #	01119–01
Host Material	Coal SS08
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



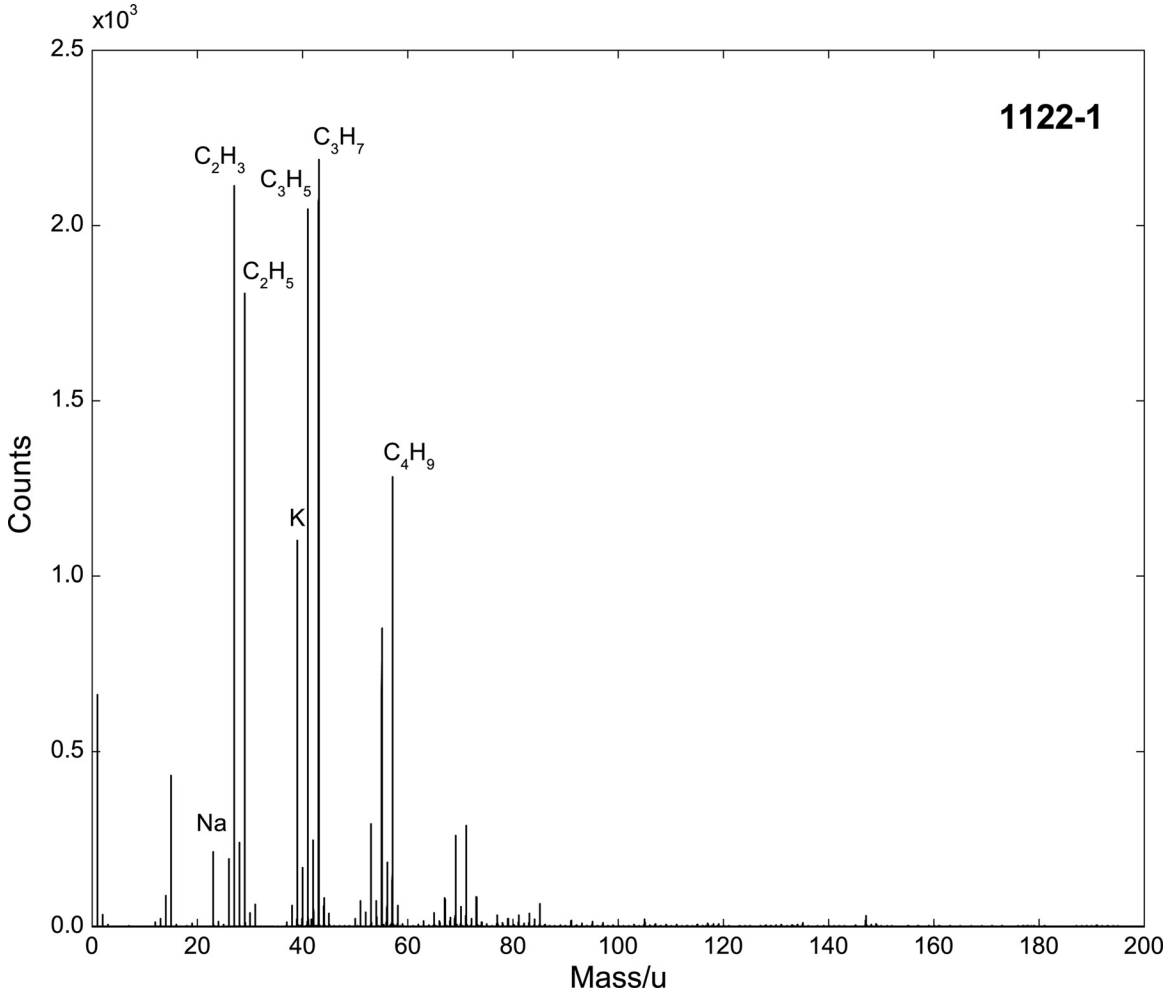
Accession #	01120–01
Host Material	Coal SS09
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



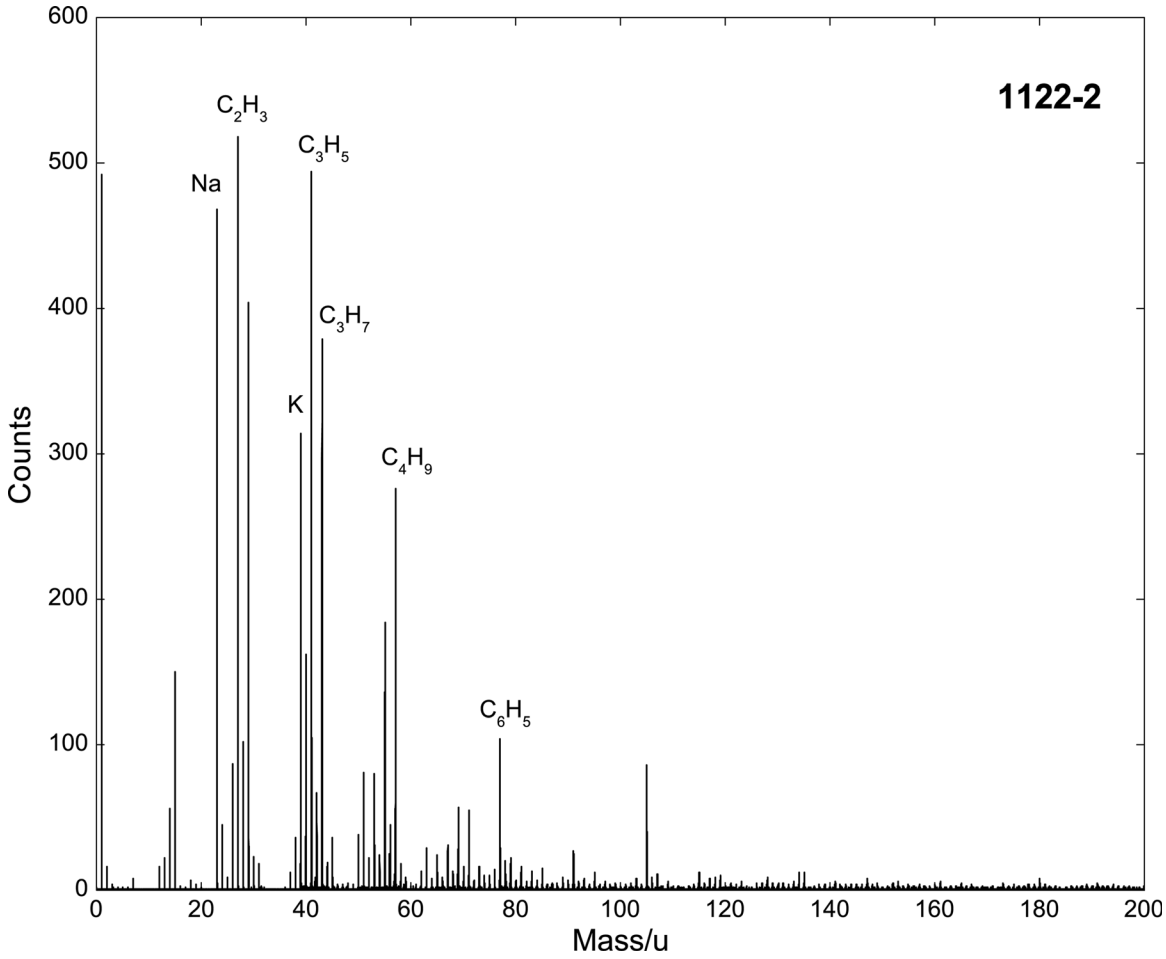
Accession #	01121–01
Host Material	Coal SS10
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^{+}
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



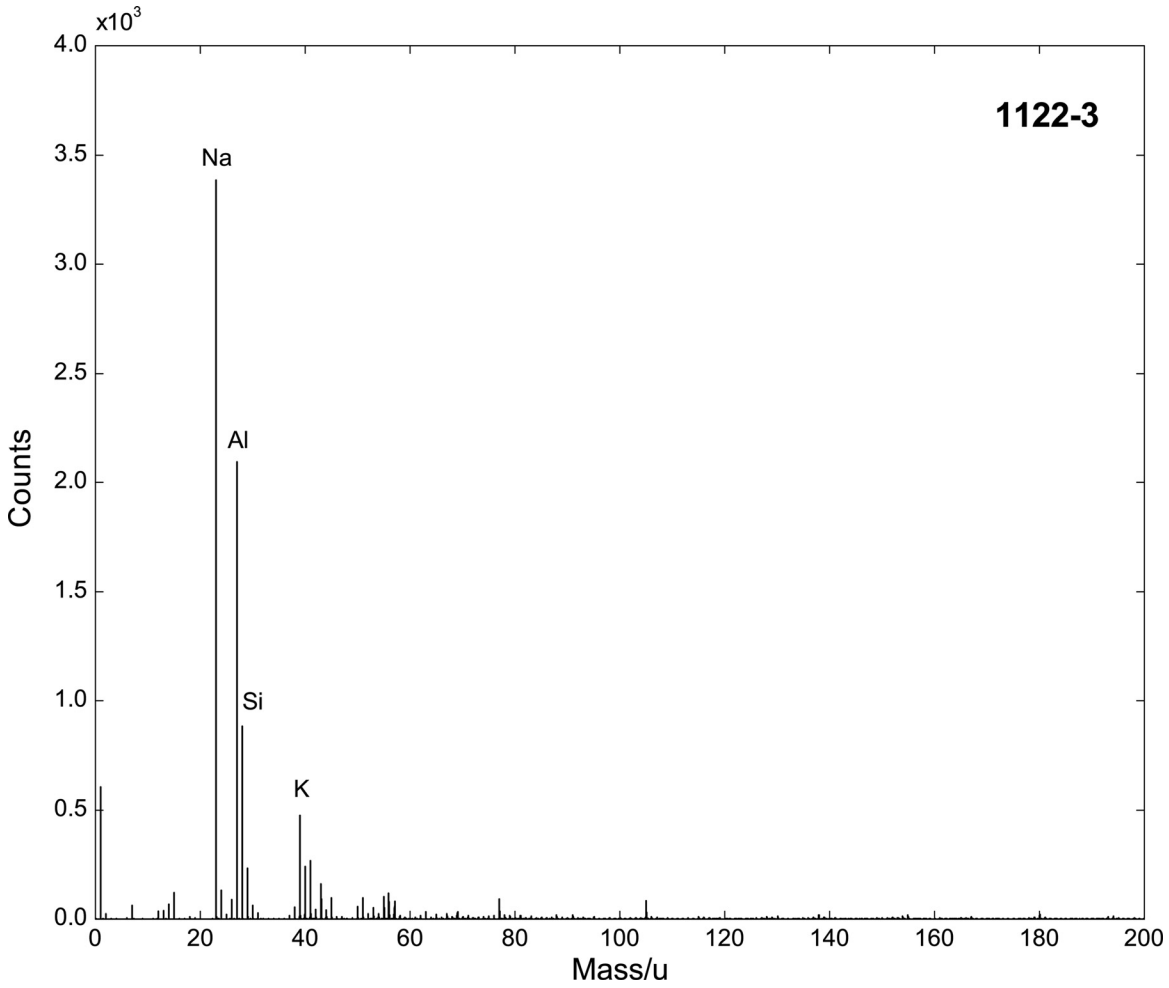
Accession #	01121–02
Host Material	Coal SS10
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^{+}
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



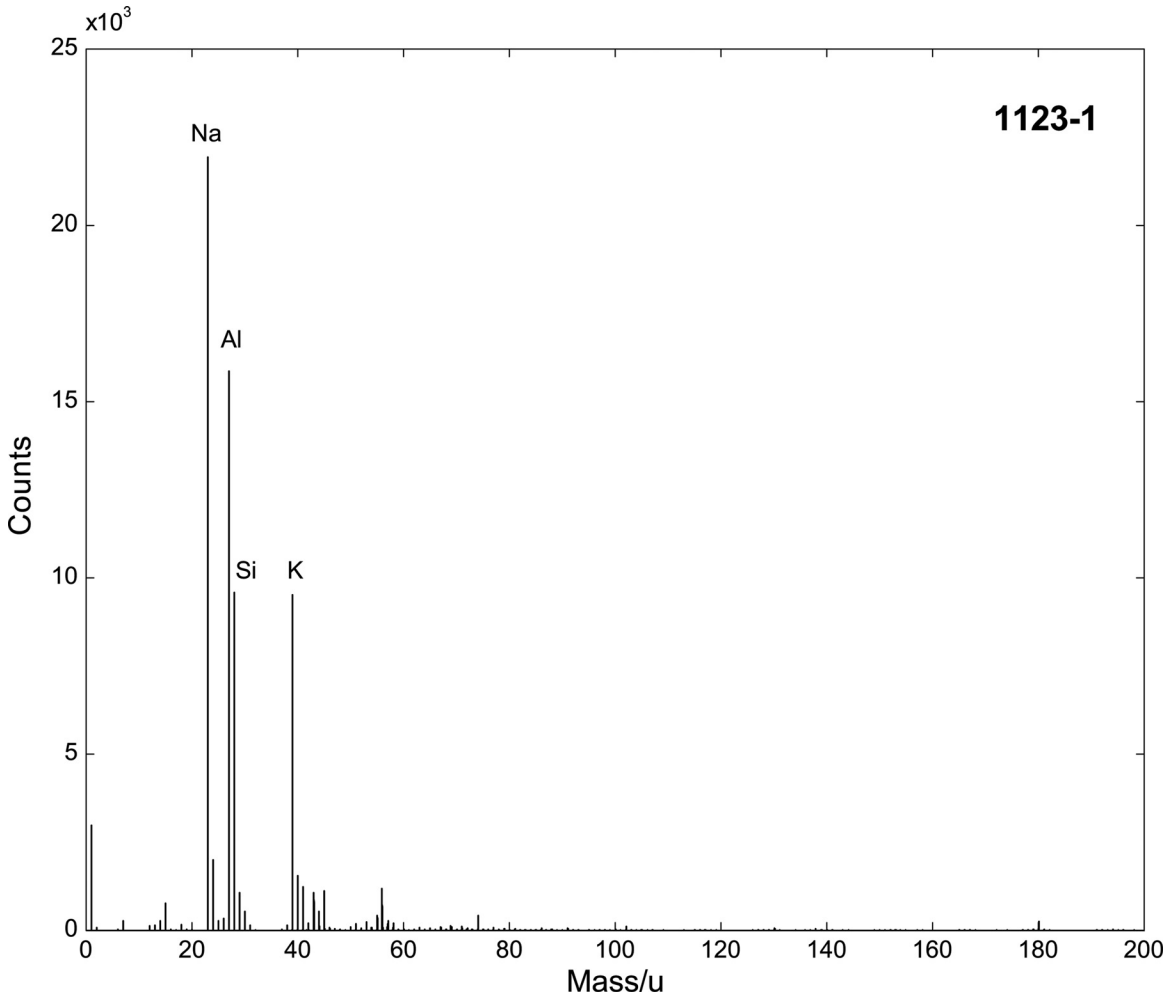
Accession #	01122–01
Host Material	Coal SS11
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



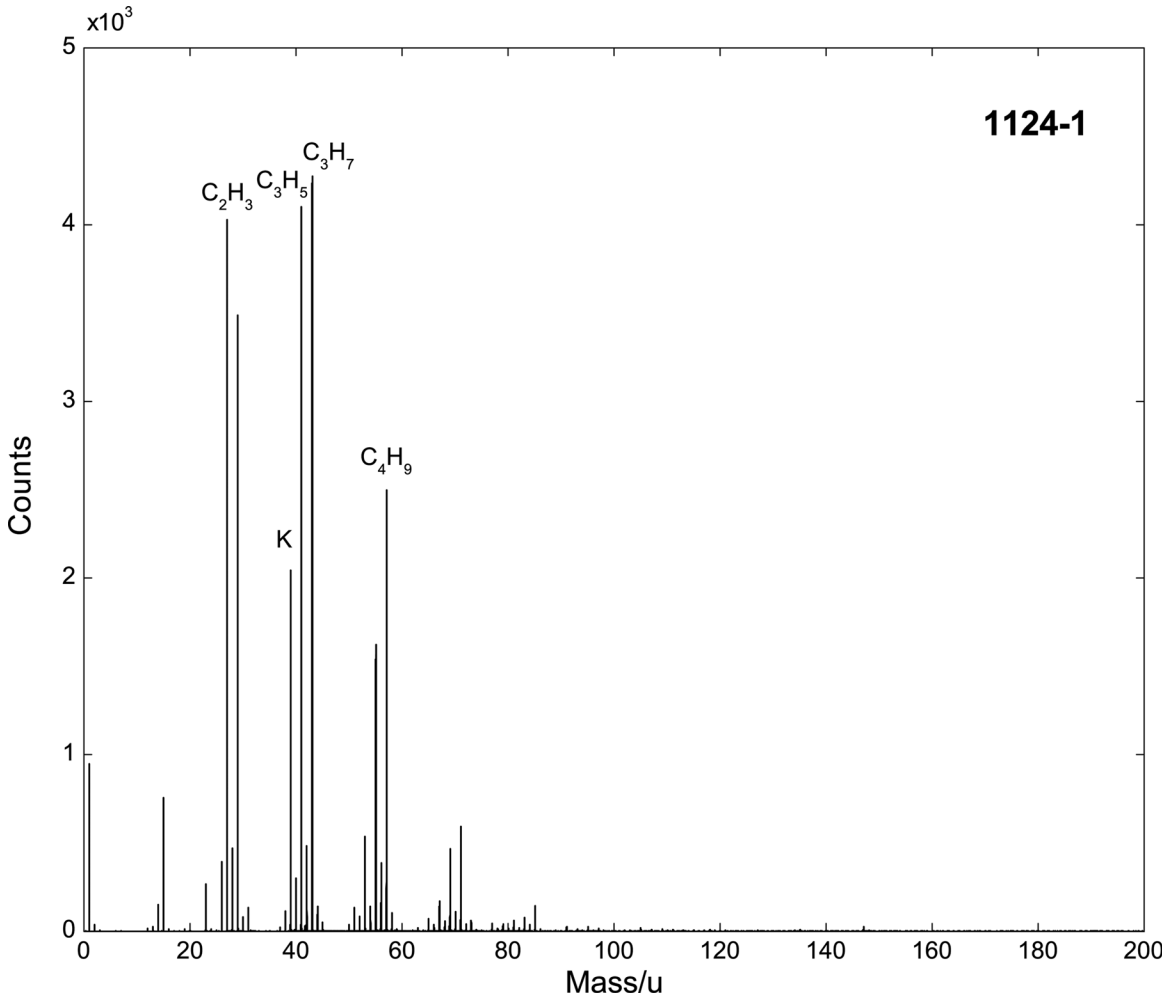
Accession #	01122–02
Host Material	Coal SS11
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



