Detailed Elemental Analysis of 1650,s Bronze materials found in Illinois Utilizing x ray beams from the Tracer III V+ and The Artax systems

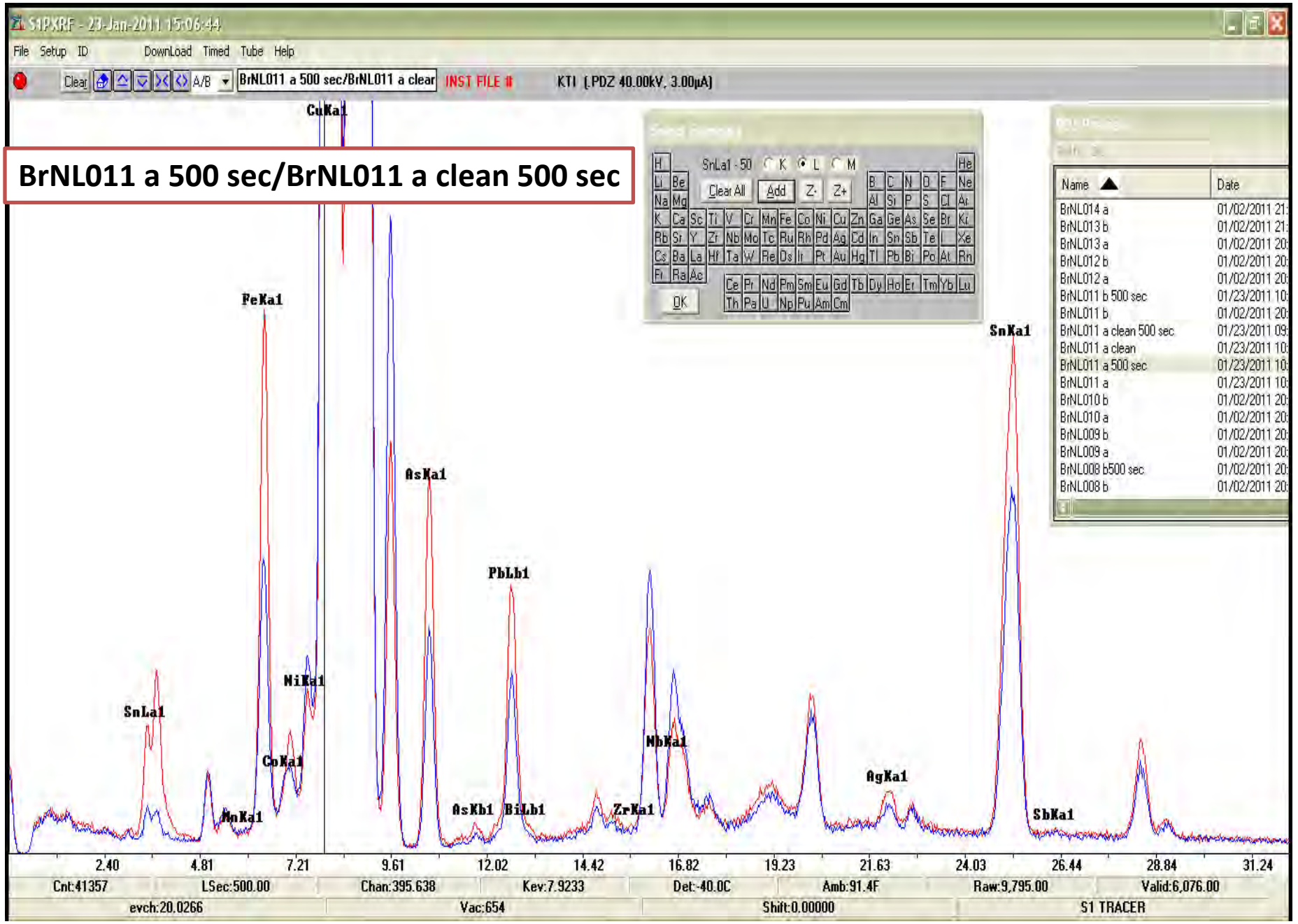
Comparison of as found surface and cleaned surface
Artifacts BrNL011, BrNL102, BrNL105

The following 3 slides are typical spectra of samples in a clean are and a natural area. "Cleaning" was done by scraping away the corrosion layer, until bright metal was visible.

The Tracer measurements without "Clean" in the name were taken through the corrosion layer. Artax scans were set up to cover part of the cleaned area an part of the natural area. This is clearly evident in the photographs and the plots of each element distribution. It is very important to understand it is impossible for xrf analysis to give quantitative answers when a corrosion layer is present as this material is by its nature very non uniform and x ray physics precludes quantification of these materials. So any quantitative numbers in these situations are just mean to be indicative of the possible greater or lesser presence of a element, and only logical deduction can help one with the knowledge whether the element is in the corrosion or in th base metal ;as you are measuring both in some unknown proportion. It is for this reason that when ever possible both clean and corroded surfaces where measured. Also where possible the front and back of each item was measured as early Cu alloys by there very nature are very non uniform.

The measurements with the Tracer were taken with the Rh X ray tube set at 40 Kv and 3 micro amps, with a .001" Ti - .012" Al beam filter for 500 sec to assure that the trace elements could be detected in the raw spectrum.