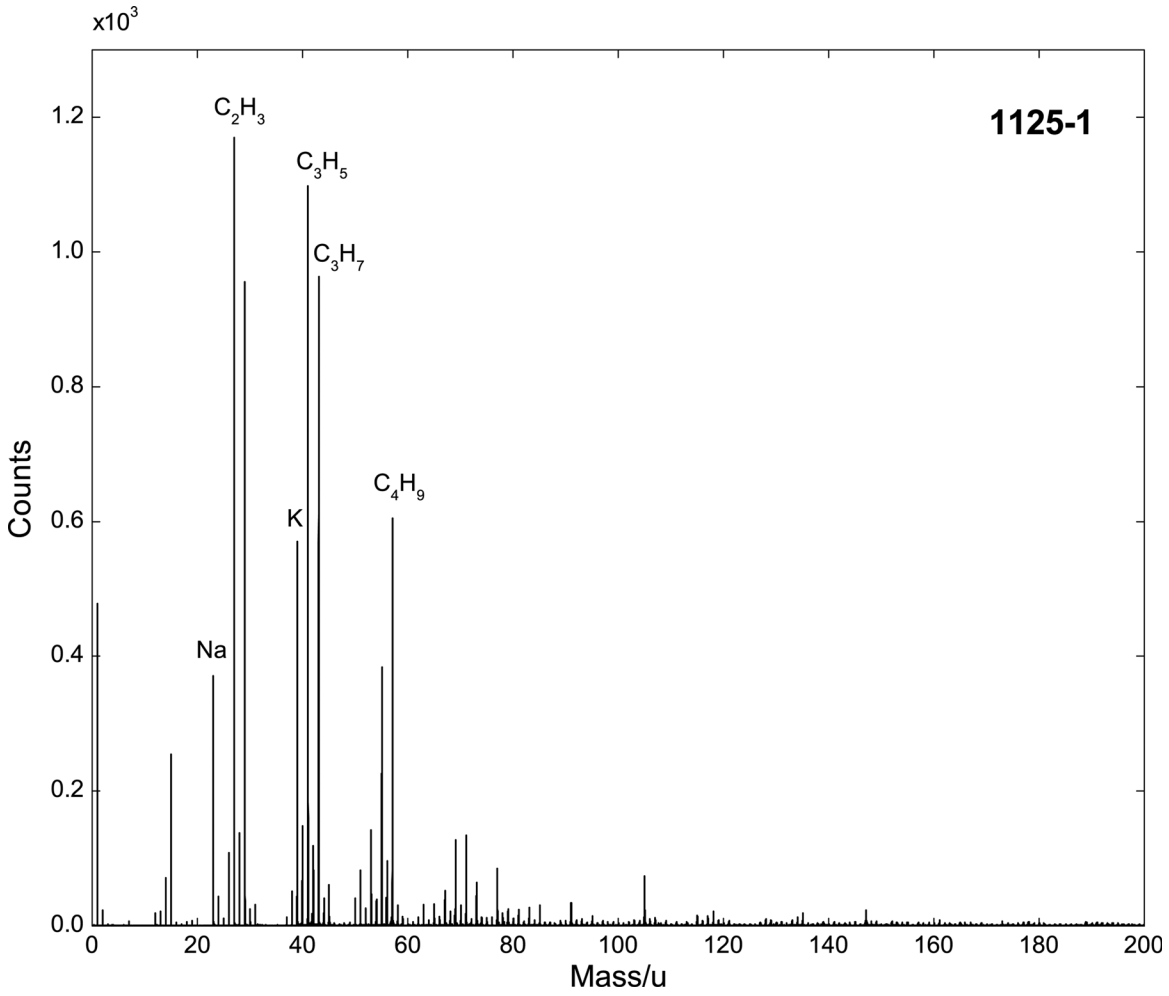
Accession #	01122–03
Host Material	Coal SS11
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



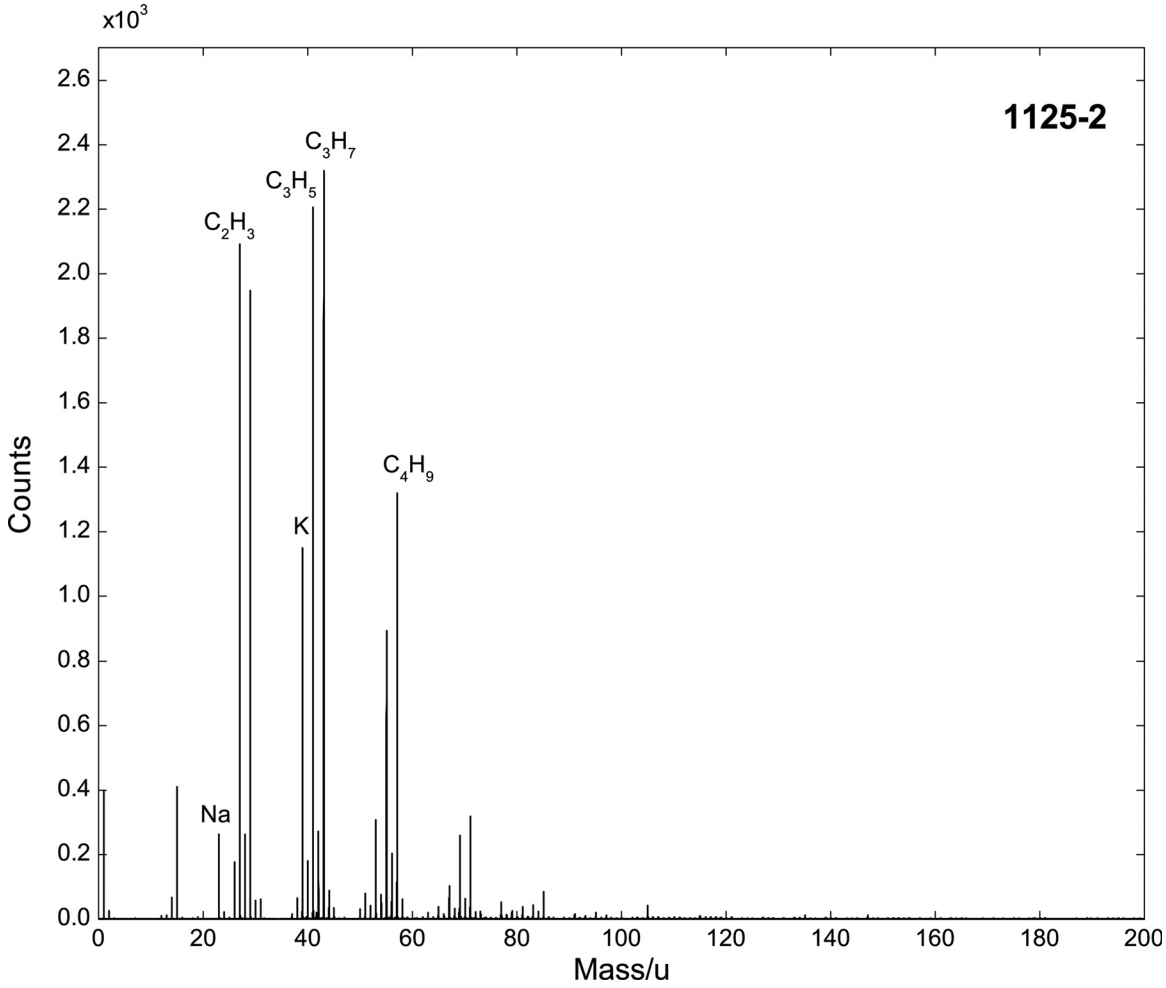
Accession #	01123–01
Host Material	Coal SS12
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



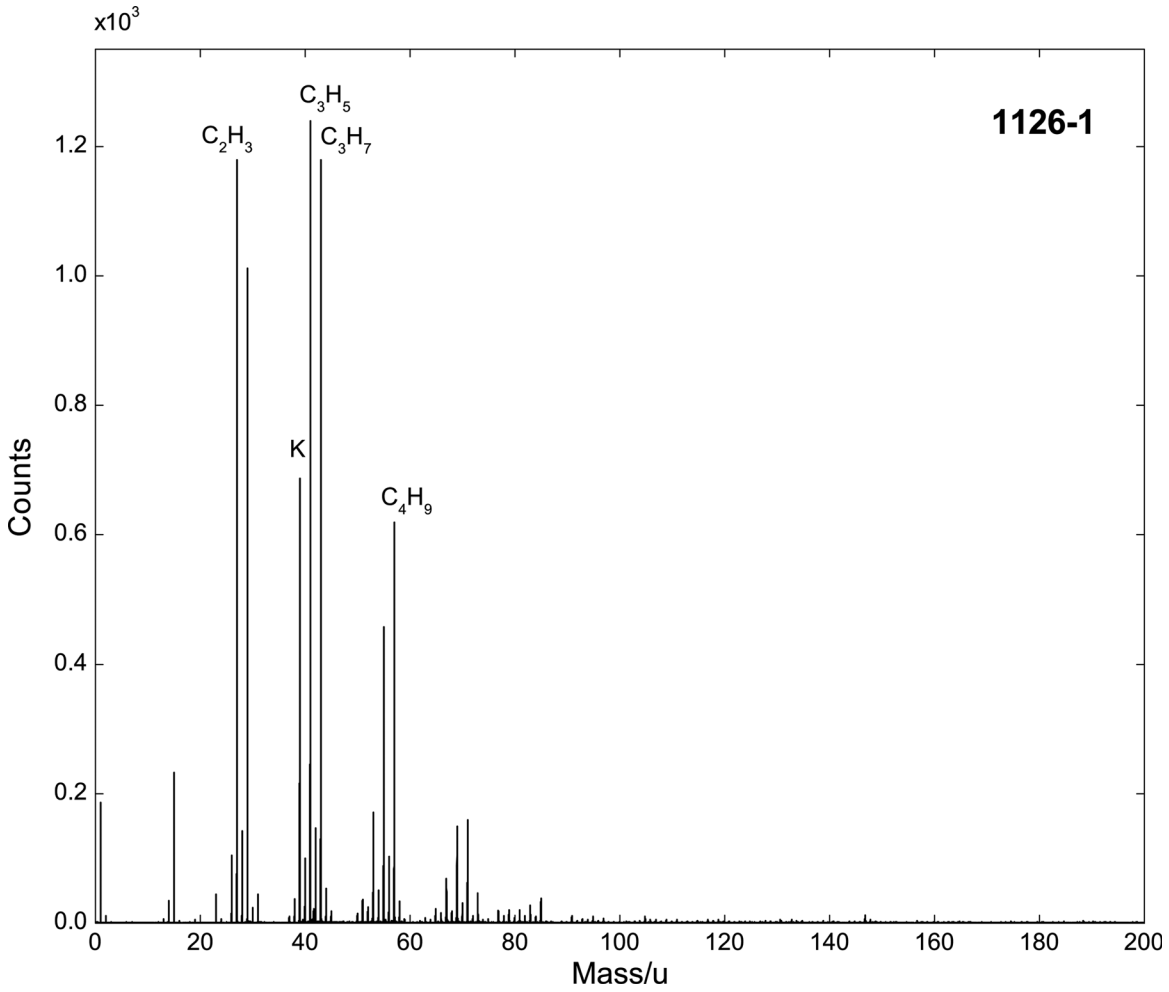
Accession #	01124–01
Host Material	Coal SS13
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



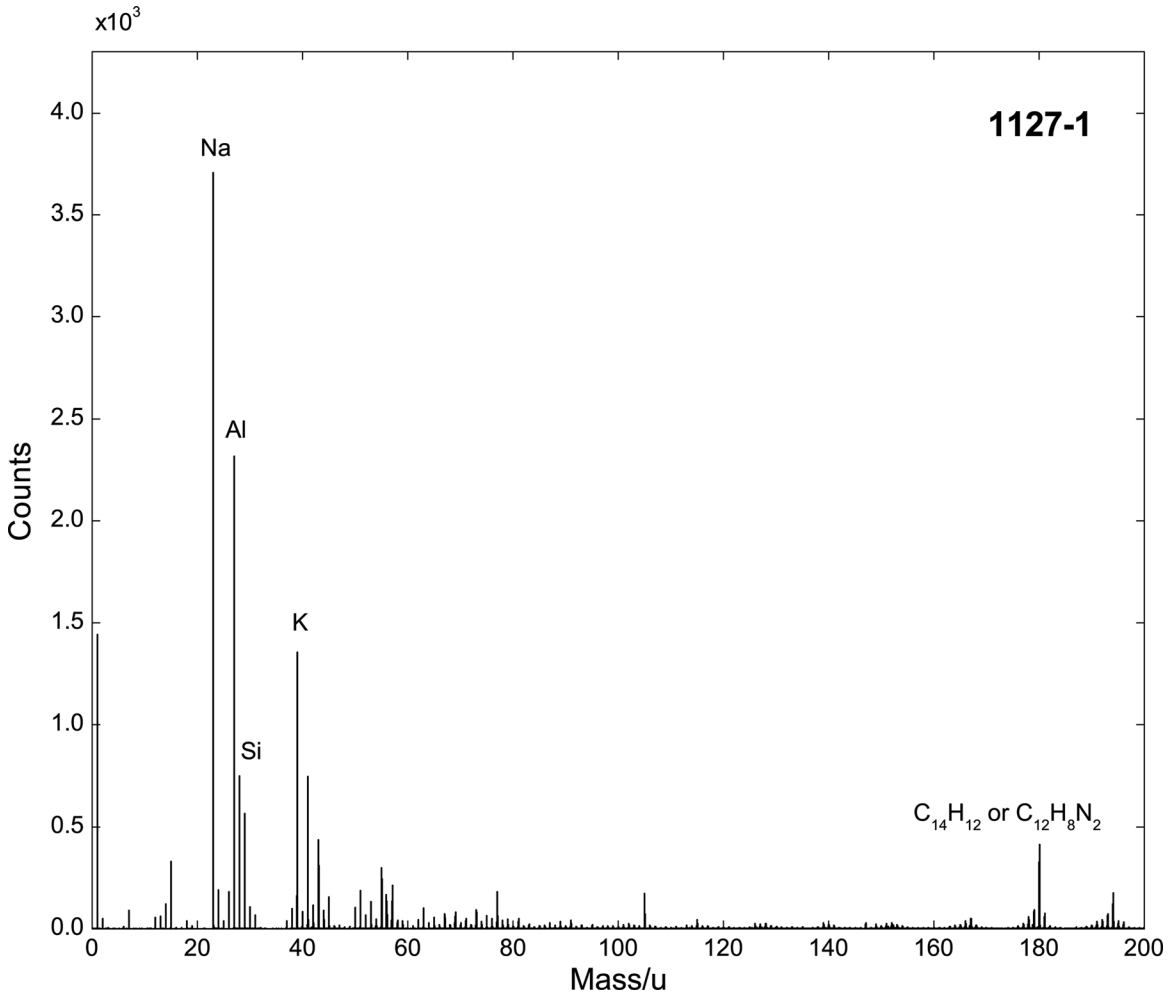
Accession #	01125–01
Host Material	Coal SS14
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



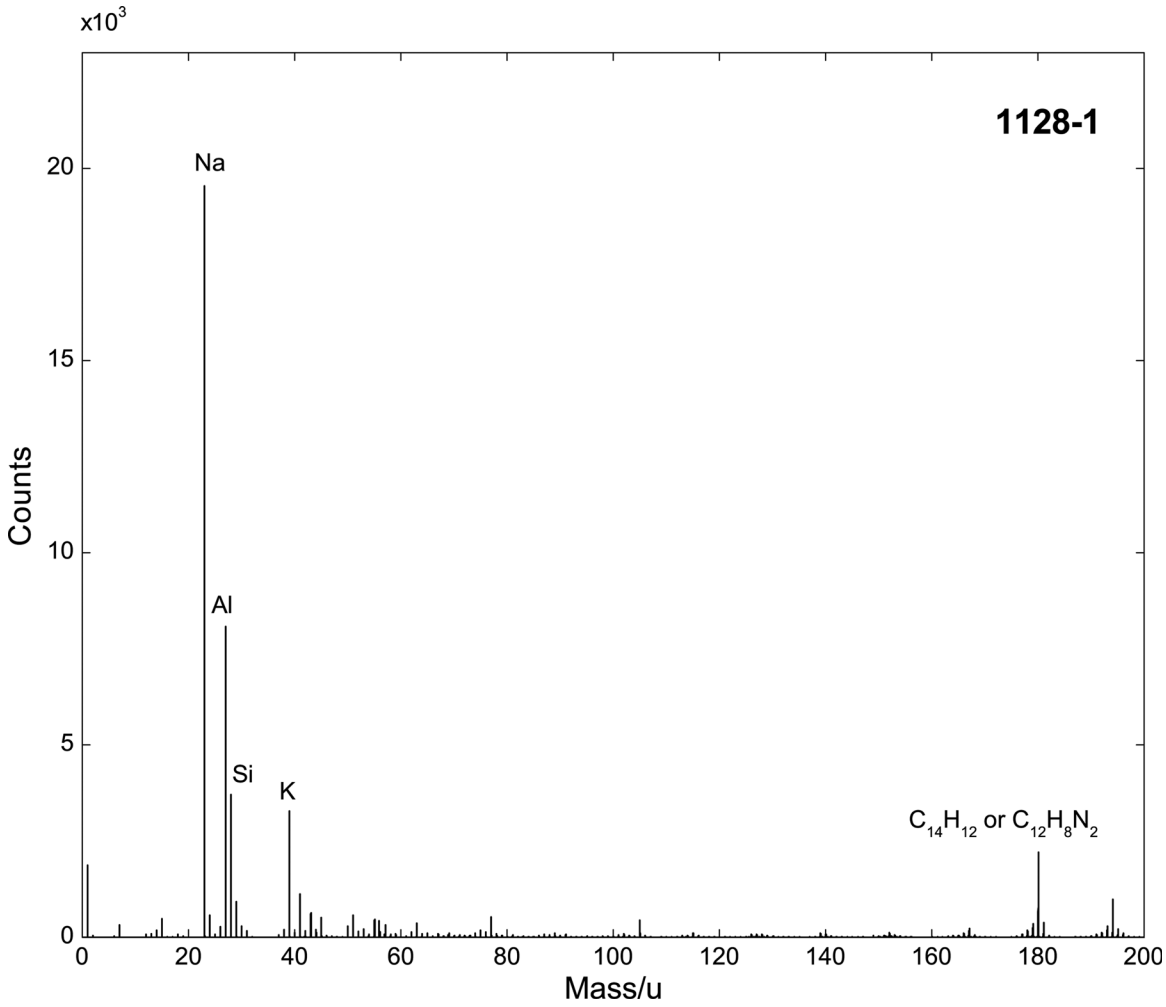
Accession #	01125–02
Host Material	Coal SS14
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



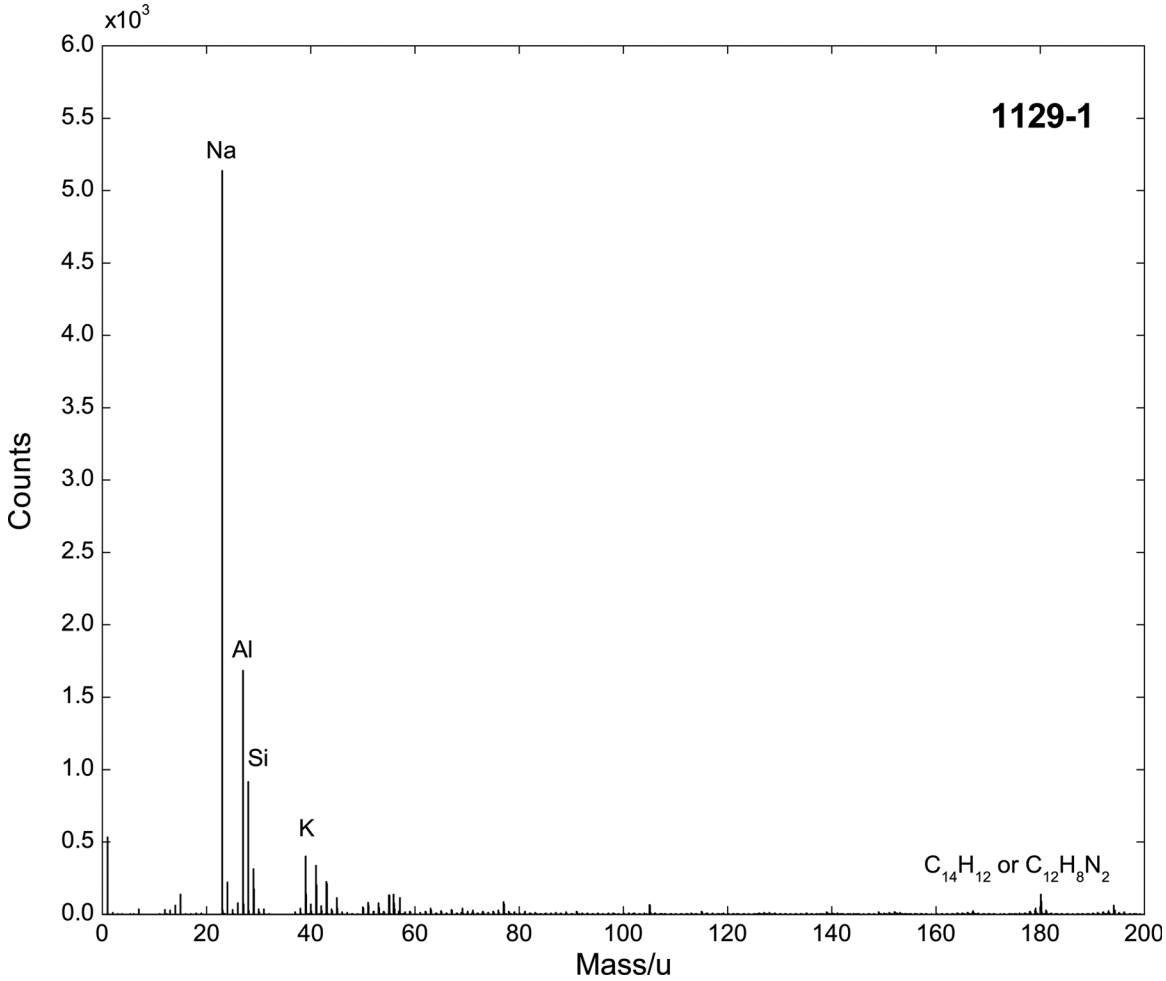
Accession #	01126–01
Host Material	Coal SS15
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



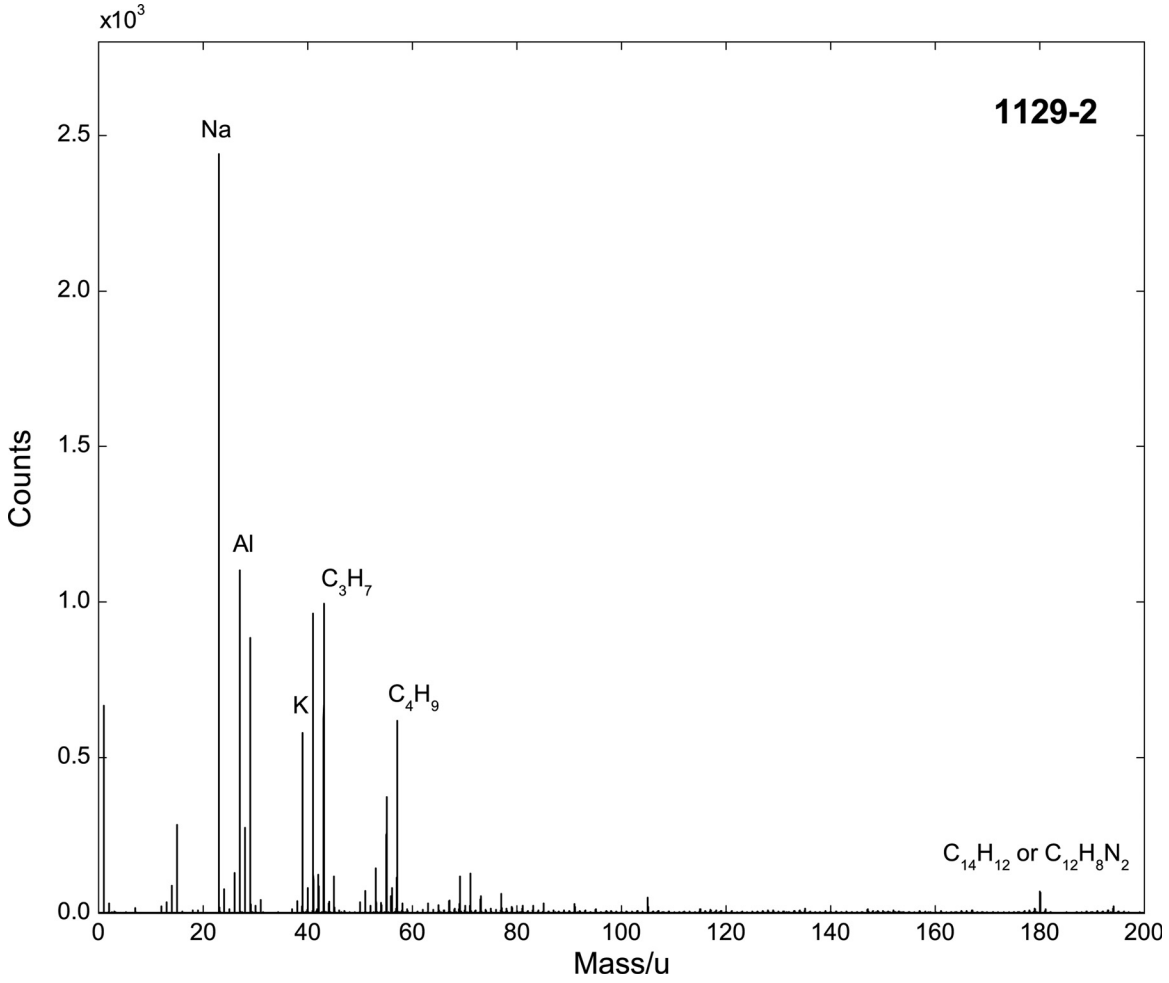
Accession #	01127–01
Host Material	Coal SS16
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



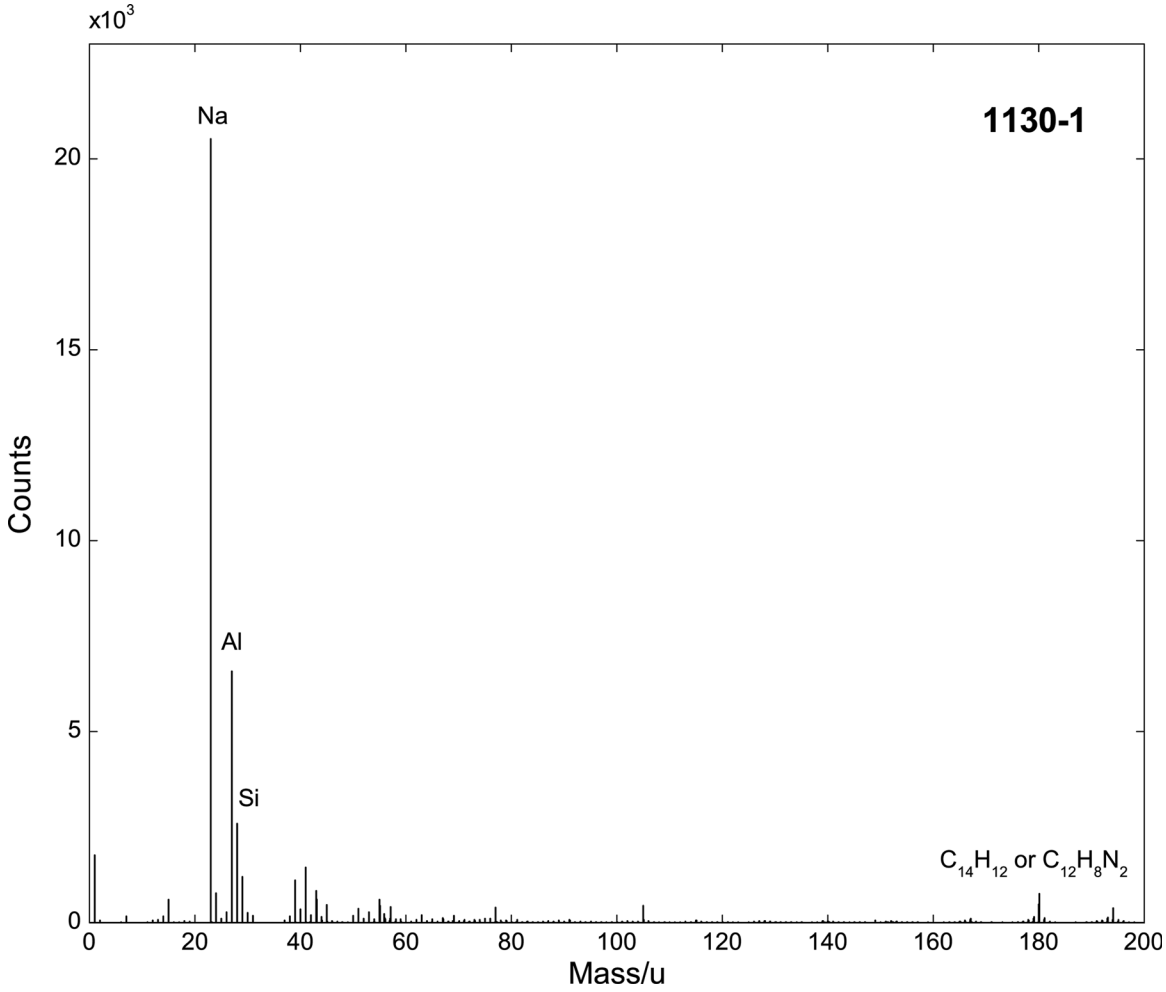
Accession #	01128–01
Host Material	Coal SS17
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



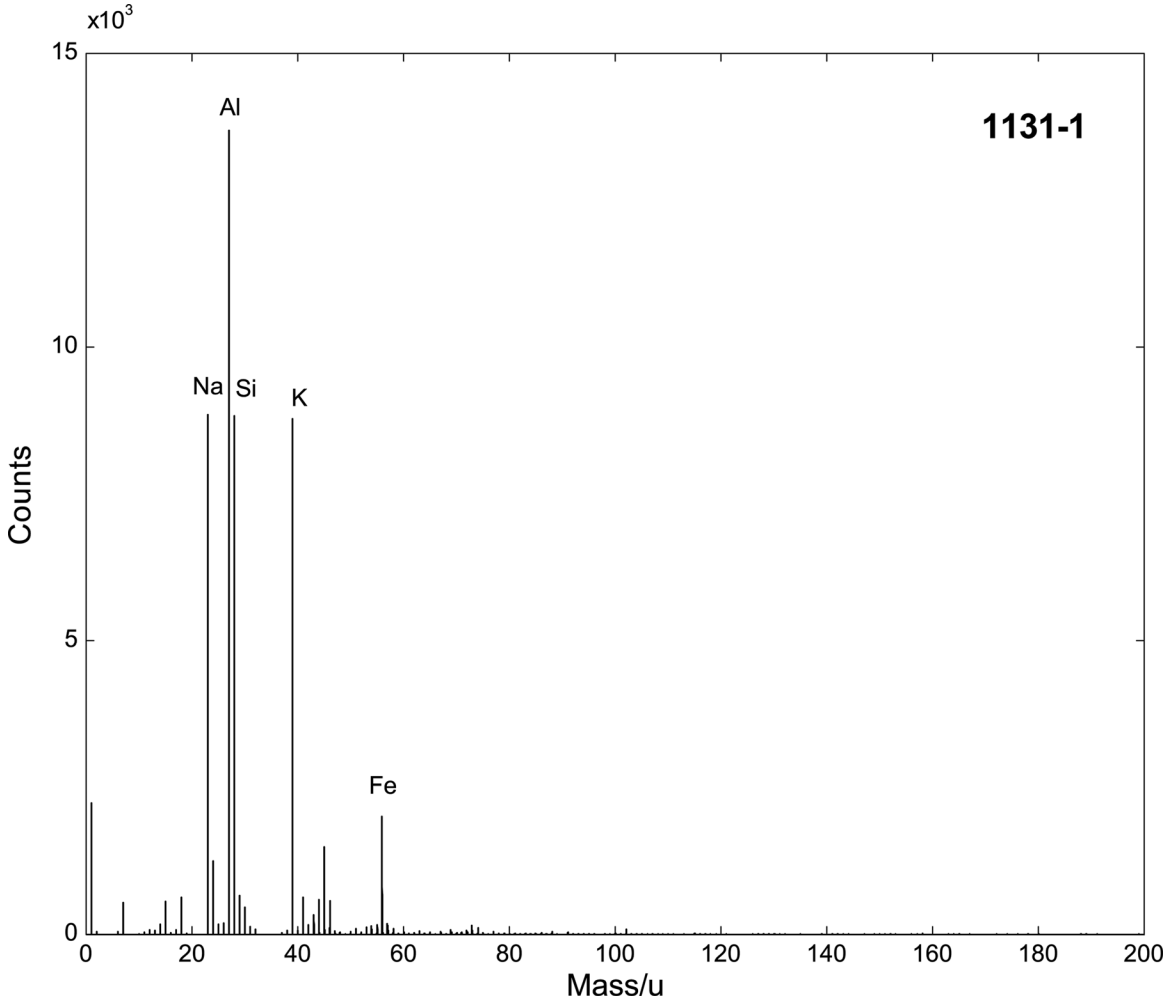
Accession #	01129–01
Host Material	Coal SS18
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



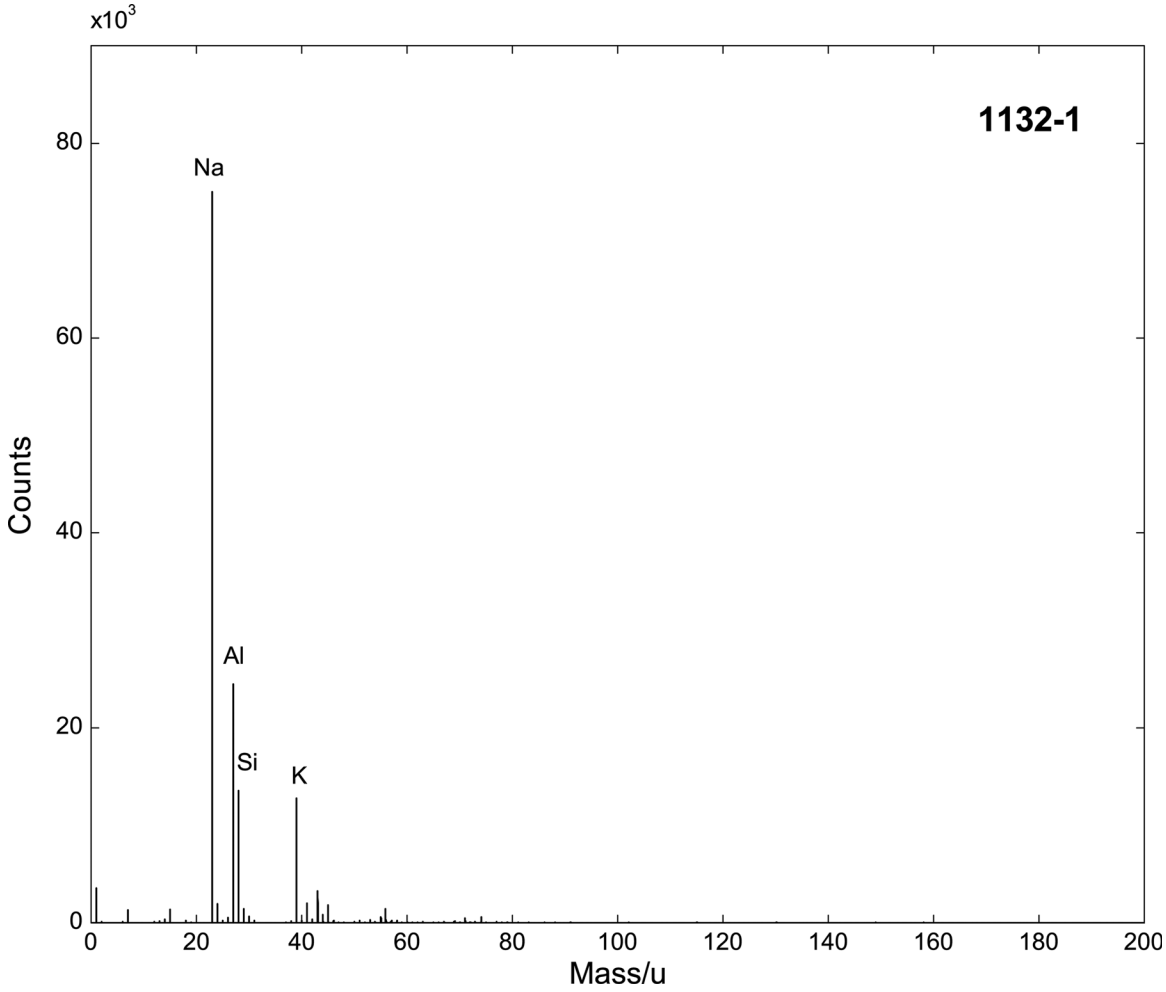
Accession #	01129–02
Host Material	Coal SS18
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	$\sim$5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm $\times$ 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