Below are the actual raw spectra of each location "scanned " with the Artax are overlayed so one can easily see the elemental differences for 3 artifacts BrNL011, BrNL102, BrNL105 cleaned and natural.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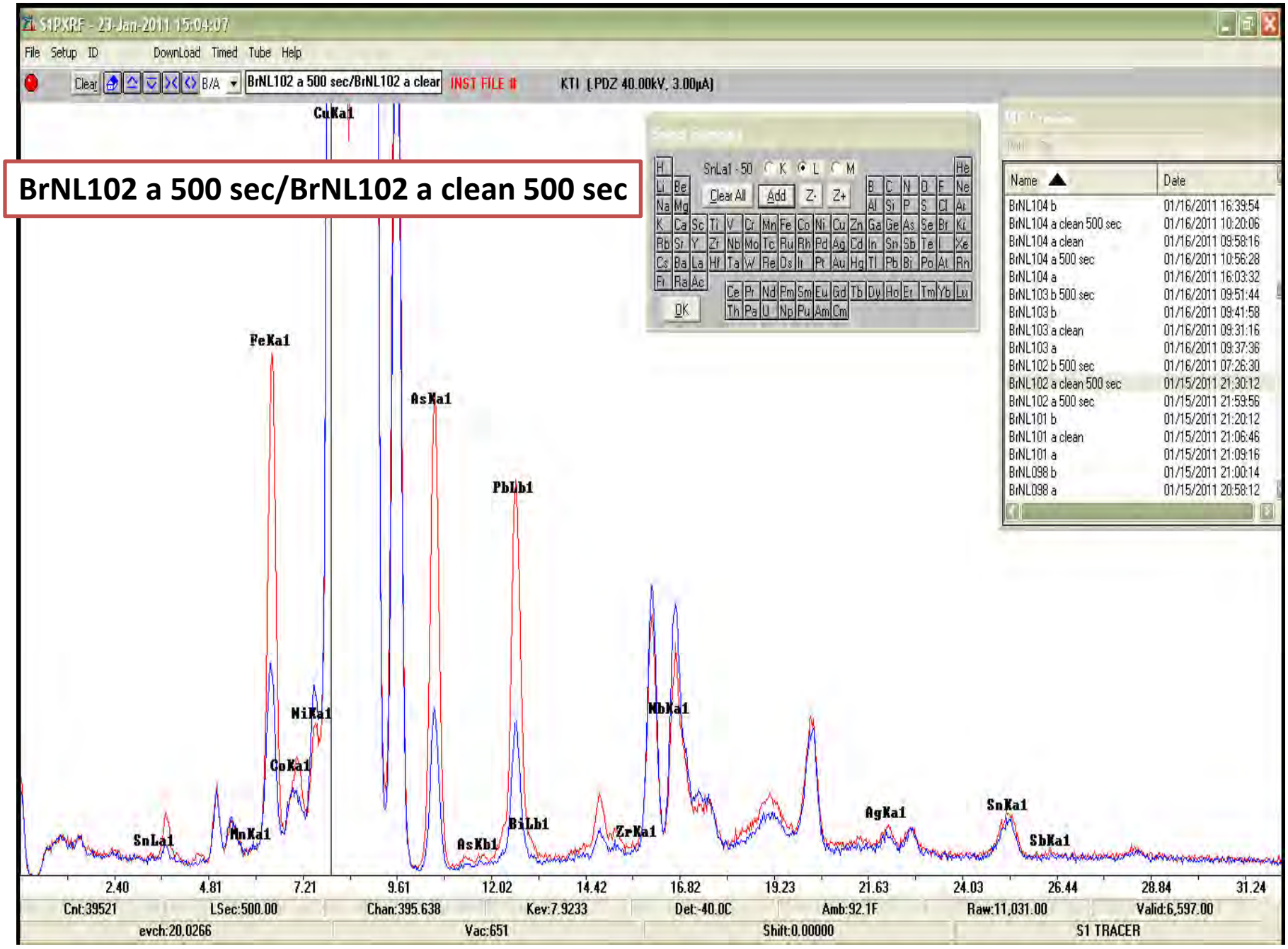
File Setup ID DownLoad Timed Tube Help
Clear A/B BrNL011 a 500 sec/BrNL011 a clear INST FILE # KTI (PDZ 40.00kV, 3.00µA)
BrNL011 a 500 sec/BrNL011 a clean 500 sec
CuKa1
FeKa1
AsKa1
PbLb1
SnKa1
SnLa1
NiKa1
CoKa1
MnKa1
AsKb1
BiLb1
ZrKa1
NbKa1
AgKa1
SbKa1
SnLa1 - 50
K L M
Clear All
Add
Z-
Z+
OK
Name
Date
BrNL014 a 01/02/2011 21:
BrNL013 b 01/02/2011 21:
BrNL013 a 01/02/2011 20:
BrNL012 b 01/02/2011 20:
BrNL012 a 01/02/2011 20:
BrNL011 b 500 sec 01/23/2011 10:
BrNL011 b 01/02/2011 20:
BrNL011 a clean 500 sec 01/23/2011 09:
BrNL011 a clean 01/23/2011 10:
BrNL011 a 500 sec 01/23/2011 10:
BrNL011 a 01/23/2011 10:
BrNL010 b 01/02/2011 20:
BrNL010 a 01/02/2011 20:
BrNL009 b 01/02/2011 20:
BrNL009 a 01/02/2011 20:
BrNL008 b500 sec 01/02/2011 20:
BrNL008 b 01/02/2011 20:
2.40 4.81 7.21 9.61 12.02 14.42 16.82 19.23 21.63 24.03 26.44 28.84 31.24
Cnt:41357 LSec:500.00 Chan:395.638 Kev:7.9233 Det:-40.0C Amb:91.4F Raw:9,795.00 Valid:6,076.00
evch:20.0266 Vac:654 Shift:0.00000 S1 TRACER