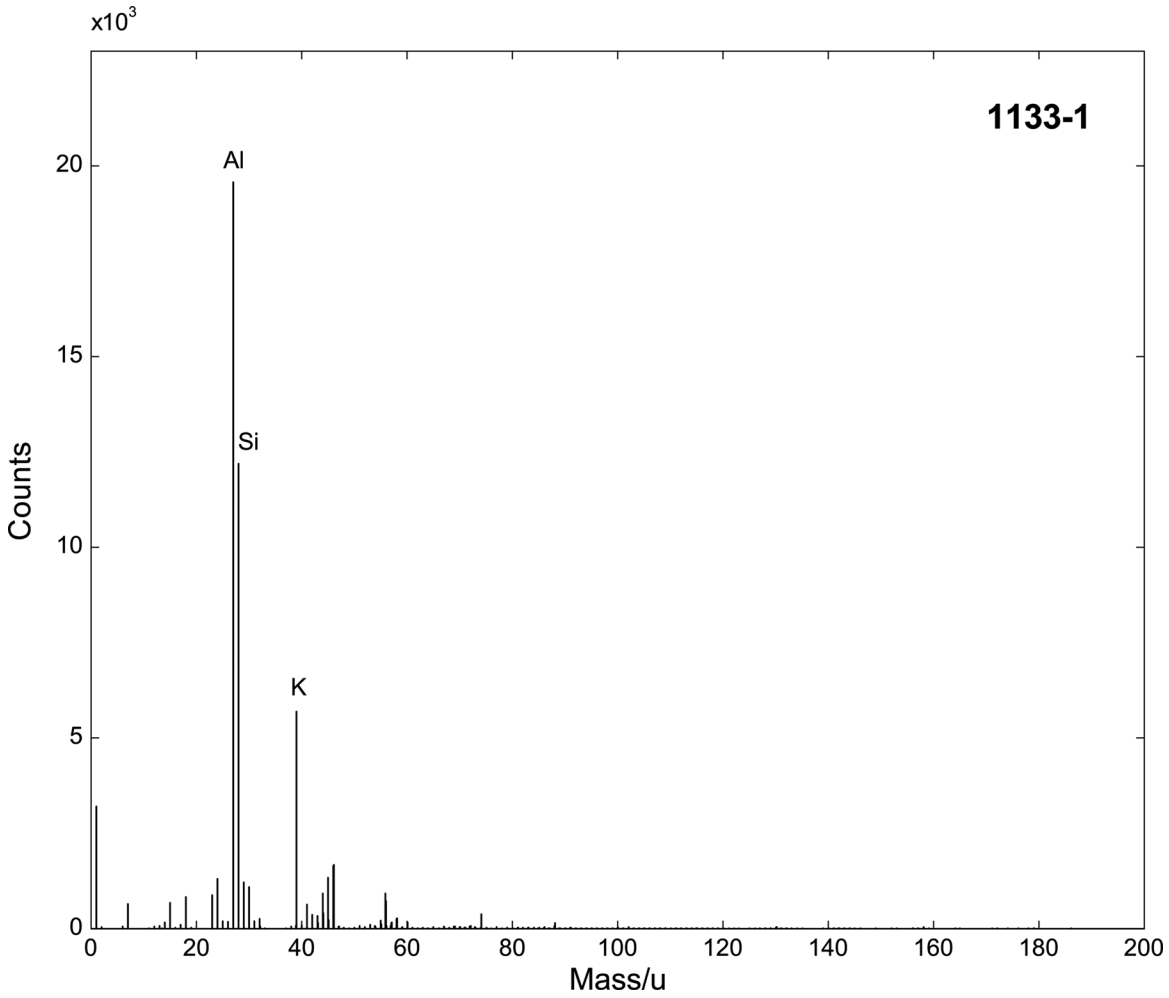
Accession #	01130–01
Host Material	Coal SS19
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



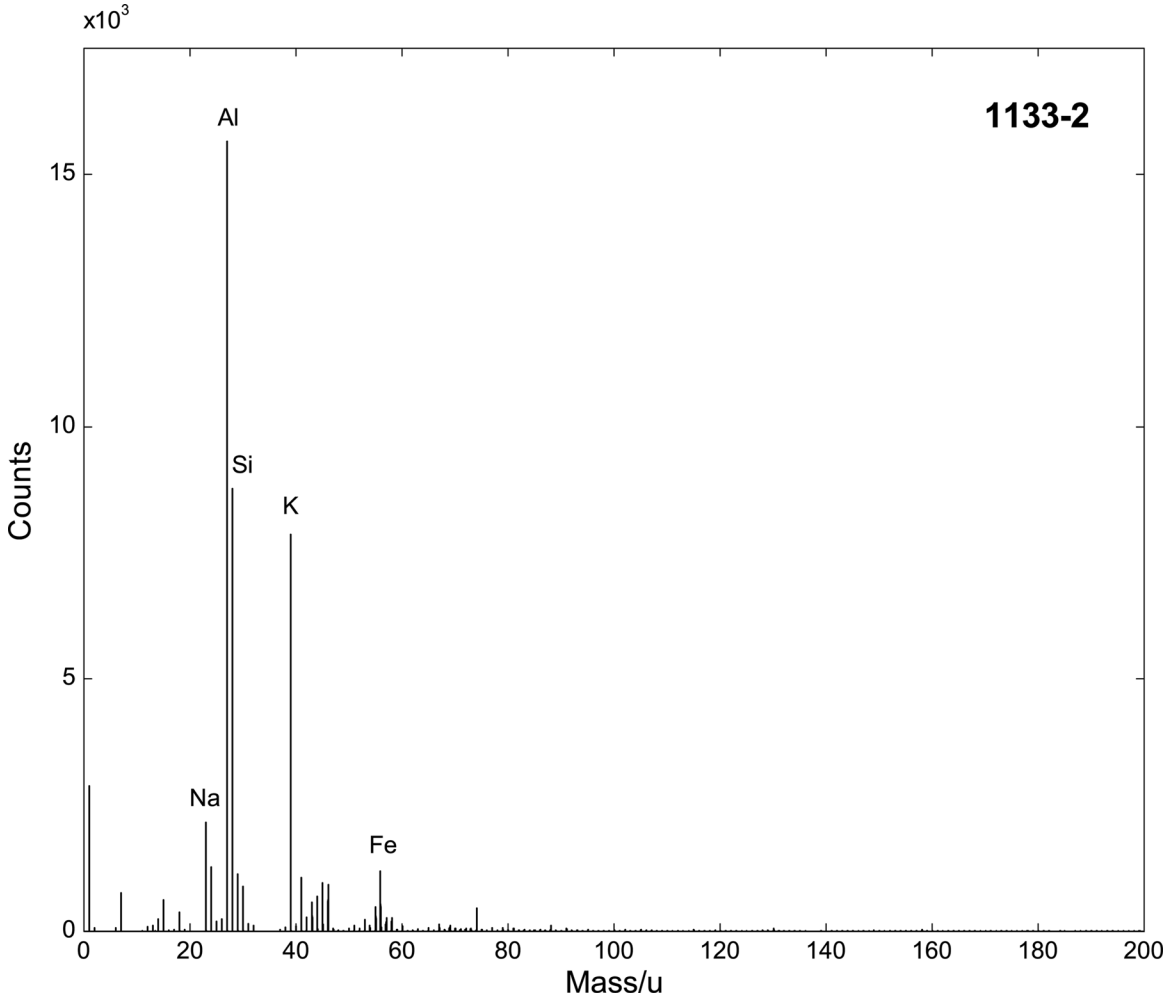
Accession #	01131–01
Host Material	Coal Blackthunder
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



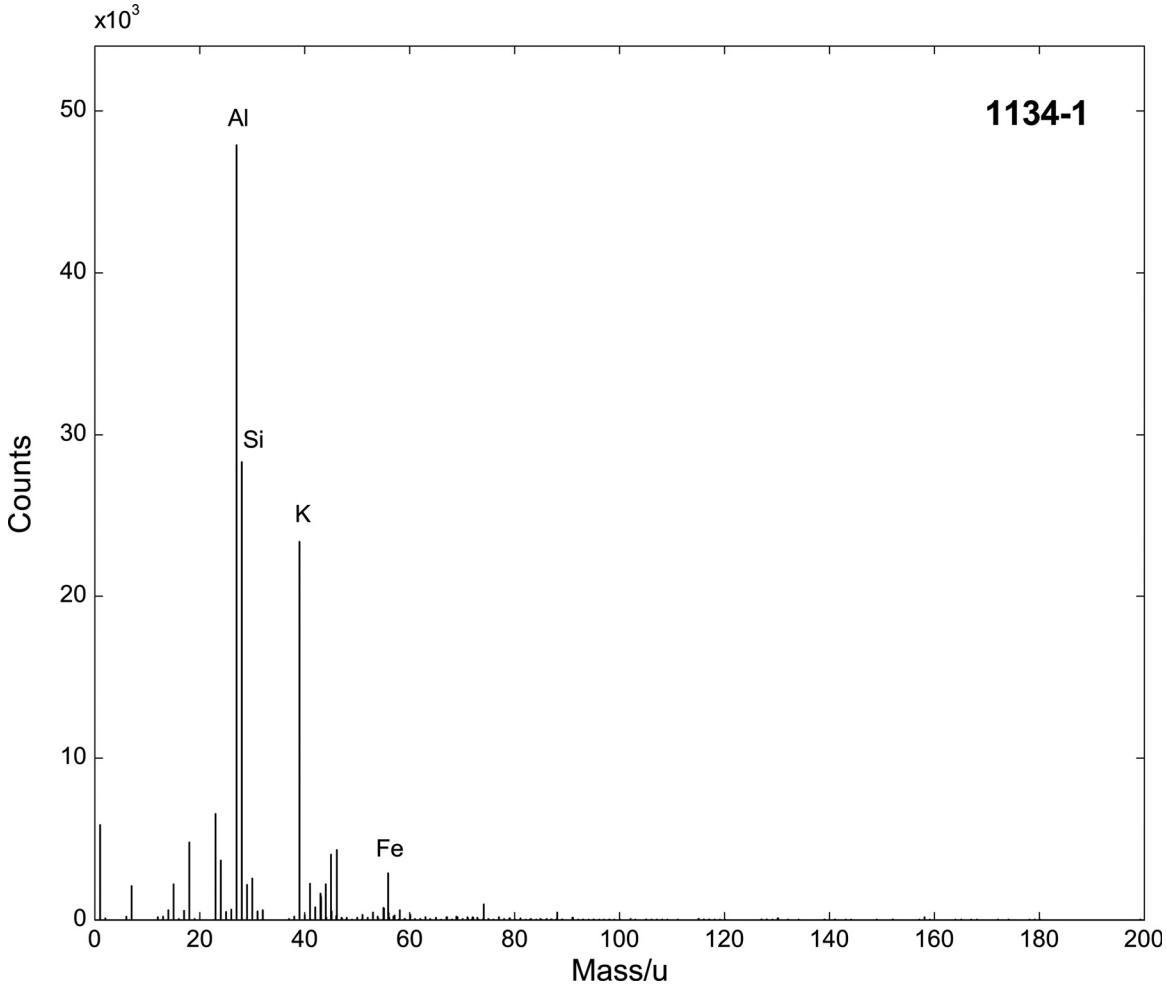
Accession #	01132–01
Host Material	Coal CJR012
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



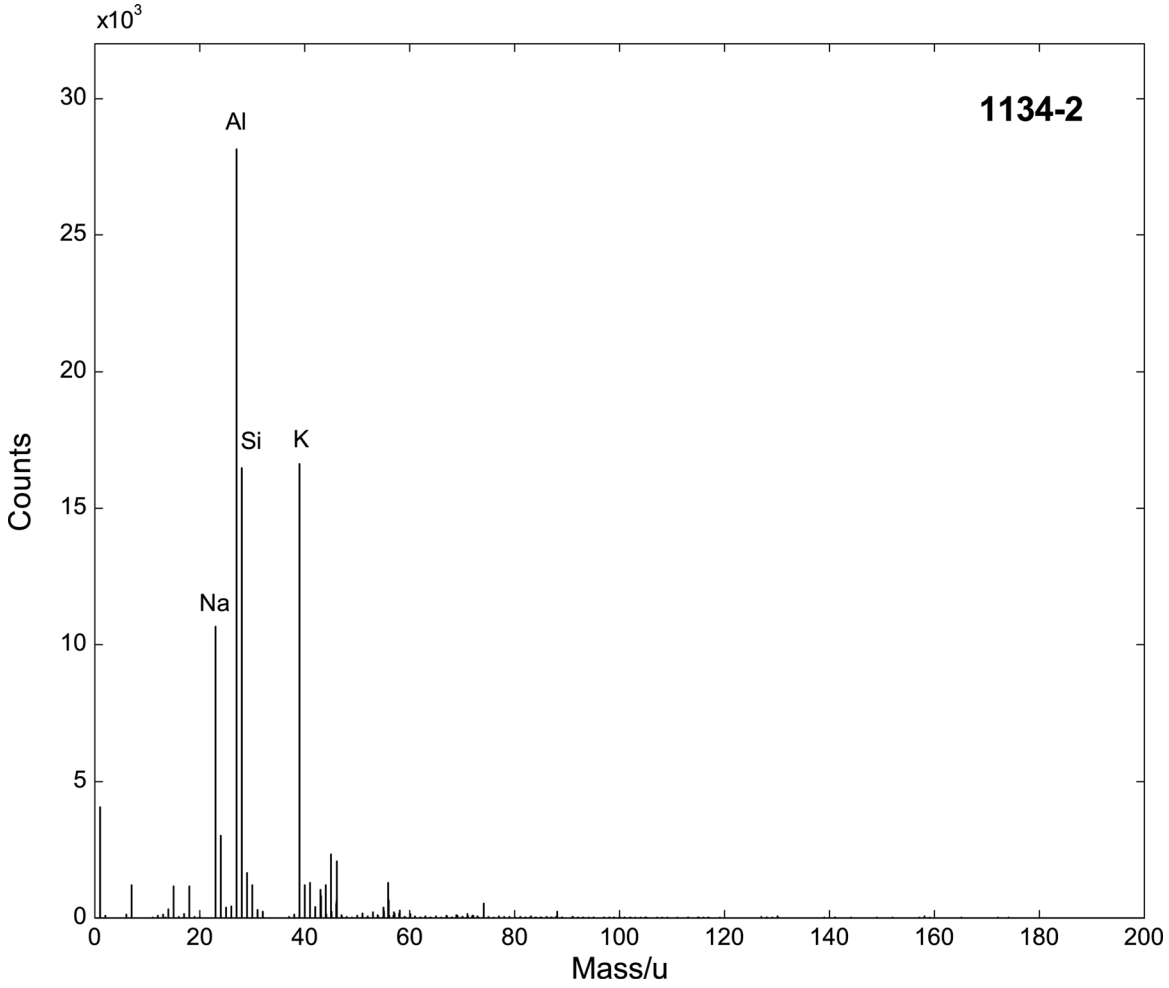
Accession #	01133–01
Host Material	Coal GAT034
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	$\sim$5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm $\times$ 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



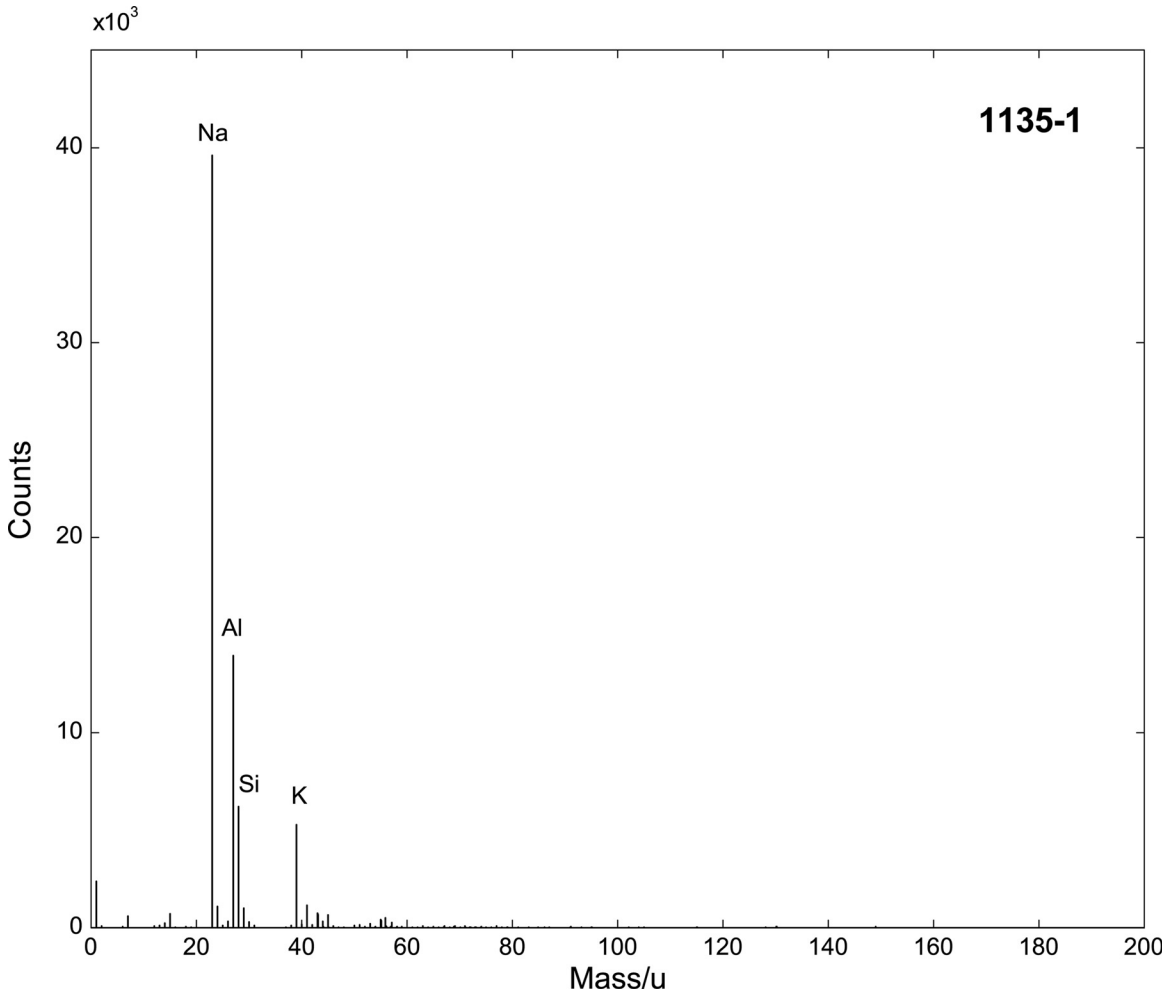
Accession #	01133–02
Host Material	Coal GAT034
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