S1PXRF - 23-Jan-2011 15:04:07
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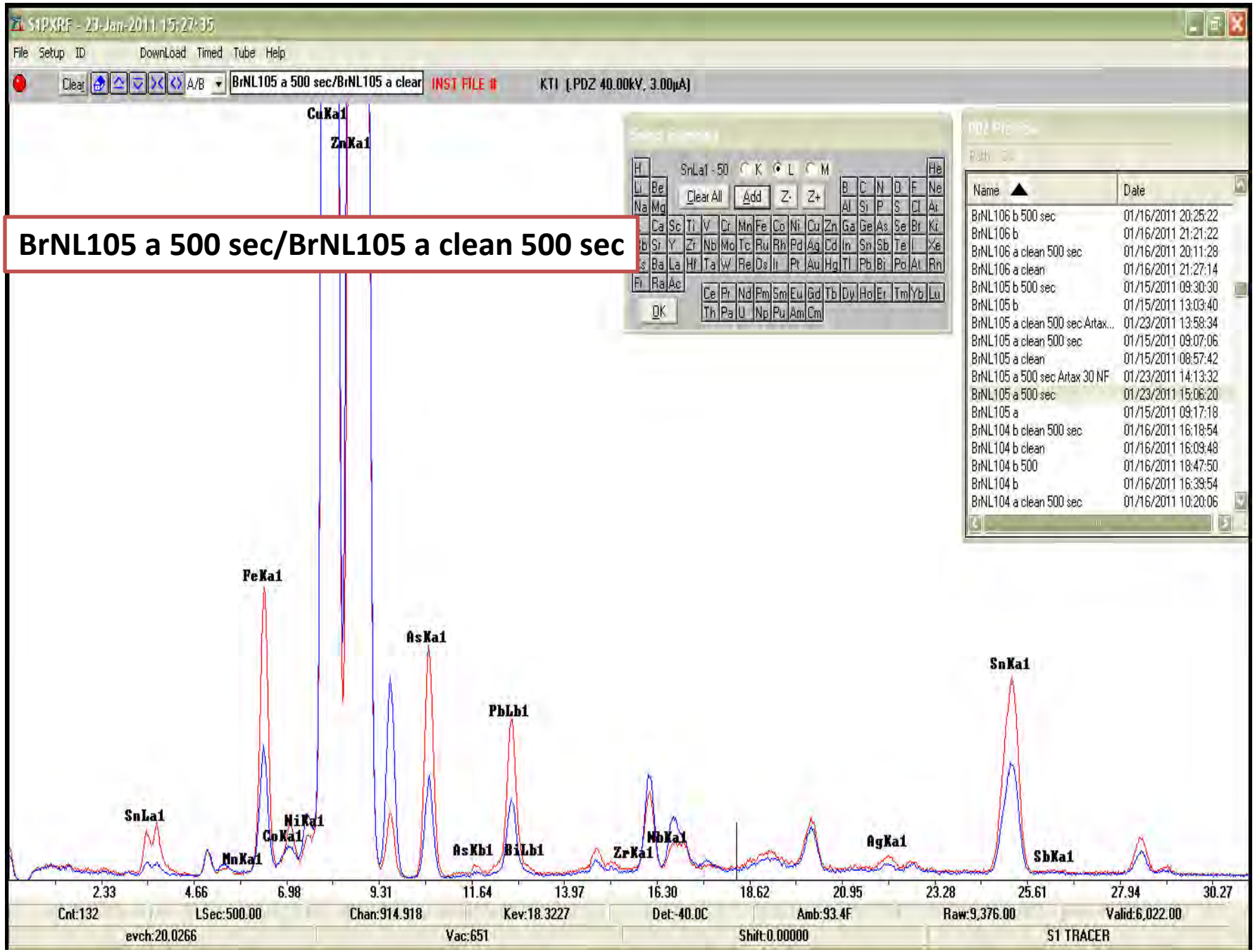
Clear B/A BrNL102 a 500 sec/BrNL102 a clear INST FILE # KTI [.PDZ 40.00kV, 3.00µA]
BrNL102 a 500 sec/BrNL102 a clean 500 sec
CuKa1
FeKa1
AsKa1
PbLb1
NiKa1
CoKa1
MnKa1
SnLa1
AsKb1
BiLb1
ZrKa1
NbKa1
AgKa1
SnKa1
SbKa1
SnLa1 - 50 K L M
Clear All Add Z- Z+
OK
Name Date
BrNL104 b 01/16/2011 16:39:54
BrNL104 a clean 500 sec 01/16/2011 10:20:06
BrNL104 a clean 01/16/2011 09:58:16
BrNL104 a 500 sec 01/16/2011 10:56:28
BrNL104 a 01/16/2011 16:03:32
BrNL103 b 500 sec 01/16/2011 09:51:44
BrNL103 b 01/16/2011 09:41:58
BrNL103 a clean 01/16/2011 09:31:16
BrNL103 a 01/16/2011 09:37:36
BrNL102 b 500 sec 01/16/2011 07:26:30
BrNL102 a clean 500 sec 01/15/2011 21:30:12
BrNL102 a 500 sec 01/15/2011 21:59:56
BrNL101 b 01/15/2011 21:20:12
BrNL101 a clean 01/15/2011 21:06:46
BrNL101 a 01/15/2011 21:09:16
BrNL098 b 01/15/2011 21:00:14
BrNL098 a 01/15/2011 20:58:12
2.40 4.81 7.21 9.61 12.02 14.42 16.82 19.23 21.63 24.03 26.44 28.84 31.24
Cnt:39521 LSec:500.00 Chan:395.638 Kev:7.9233 Det:-40.0C Amb:92.1F Raw:11,031.00 Valid:6,597.00
evch:20.0266 Vac:651 Shift:0.00000 S1 TRACER