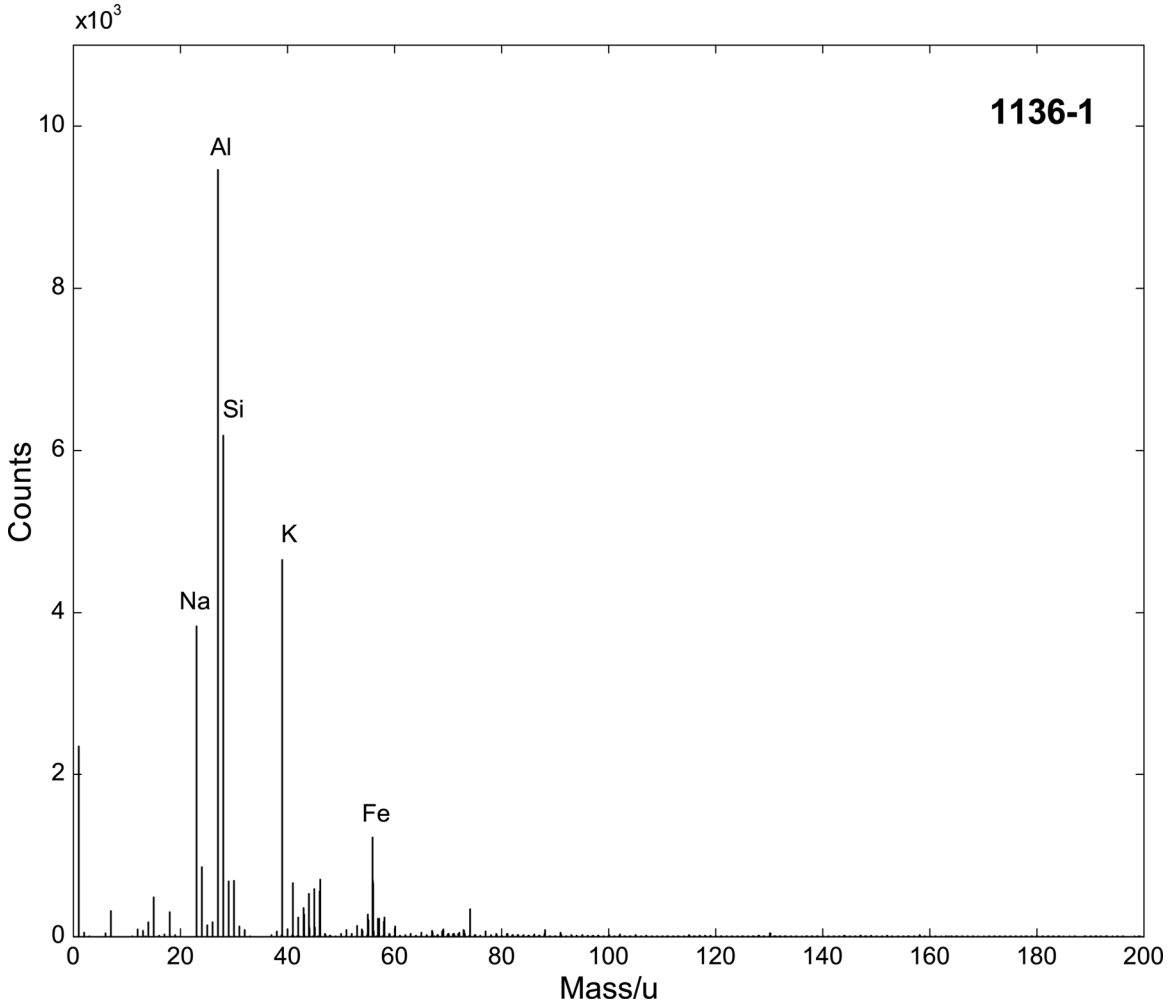
Accession #	01134–01
Host Material	Coal GAT035
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



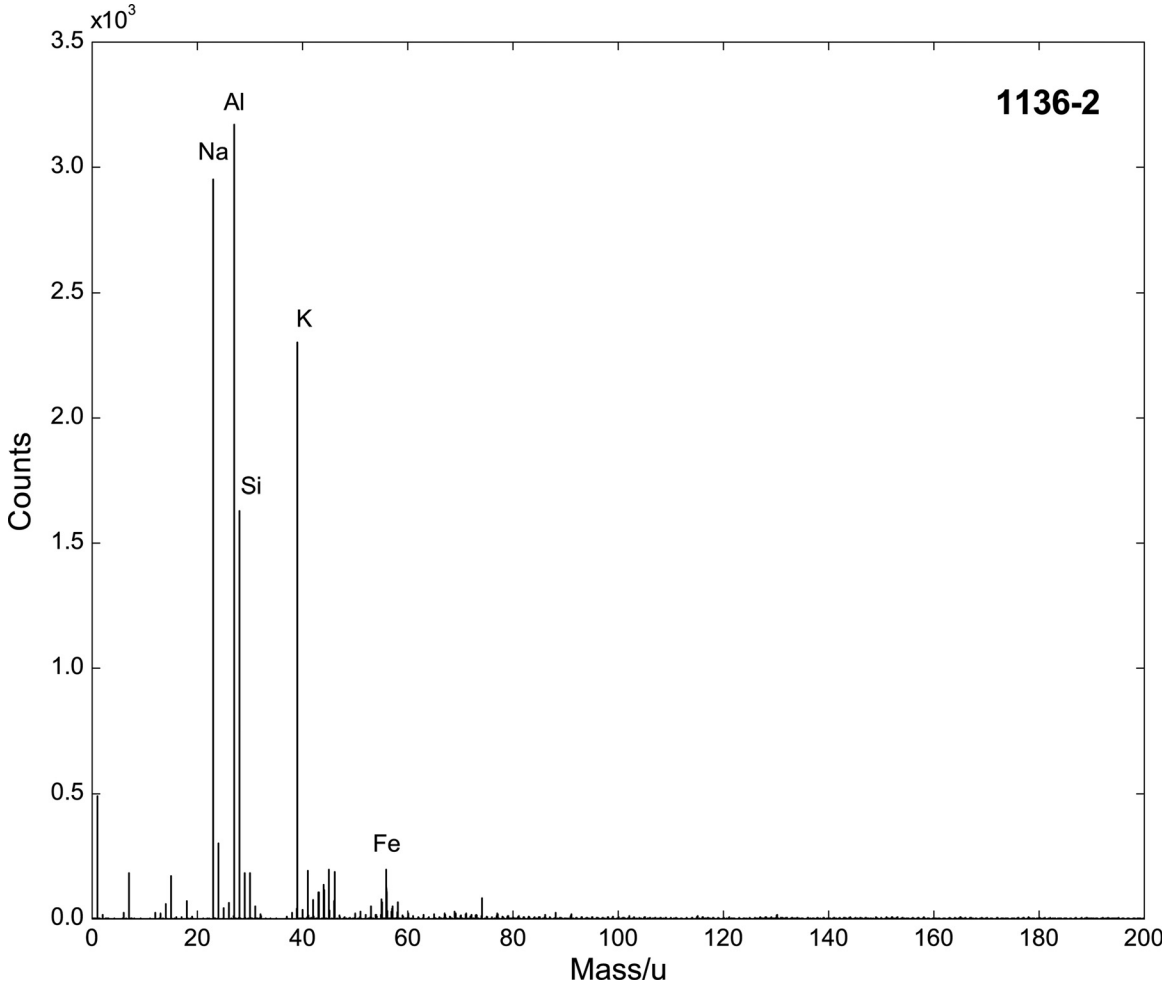
Accession #	01134–02
Host Material	Coal GAT035
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



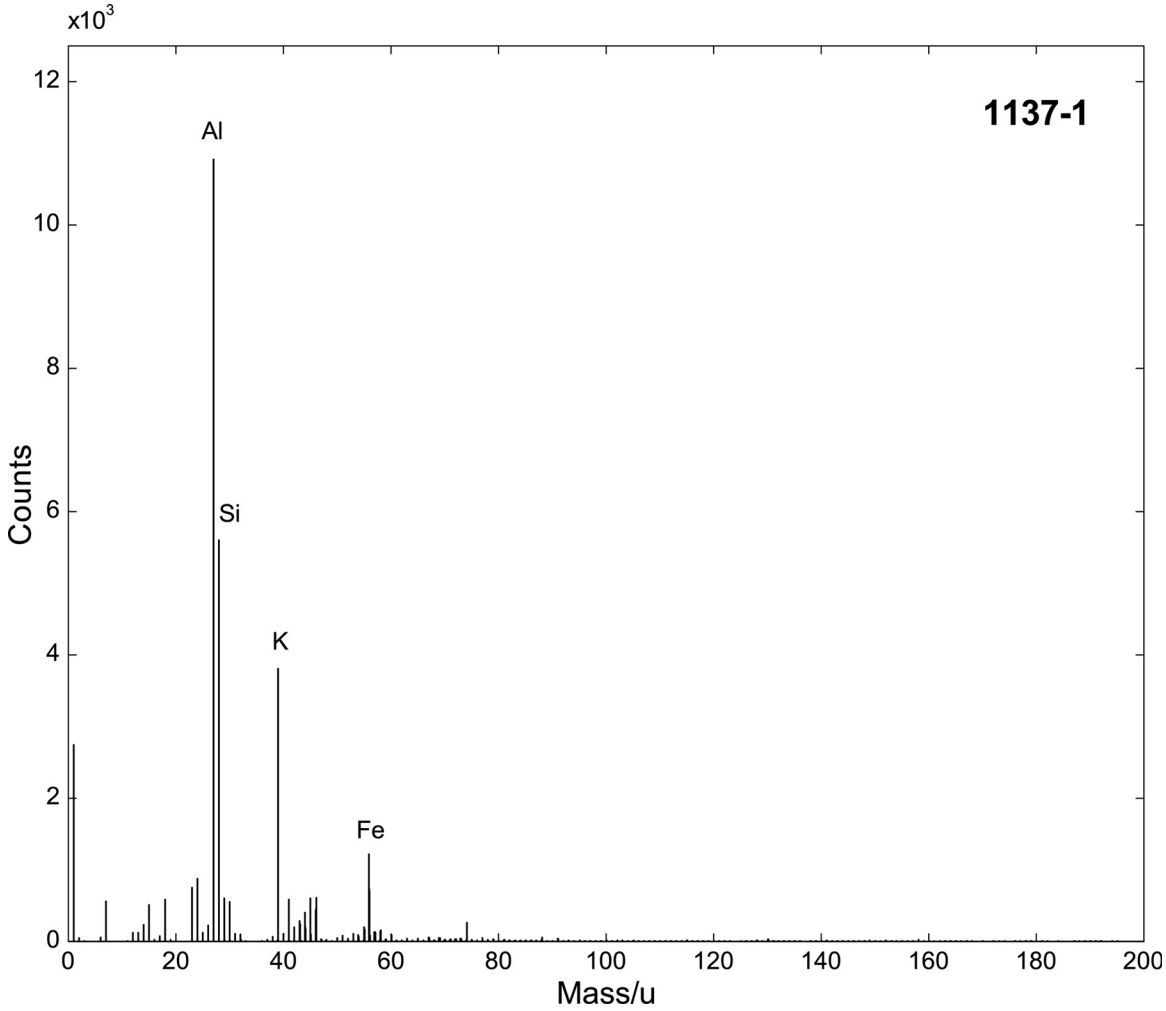
Accession #	01135–01
Host Material	Coal GBJ010
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



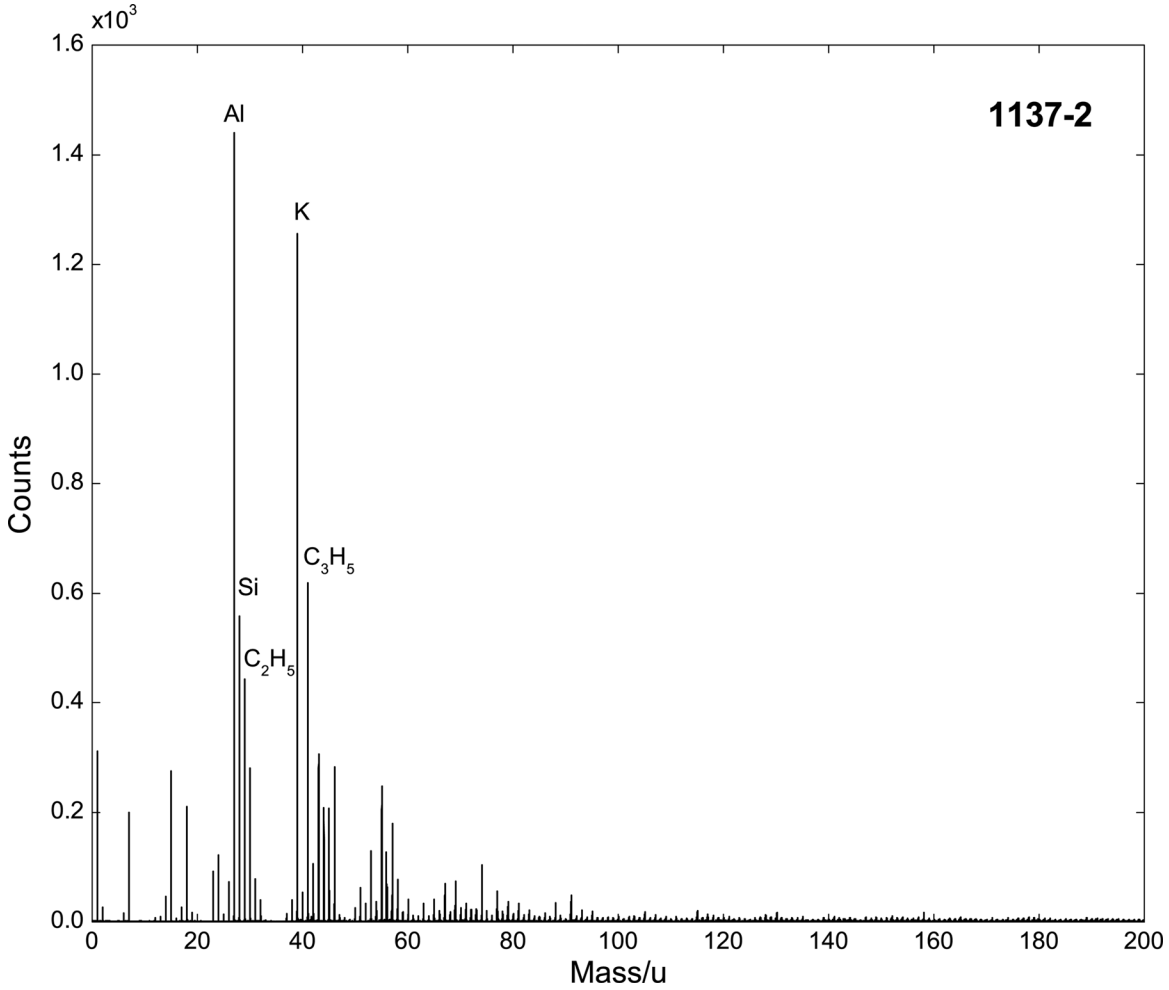
Accession #	01136–01
Host Material	Coal GLJ005
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



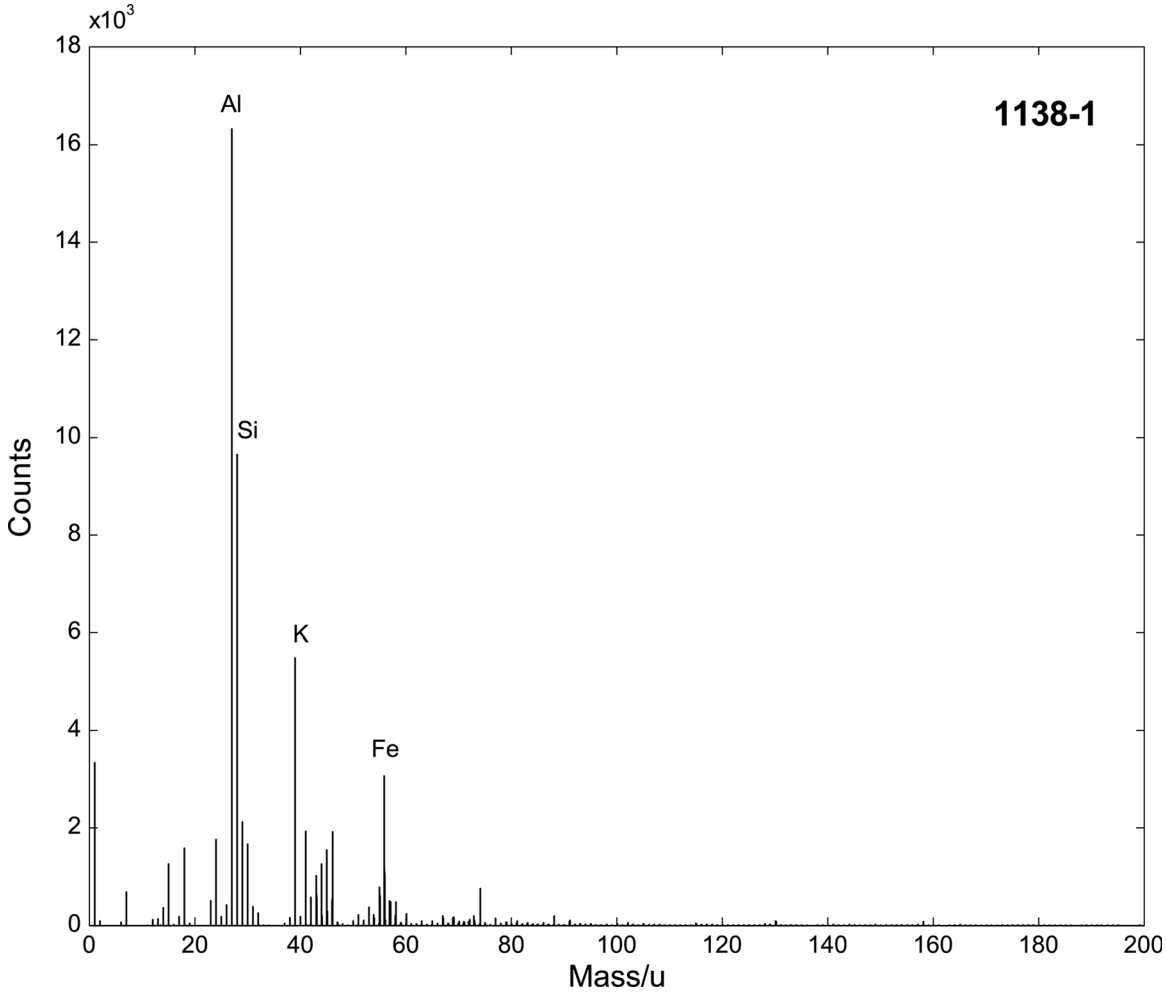
Accession #	01136–02
Host Material	Coal GLJ005
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