S1PXRF - 23-Jan-2011 15:27:35
File Setup ID DownLoad Timed Tube Help
Clear A/B BrNL105 a 500 sec/BrNL105 a clear INST FILE # KTI [.PDZ 40.00kV, 3.00µA]
BrNL105 a 500 sec/BrNL105 a clean 500 sec
CuKa1
ZnKa1
FeKa1
AsKa1
PbLb1
SnKa1
SnLa1
MnKa1
CoKa1
NiKa1
AsKb1
BiLb1
ZrKa1
NbKa1
AgKa1
SbKa1
Name
Date
BrNL106 b 500 sec 01/16/2011 20:25:22
BrNL106 b 01/16/2011 21:21:22
BrNL106 a clean 500 sec 01/16/2011 20:11:28
BrNL106 a clean 01/16/2011 21:27:14
BrNL105 b 500 sec 01/15/2011 09:30:30
BrNL105 b 01/15/2011 13:03:40
BrNL105 a clean 500 sec Artax... 01/23/2011 13:58:34
BrNL105 a clean 500 sec 01/15/2011 09:07:06
BrNL105 a clean 01/15/2011 08:57:42
BrNL105 a 500 sec Artax 30 NF 01/23/2011 14:13:32
BrNL105 a 500 sec 01/23/2011 15:06:20
BrNL105 a 01/15/2011 09:17:18
BrNL104 b clean 500 sec 01/16/2011 16:18:54
BrNL104 b clean 01/16/2011 16:09:48
BrNL104 b 500 01/16/2011 18:47:50
BrNL104 b 01/16/2011 16:39:54
BrNL104 a clean 500 sec 01/16/2011 10:20:06
2.33 4.66 6.98 9.31 11.64 13.97 16.30 18.62 20.95 23.28 25.61 27.94 30.27
Cnt:132 LSec:500.00 Chan:914.918 Kev:18.3227 Det:-40.0C Amb:93.4F Raw:9,376.00 Valid:6,022.00
evch:20.0266 Vac:651 Shift:0.00000 S1 TRACER

Tracer III V + quantitative analysis of each analysis

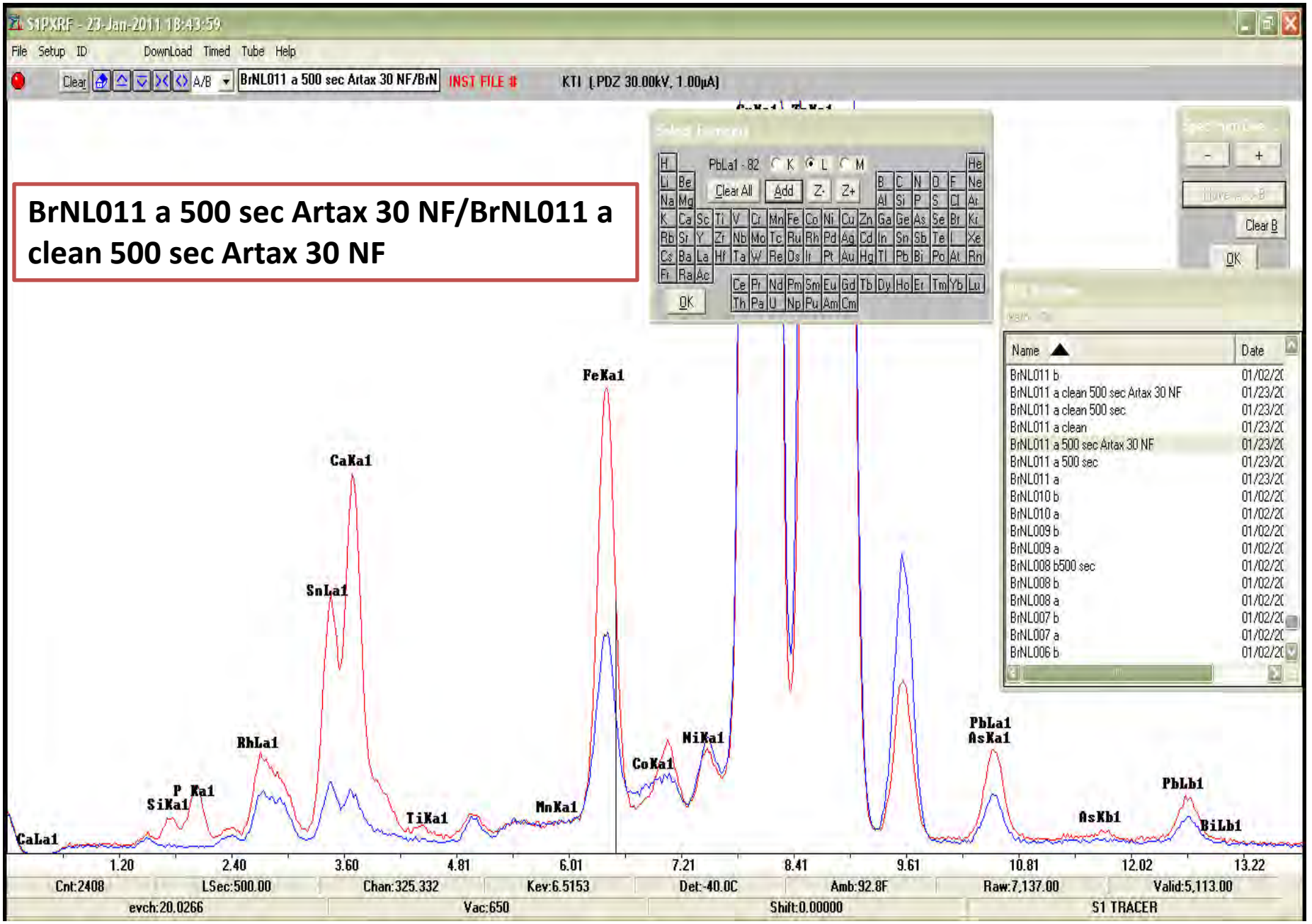
Note that the in all cases for the clean metal analysis the Fe, Cu, As, Pb, Sn, Ag, and Sb are lower and the Zn and Ni are higher. This is also clearly evident in the the Artax scans which follow. **Note only the Clean analysis below is accurate**.

	BrNL011 a 500 sec	BrNL011 a clean 500 sec	BrNL105 a	BrNL105 a clean 500 sec	BrNL102 a 500 sec	BrNL102 a clean 500 sec
FeKa1	0.90	0.39	1.52	0.49	0.76	0.20
NiKa1	0.15	0.19	0.06	0.17	0.08	0.13
CuKa1	75.96	75.94	77.80	77.16	71.56	70.83
ZnKa1	14.79	17.10	10.10	15.89	22.58	25.01
AsKa1	0.17	0.04	0.62	0.06	0.07	0.01
PbLb1	1.79	1.09	3.37	1.39	2.46	0.84
AgKa1	0.05	0.02	0.08	0.02	0.02	0.01
SnKa1	4.60	3.12	5.57	2.71	0.37	0.28
SbKa1	0.06	0.03	0.13	0.04	0.05	0.00
SUM	98.49	97.92	99.27	97.93	97.95	97.32

The slides below depict the same samples as above but the measurement parameters were set to match those used in the area elemental area analysis done with the Artax. The Artax is a 0.065 mm micro focus xrf analyzer capable of scanning and object to produce a detailed elemental map. The spacing between the analysis locations was .060 mm. The results of the maps are shown after the Tracer analysis below.

To assure that one clearly understood the detail of the spectra. The Tracer was run at the same setting on the same sample . Thus producing another perspective on what was mapped.