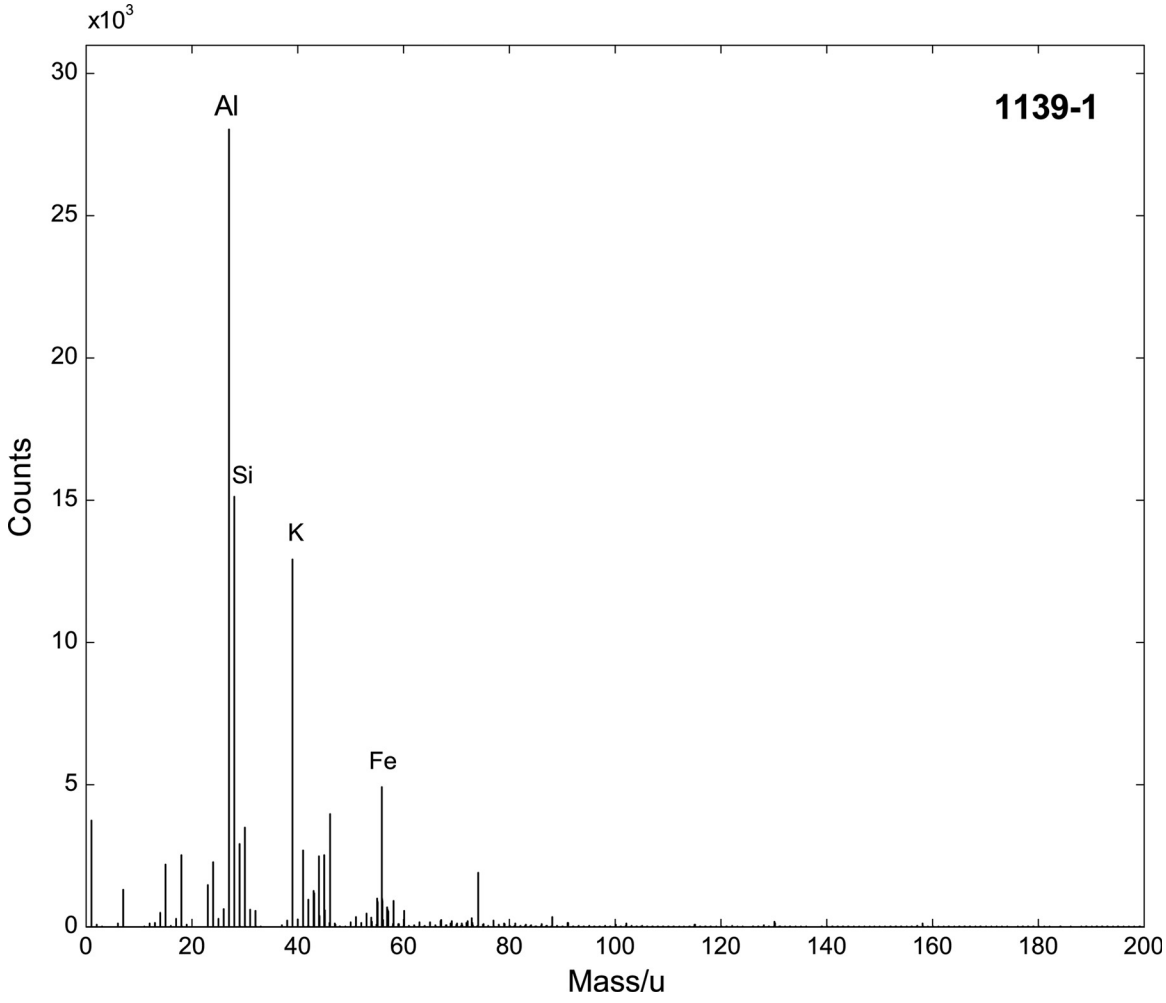
Accession #	01137–01
Host Material	Coal GPB062
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



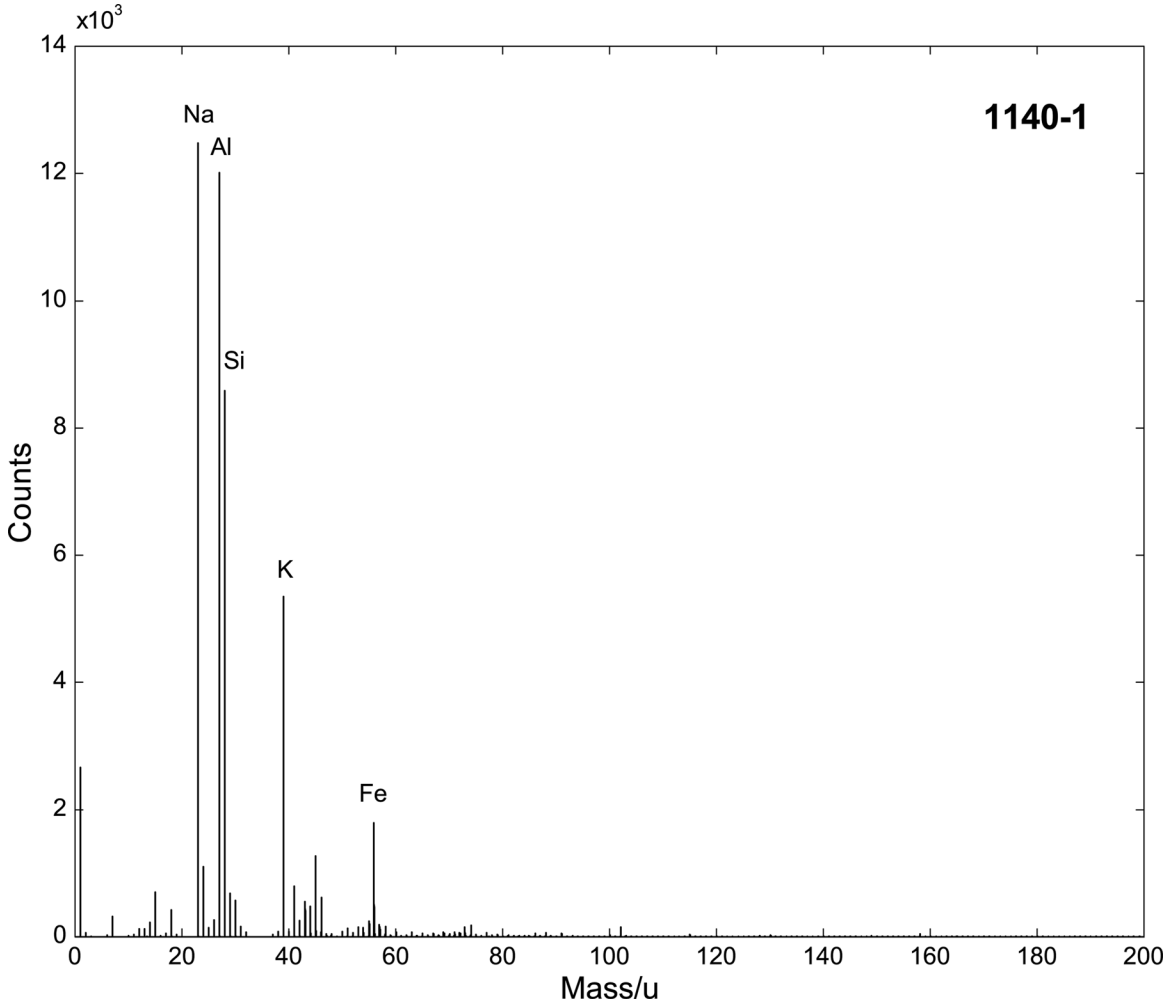
Accession #	01137–02
Host Material	Coal GPB062
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



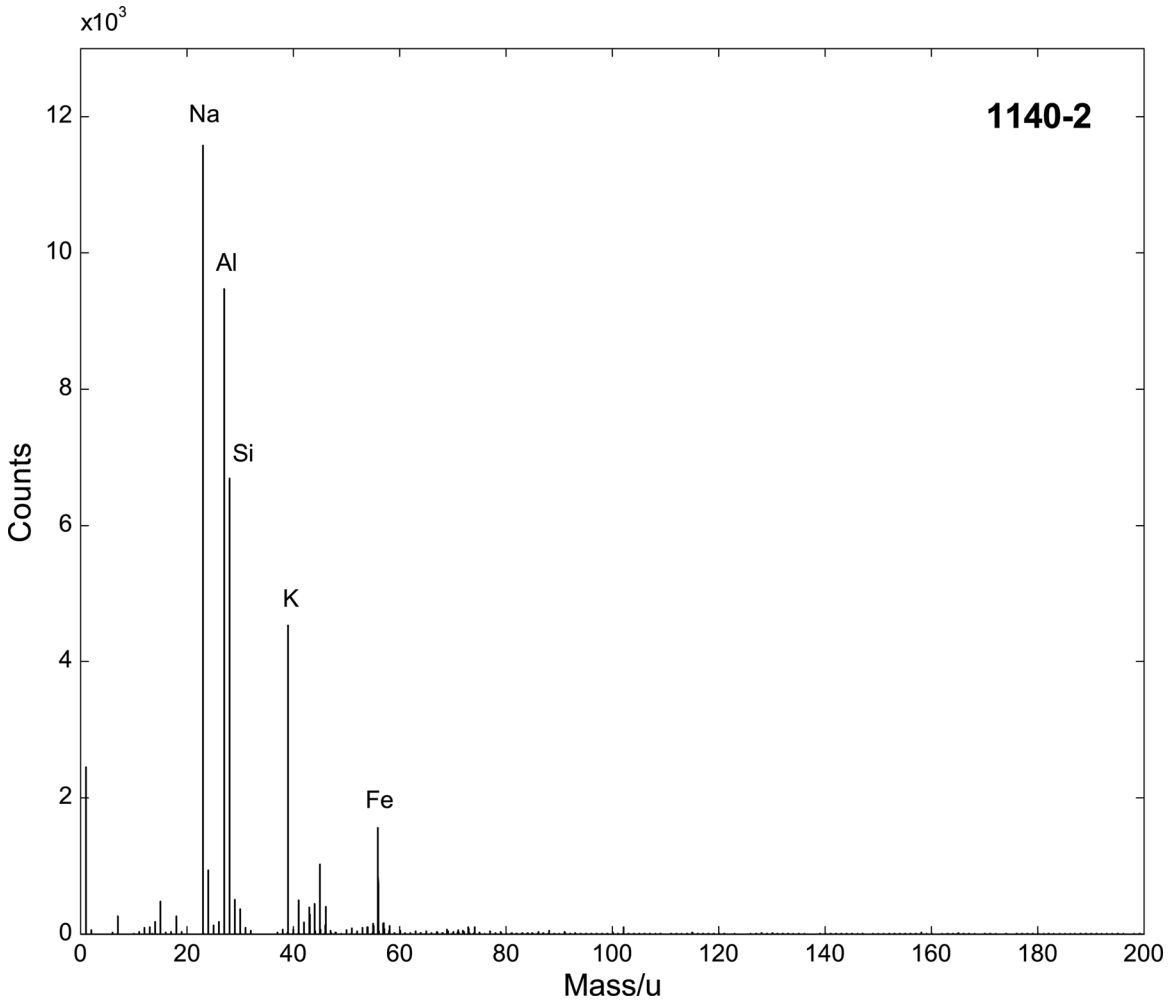
Accession #	01138–01
Host Material	Coal HGB011
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



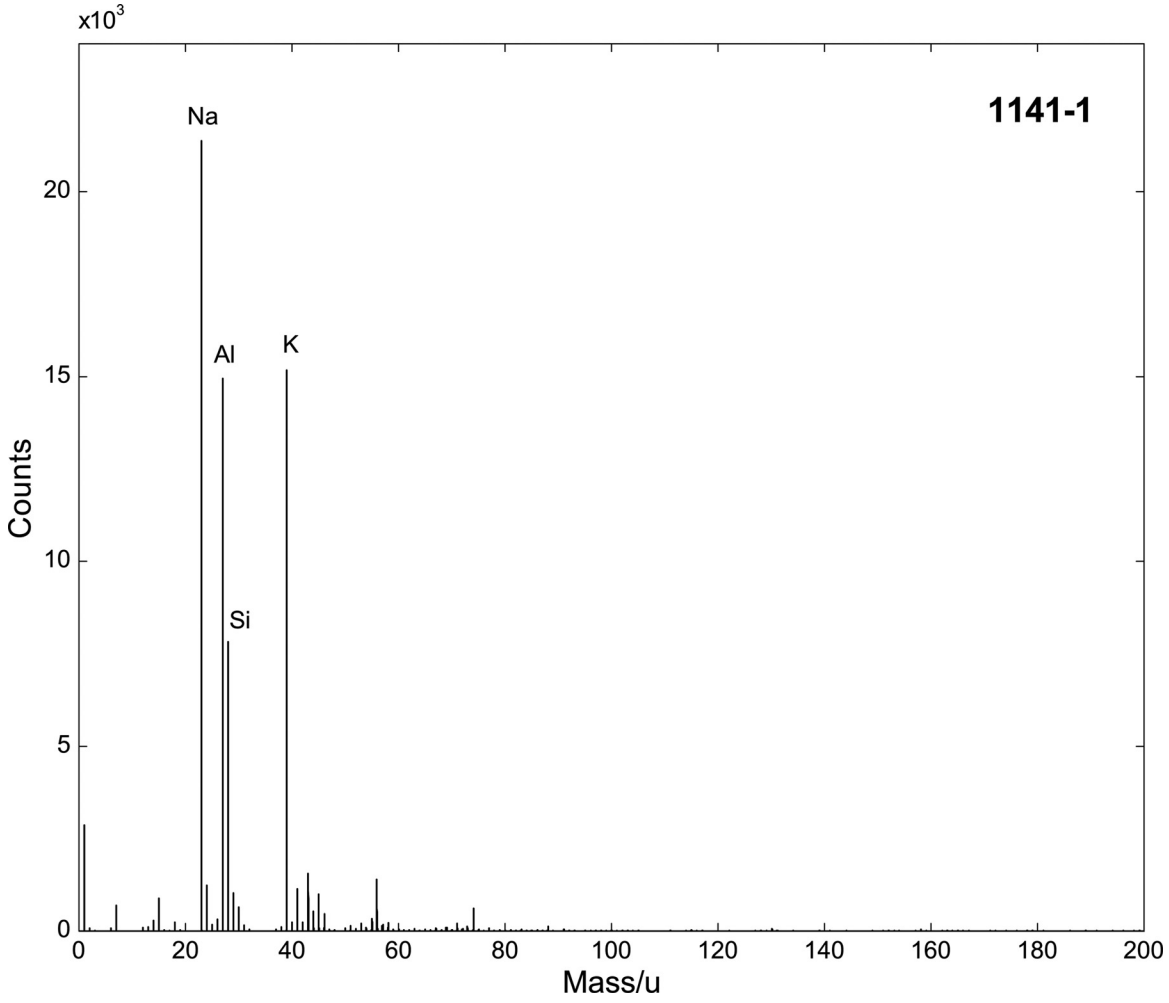
Accession #	01139–01
Host Material	Coal HNA015
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



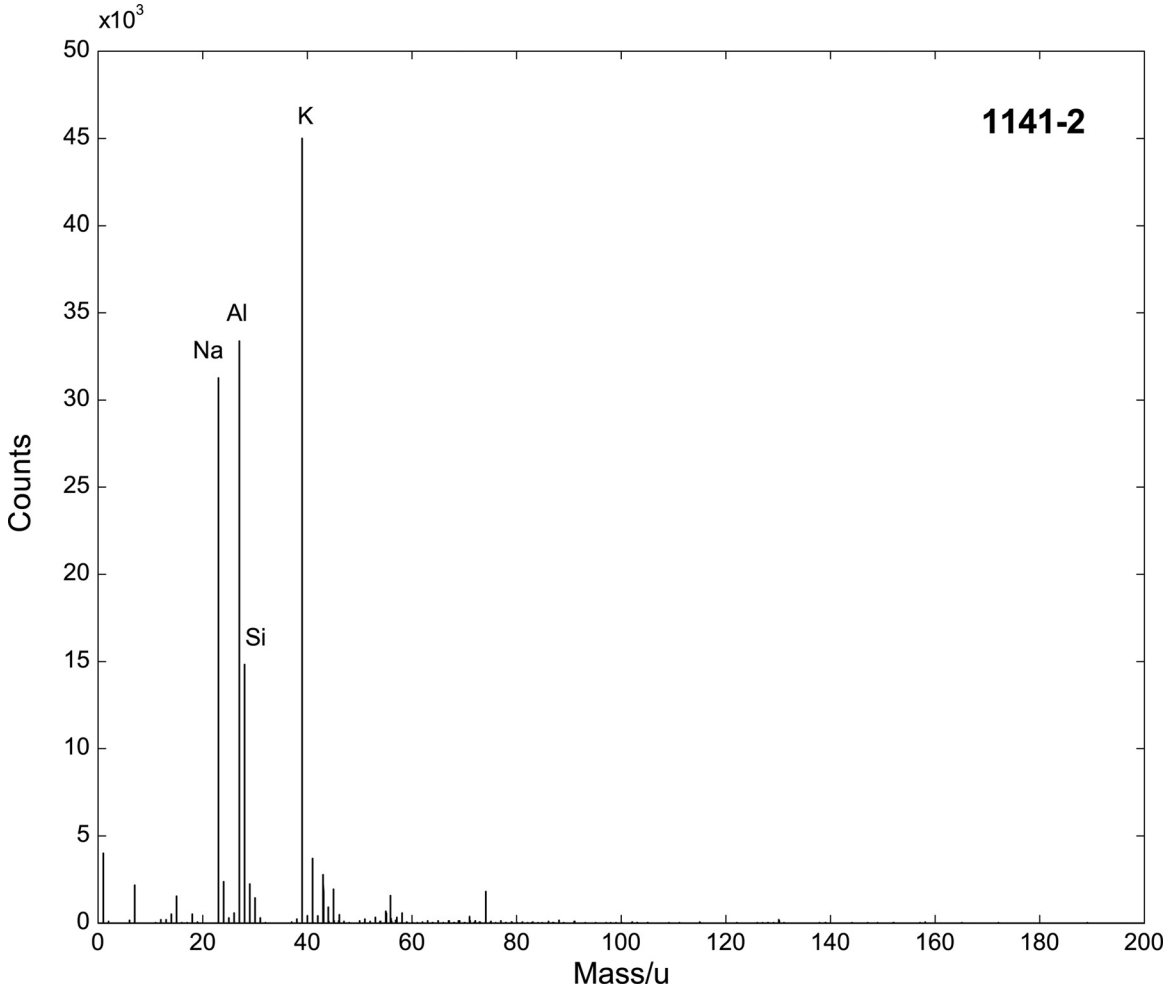
Accession #	01140–01
Host Material	Coal ILL6
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