In detail for the 3 sets of spectra below the presence of Si, P, and increase Sn and Fe, as well as, the increase in the Rh L x rays scattered back to the detector from the samples that have not been "cleaned". This is because of the significantly higher percent of low mass elements present in the corrosion layer. Note these are not "measured" by xrf because the x rays they emit are too low in energy to detect. For instance H, O. N and C also make up the corrosion layer and are undetected but increase the scatter of the x rays from the surface of the sample.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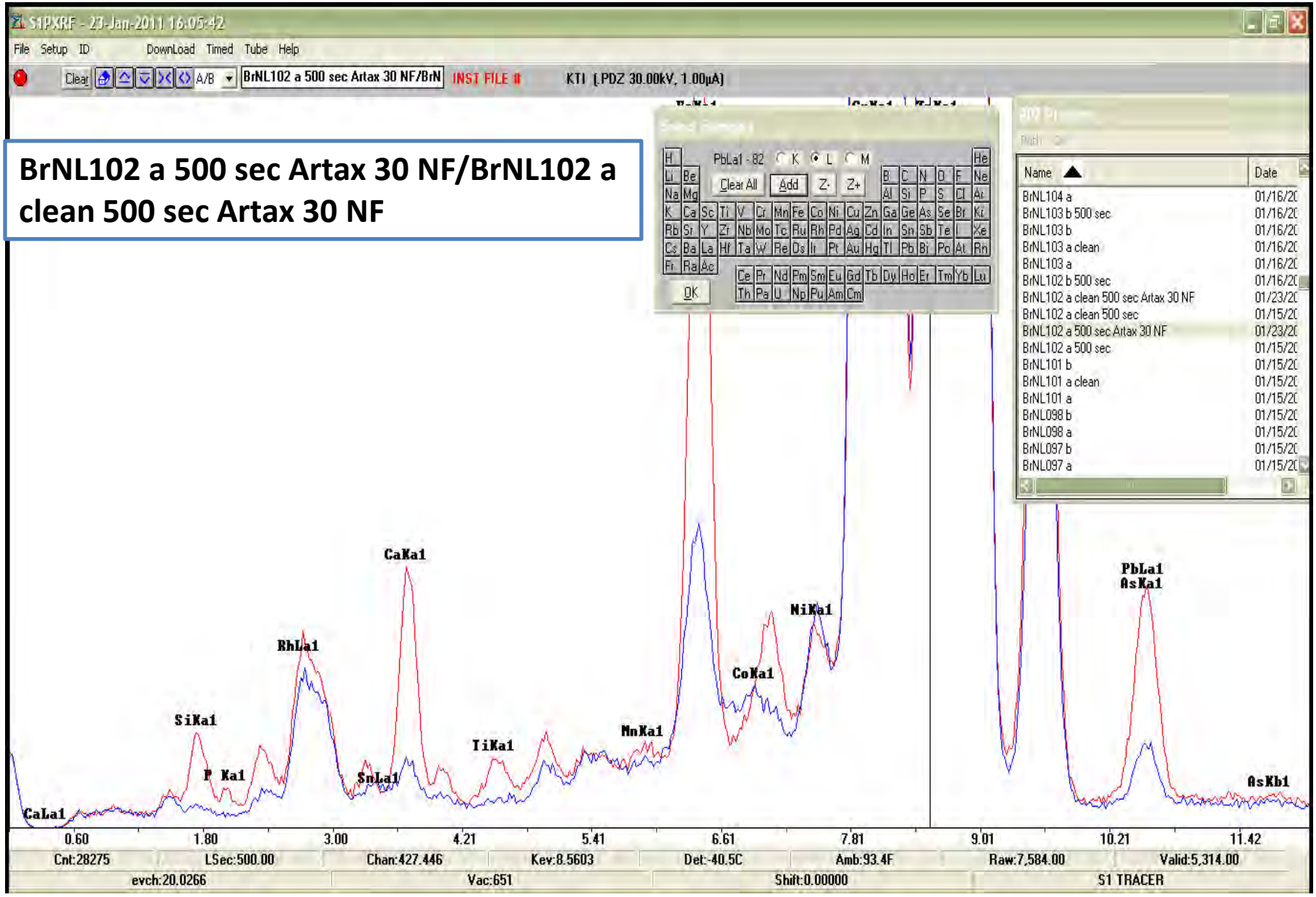
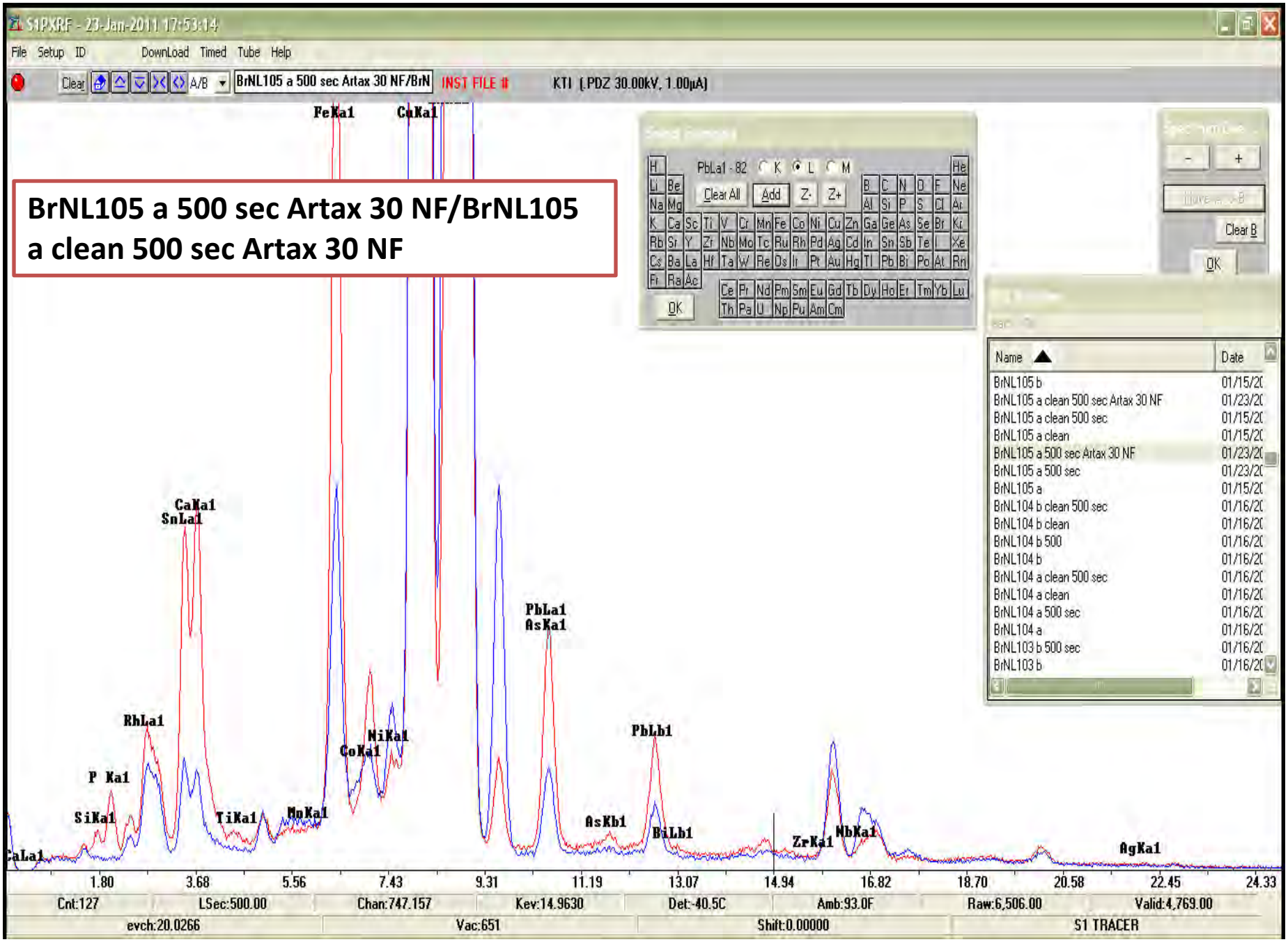
Clear A/B BrNL011 a 500 sec Artax 30 NF/BrN INST FILE # KTI (PDZ 30.00kV, 1.00µA)
BrNL011 a 500 sec Artax 30 NF/BrNL011 a clean 500 sec Artax 30 NF
PbLa1 - 82 K L M
Clear All Add Z- Z+
OK
Clear B
Name Date
BrNL011 b 01/02/20
BrNL011 a clean 500 sec Artax 30 NF 01/23/20
BrNL011 a clean 500 sec 01/23/20
BrNL011 a clean 01/23/20
BrNL011 a 500 sec Artax 30 NF 01/23/20
BrNL011 a 500 sec 01/23/20
BrNL011 a 01/23/20
BrNL010 b 01/02/20
BrNL010 a 01/02/20
BrNL009 b 01/02/20
BrNL009 a 01/02/20
BrNL008 b500 sec 01/02/20
BrNL008 b 01/02/20
BrNL008 a 01/02/20
BrNL007 b 01/02/20
BrNL007 a 01/02/20
BrNL006 b 01/02/20
CaLa1
SiKa1
P Ka1
RhLa1
CaKa1
SnLa1
TiKa1
MnKa1
FeKa1
CoKa1
NiKa1
PbLa1
AsKa1
AsKb1
PbLb1
BiLb1
1.20 2.40 3.60 4.81 6.01 7.21 8.41 9.61 10.81 12.02 13.22
Cnt:2408 LSec:500.00 Chan:325.332 Kev:6.5153 Det:-40.0C Amb:92.8F Raw:7,137.00 Valid:5,113.00
evch:20.0266 Vac:650 Shift:0.00000 S1 TRACER

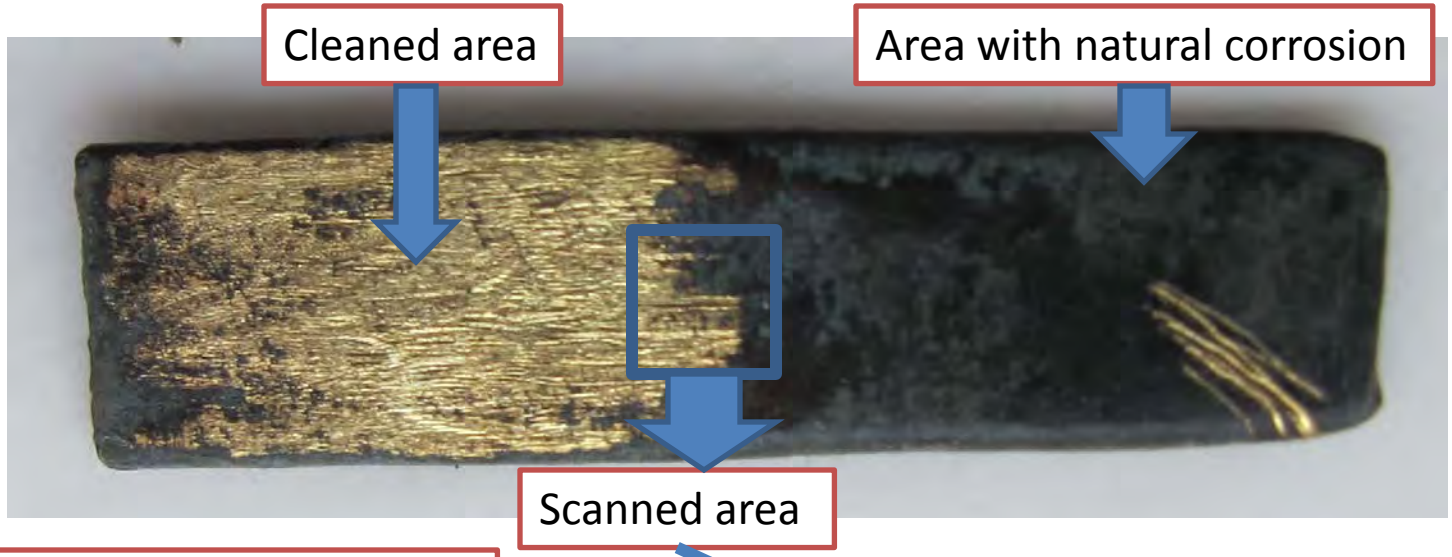

S1PXRF - 23-Jan-2011 16:05:42
File Setup ID DownLoad Timed Tube Help
Clear A/B
BrNL102 a 500 sec Artax 30 NF/BrN
INST FILE #
KTI [PDZ 30.00kV, 1.00µA]
BrNL102 a 500 sec Artax 30 NF/BrNL102 a clean 500 sec Artax 30 NF
PbLa1 - 82 K L M
Clear All
Add
Z-
Z+
OK
Name
Date
BrNL104 a 01/16/20
BrNL103 b 500 sec 01/16/20
BrNL103 b 01/16/20
BrNL103 a clean 01/16/20
BrNL103 a 01/16/20
BrNL102 b 500 sec 01/16/20
BrNL102 a clean 500 sec Artax 30 NF 01/23/20
BrNL102 a clean 500 sec 01/15/20
BrNL102 a 500 sec Artax 30 NF 01/23/20
BrNL102 a 500 sec 01/15/20
BrNL101 b 01/15/20
BrNL101 a clean 01/15/20
BrNL101 a 01/15/20
BrNL098 b 01/15/20
BrNL098 a 01/15/20
BrNL097 b 01/15/20
BrNL097 a 01/15/20
CaLa1
SiKa1
P Ka1
RhLa1
SnLa1
CaKa1
TiKa1
MnKa1
CoKa1
NiKa1
PbLa1
AsKa1
AsKb1
0.60
1.80
3.00
4.21
5.41
6.61
7.81
9.01
10.21
11.42
Cnt:28275
LSec:500.00
Chan:427.446
Kev:8.5603
Det:-40.5C
Amb:93.4F
Raw:7,584.00
Valid:5,314.00
evch:20.0266
Vac:651
Shift:0.00000
S1 TRACER