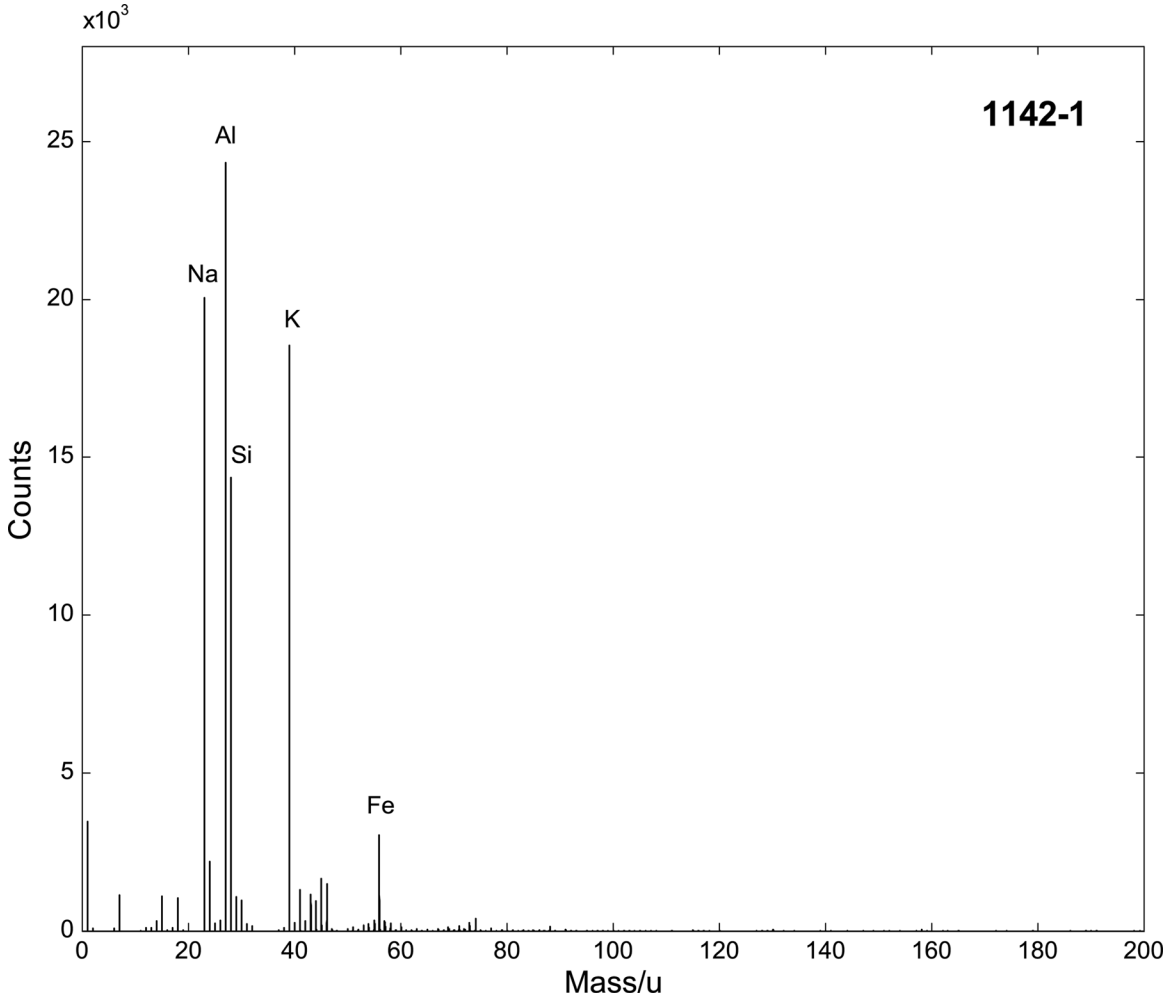
Accession #	01140–02
Host Material	Coal ILL6
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



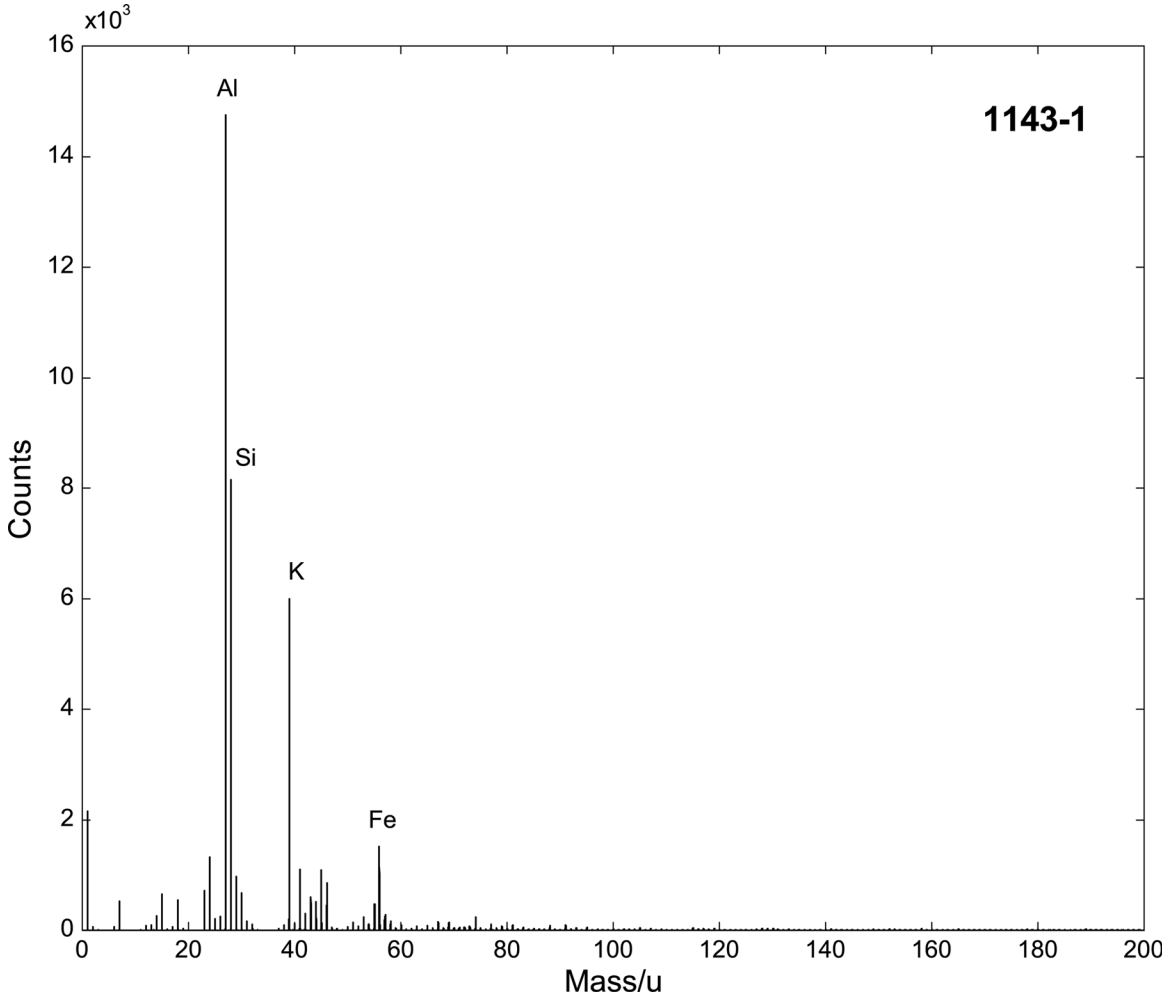
Accession #	01141–01
Host Material	Coal JIG014
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



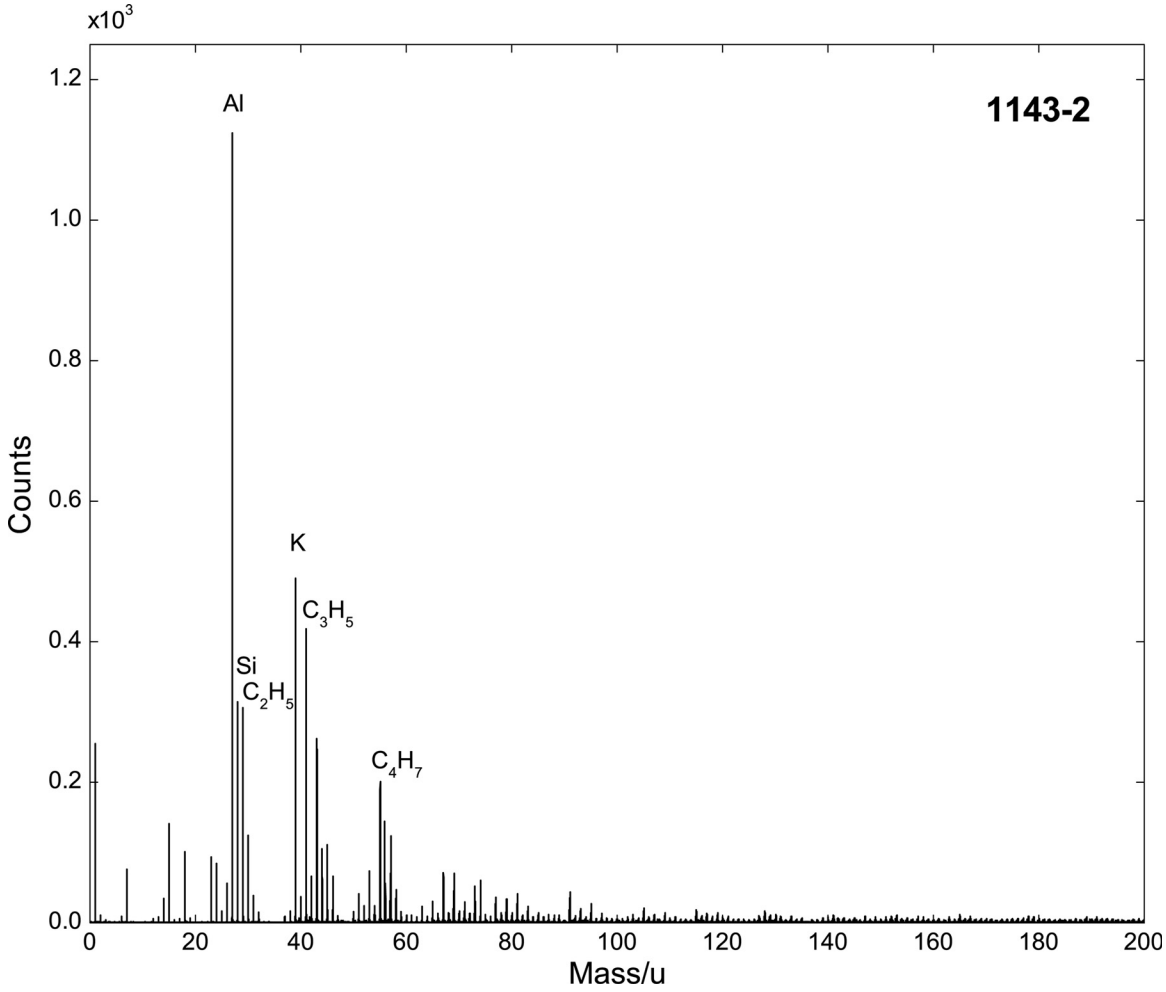
Accession #	01141–02
Host Material	Coal JIG014
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



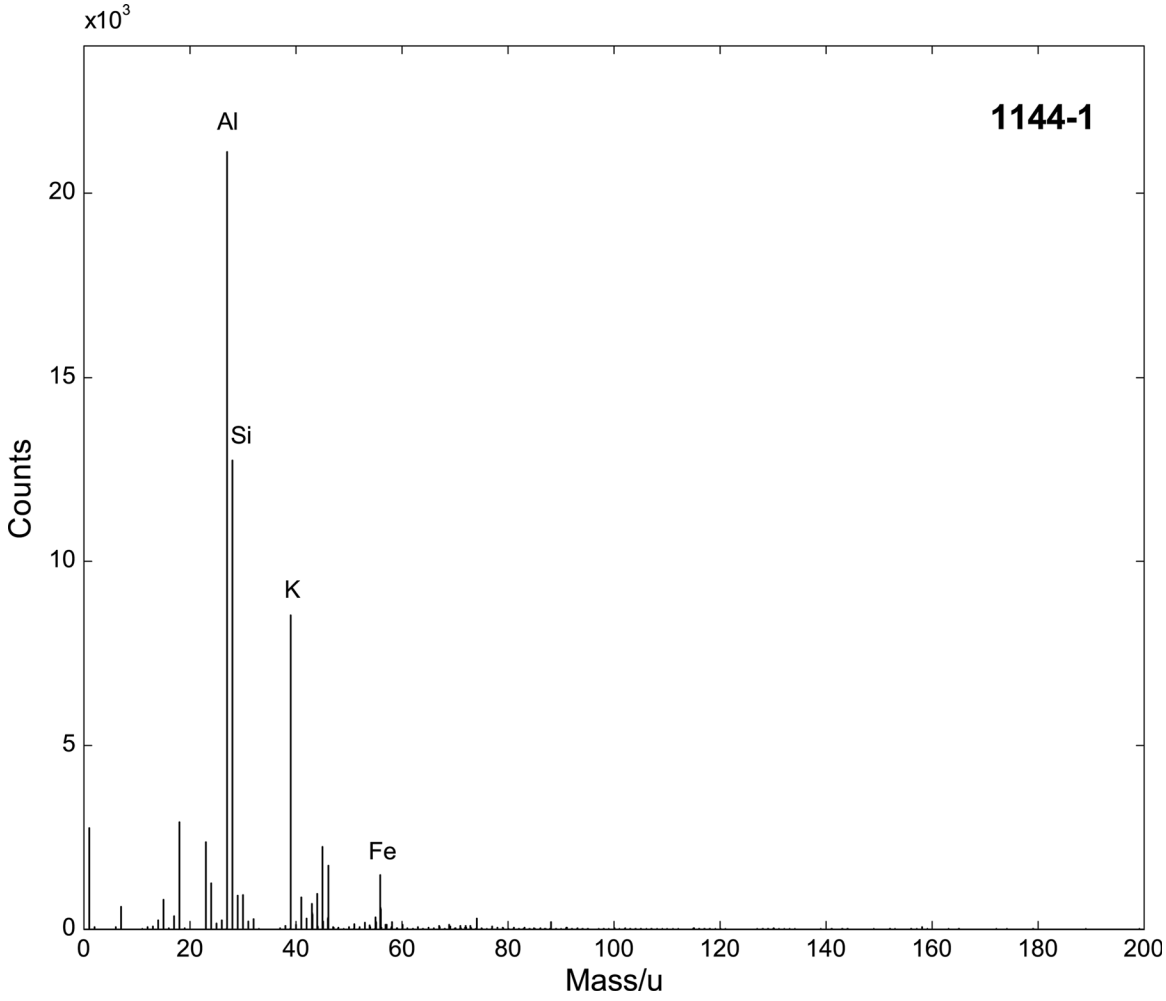
Accession #	01142–01
Host Material	Coal JIG017
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



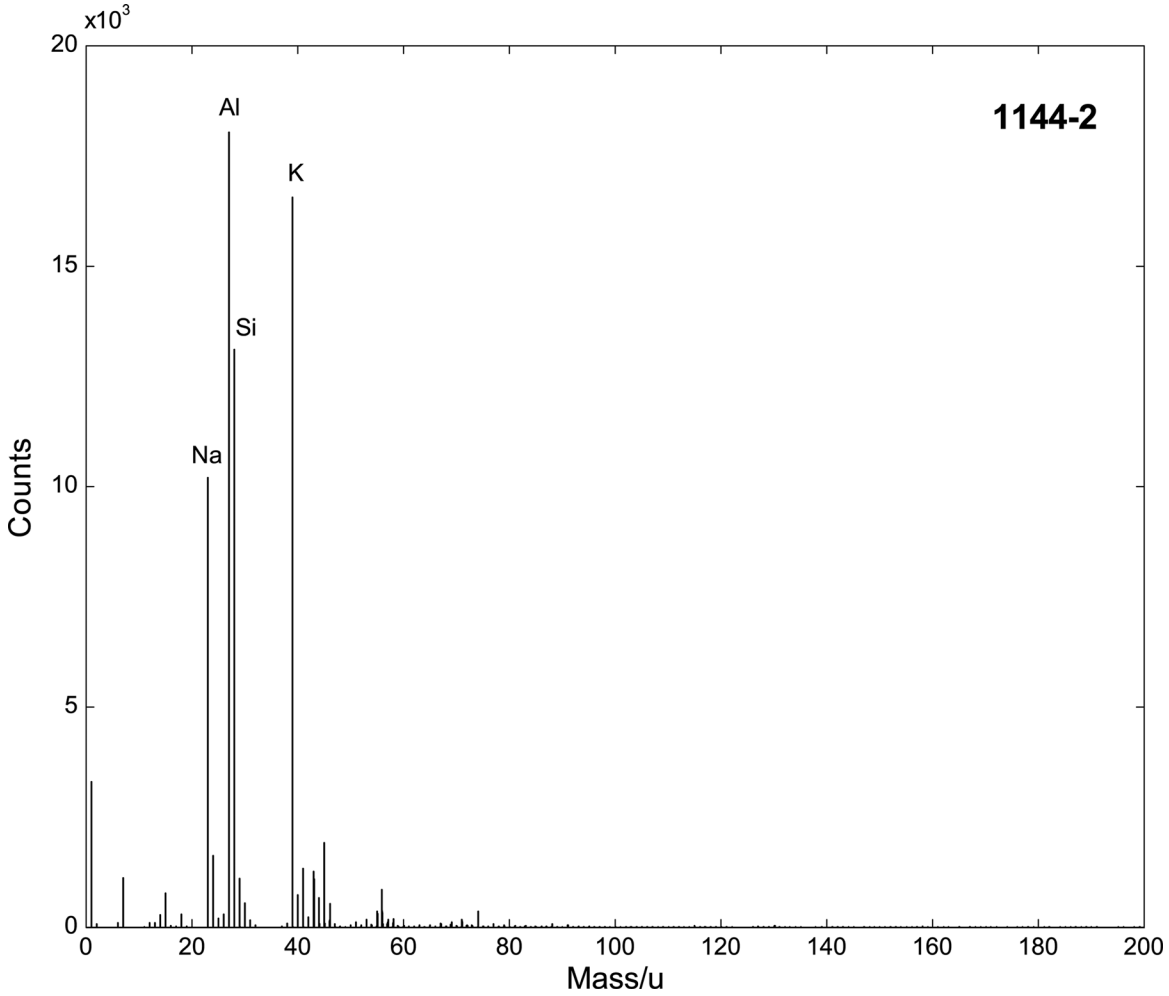
Accession #	01143–01
Host Material	Coal PCT010
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	∼5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°



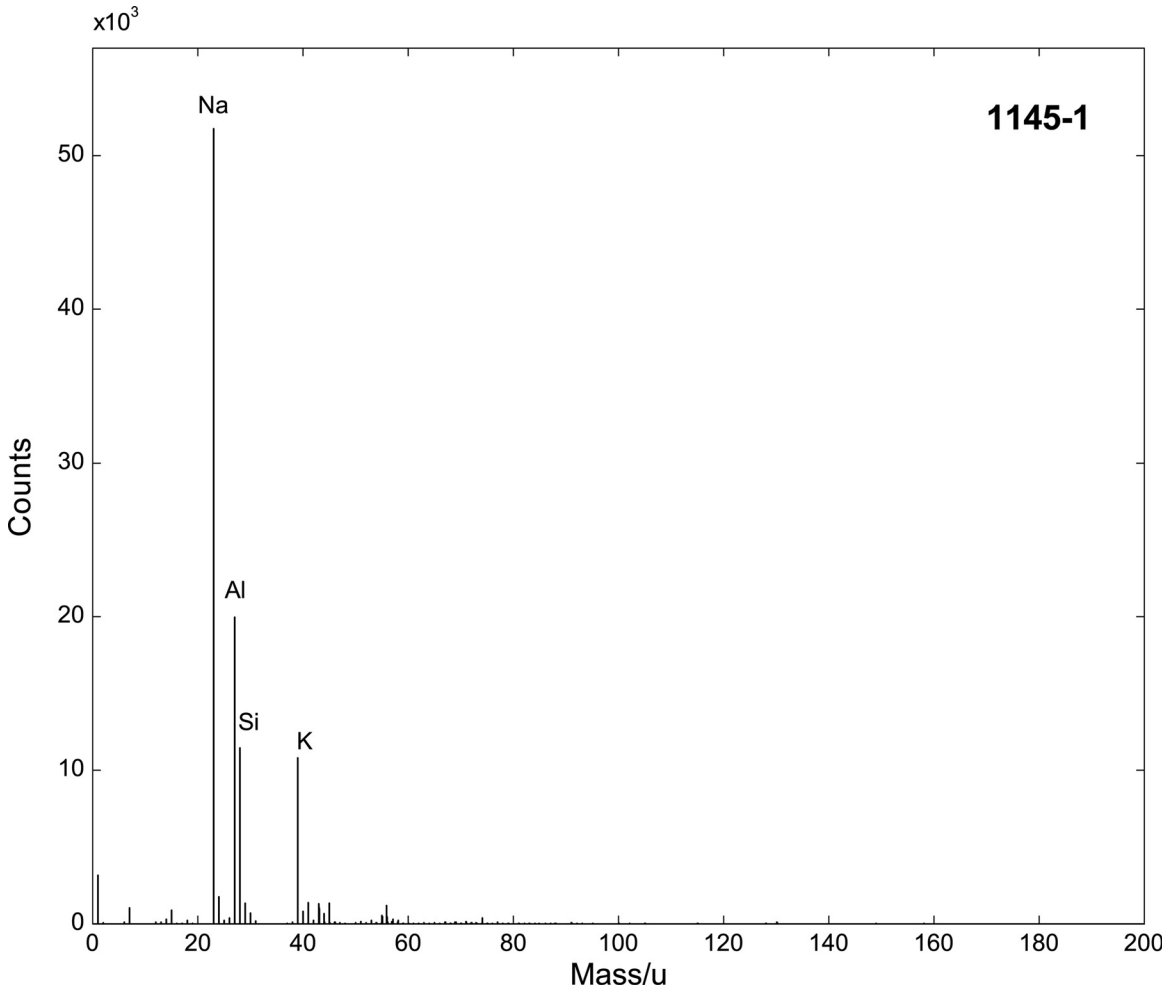
Accession #	01143–02
Host Material	Coal PCT010
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



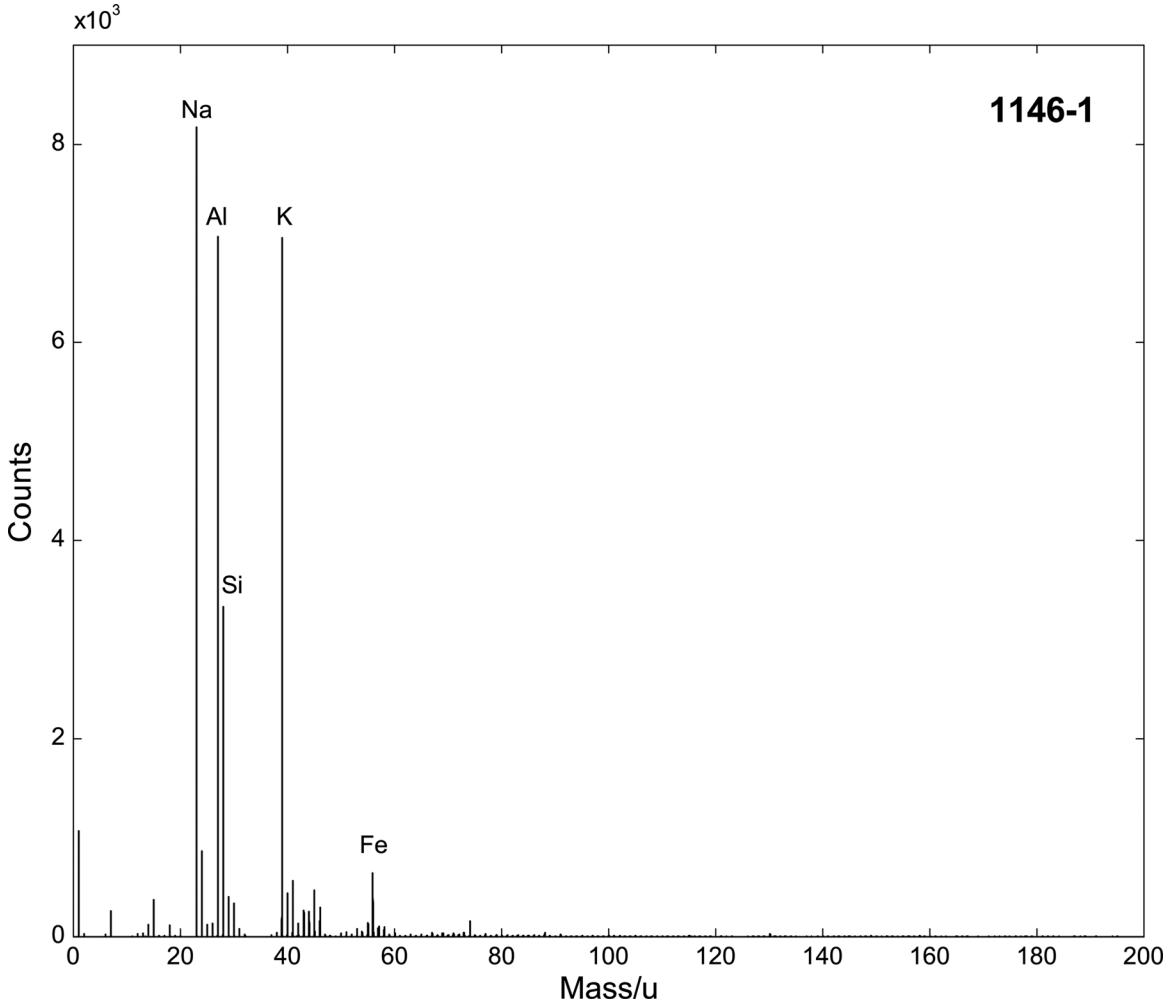
Accession #	01144–01
Host Material	Coal PCT012
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



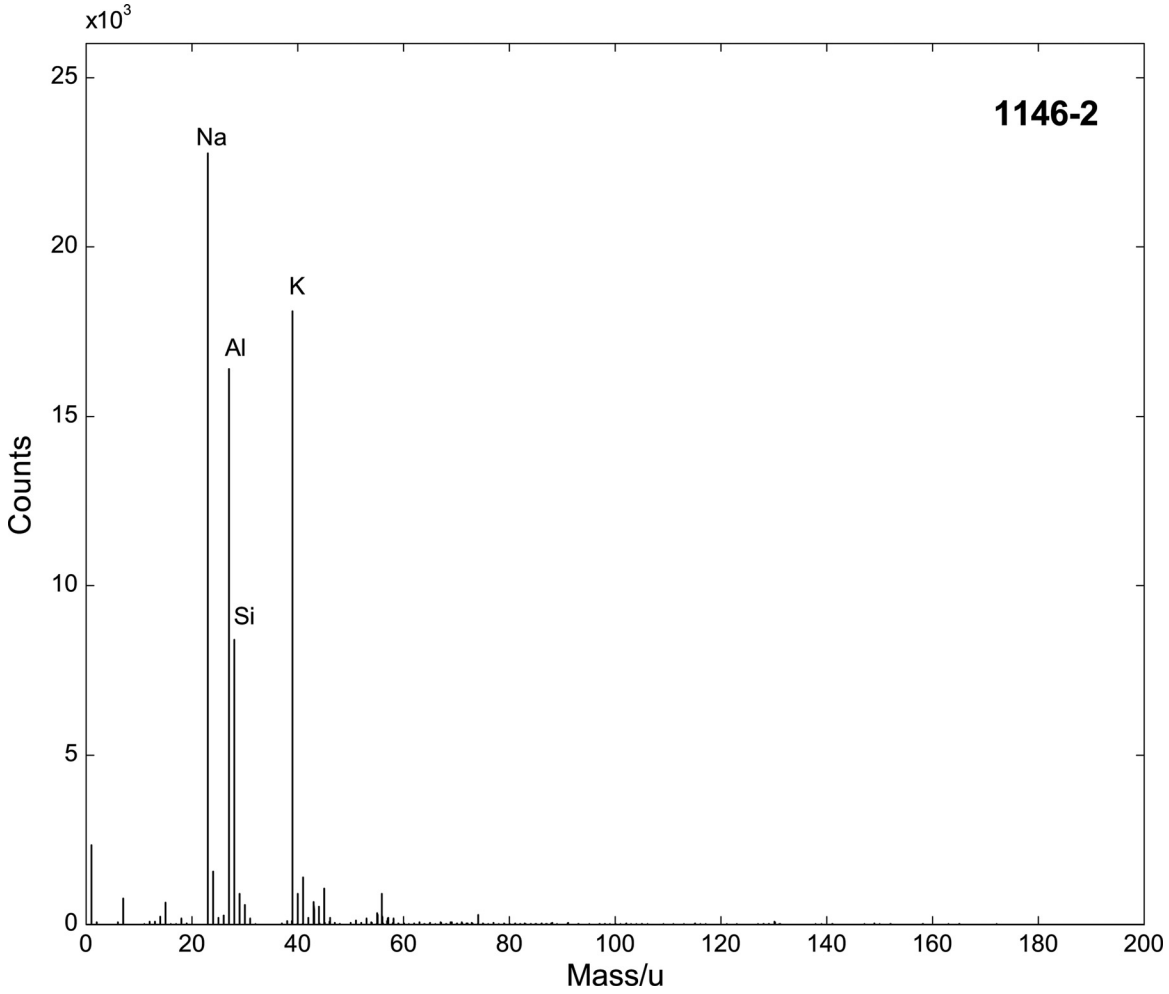
Accession #	01144–02
Host Material	Coal PCT012
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



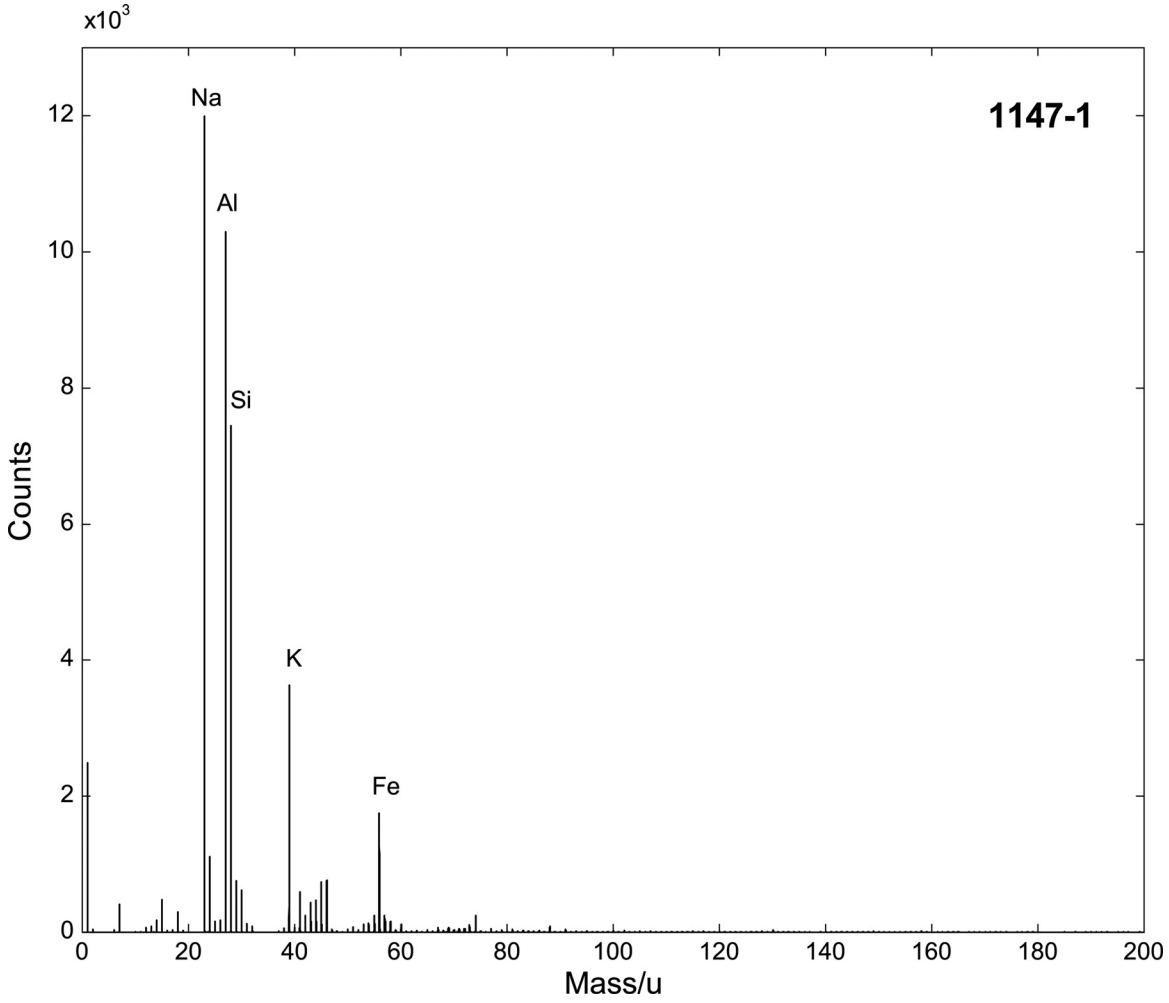
Accession #	01145–01
Host Material	Coal RBL014
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



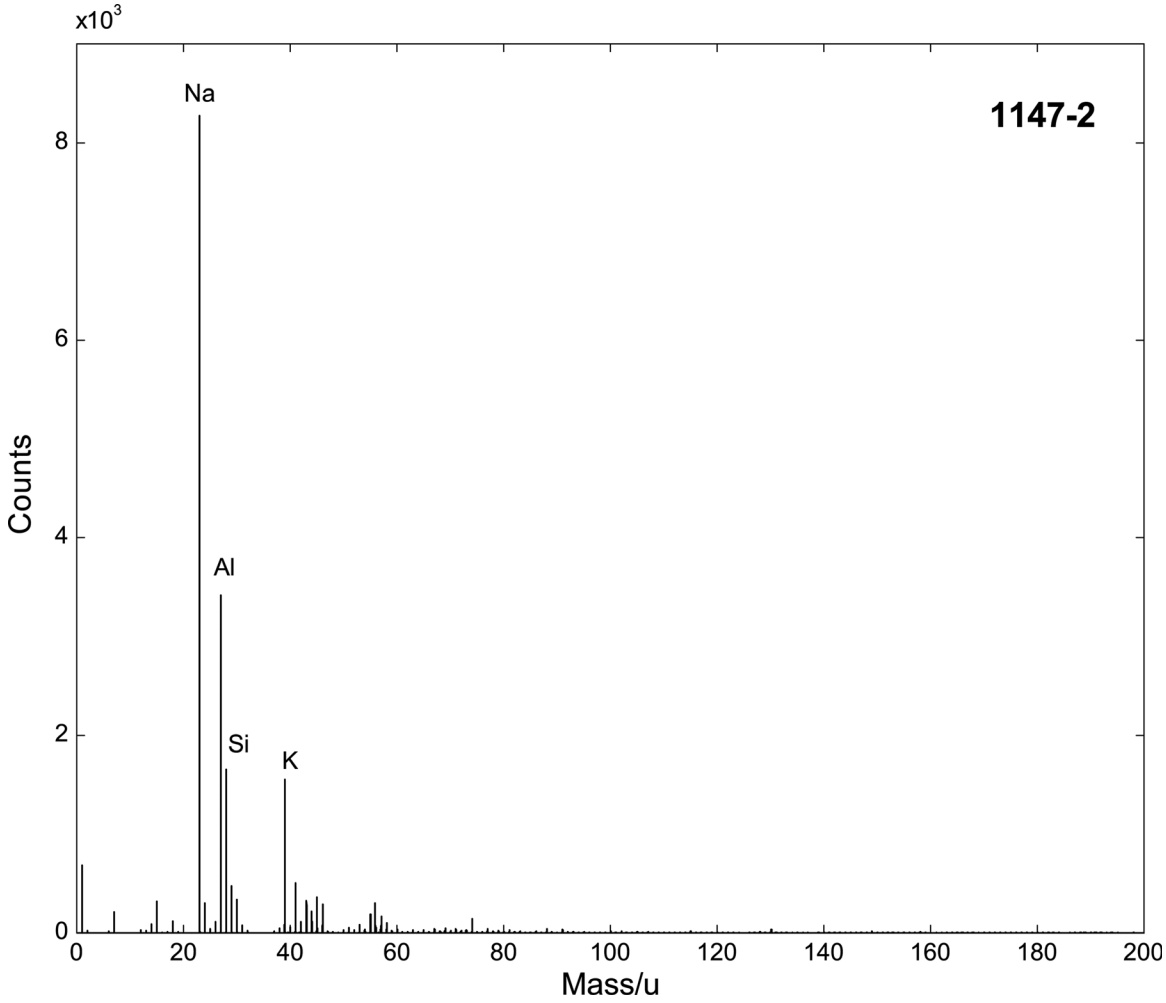
Accession #	01146–01
Host Material	Coal RLL012
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



Accession #	01146–02
Host Material	Coal RLL012
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



Accession #	01147–01
Host Material	Coal RLL014
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	



Accession #	01147–02
Host Material	Coal RLL014
Technique	ToF-SIMS
Mass Range	200 Da
Instrument	ION-TOF TOF-SIMS IV
Analyzer Type	time-of-flight, reflectron
Analyzer Mass Resolution	~5000
Detector Type	Electron multiplier
Specimen Normal to Analyzer	0°
Primary Beam Ion Gun	ION-TOF
Primary Species	Ga^+
Primary Ion Pulse Length	25×10^{-9} sec
Primary Ion Pulse Rate	10 kHz
Net Beam Voltage	25000
Beam Current	1.5 nA
Beam Diameter	0.1 μm
Beam Raster Width	500 μm × 500 μm
Beam Incident Angle	45° (45° effective)
Source to Analyzer Angle	45°
Comment	