S1PXRF - 23-Jan-2011 17:53:14
File Setup ID DownLoad Timed Tube Help
Clear A/B
BrNL105 a 500 sec Artax 30 NF/BrN
INST FILE #
KTI (PDZ 30.00kV, 1.00µA)
BrNL105 a 500 sec Artax 30 NF/BrNL105 a clean 500 sec Artax 30 NF
PbLa1 - 82 K L M
Clear All
Add
Z-
Z+
OK
Clear B
Name
Date
BrNL105 b 01/15/20
BrNL105 a clean 500 sec Artax 30 NF 01/23/20
BrNL105 a clean 500 sec 01/15/20
BrNL105 a clean 01/15/20
BrNL105 a 500 sec Artax 30 NF 01/23/20
BrNL105 a 500 sec 01/23/20
BrNL105 a 01/15/20
BrNL104 b clean 500 sec 01/16/20
BrNL104 b clean 01/16/20
BrNL104 b 500 01/16/20
BrNL104 b 01/16/20
BrNL104 a clean 500 sec 01/16/20
BrNL104 a clean 01/16/20
BrNL104 a 500 sec 01/16/20
BrNL104 a 01/16/20
BrNL103 b 500 sec 01/16/20
BrNL103 b 01/16/20
FeKa1
CuKa1
CaKa1
SnLa1
PbLa1
AsKa1
RhLa1
P Ka1
SiKa1
TiKa1
MoKa1
CoKa1
NiKa1
PbLb1
AsKb1
BiLb1
ZrKa1
NbKa1
AgKa1
CaLa1
1.80 3.68 5.56 7.43 9.31 11.19 13.07 14.94 16.82 18.70 20.58 22.45 24.33
Cnt:127 LSec:500.00 Chan:747.157 Kev:14.9630 Det:-40.5C Amb:93.0F Raw:6,506.00 Valid:4,769.00
evch:20.0266 Vac:651 Shift:0.00000 S1 TRACER

Tracer III V + quantitative analysis of each analysis

Note that the in all cases for the clean metal analysis the Fe, Cu, As, Pb, Sn, Ag, and Sb are lower and the Zn and Ni are higher. This is also clearly evident in the the Artax scans which follow. **Note only the Clean analysis below is accurate**.

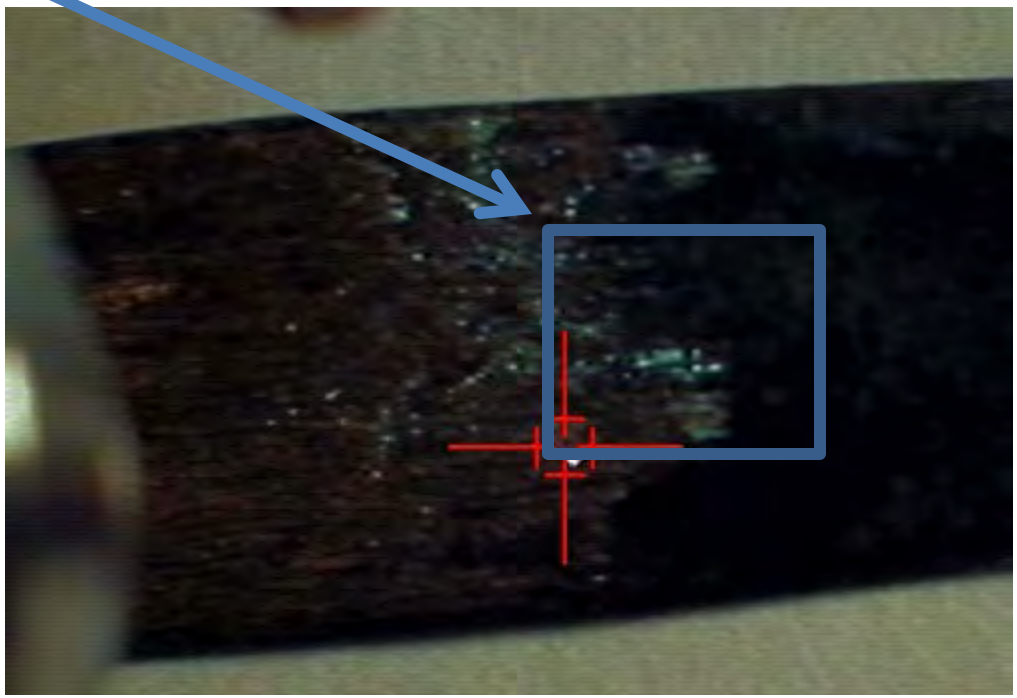
	BrNL011 a 500 sec	BrNL011 a clean 500 sec	BrNL105 a	BrNL105 a clean 500 sec	BrNL102 a 500 sec	BrNL102 a clean 500 sec
FeKa1	0.90	0.39	1.52	0.49	0.76	0.20
NiKa1	0.15	0.19	0.06	0.17	0.08	0.13
CuKa1	75.96	75.94	77.80	77.16	71.56	70.83
ZnKa1	14.79	17.10	10.10	15.89	22.58	25.01
AsKa1	0.17	0.04	0.62	0.06	0.07	0.01
PbLb1	1.79	1.09	3.37	1.39	2.46	0.84
AgKa1	0.05	0.02	0.08	0.02	0.02	0.01
SnKa1	4.60	3.12	5.57	2.71	0.37	0.28
SbKa1	0.06	0.03	0.13	0.04	0.05	0.00
SUM	98.49	97.92	99.27	97.93	97.95	97.32



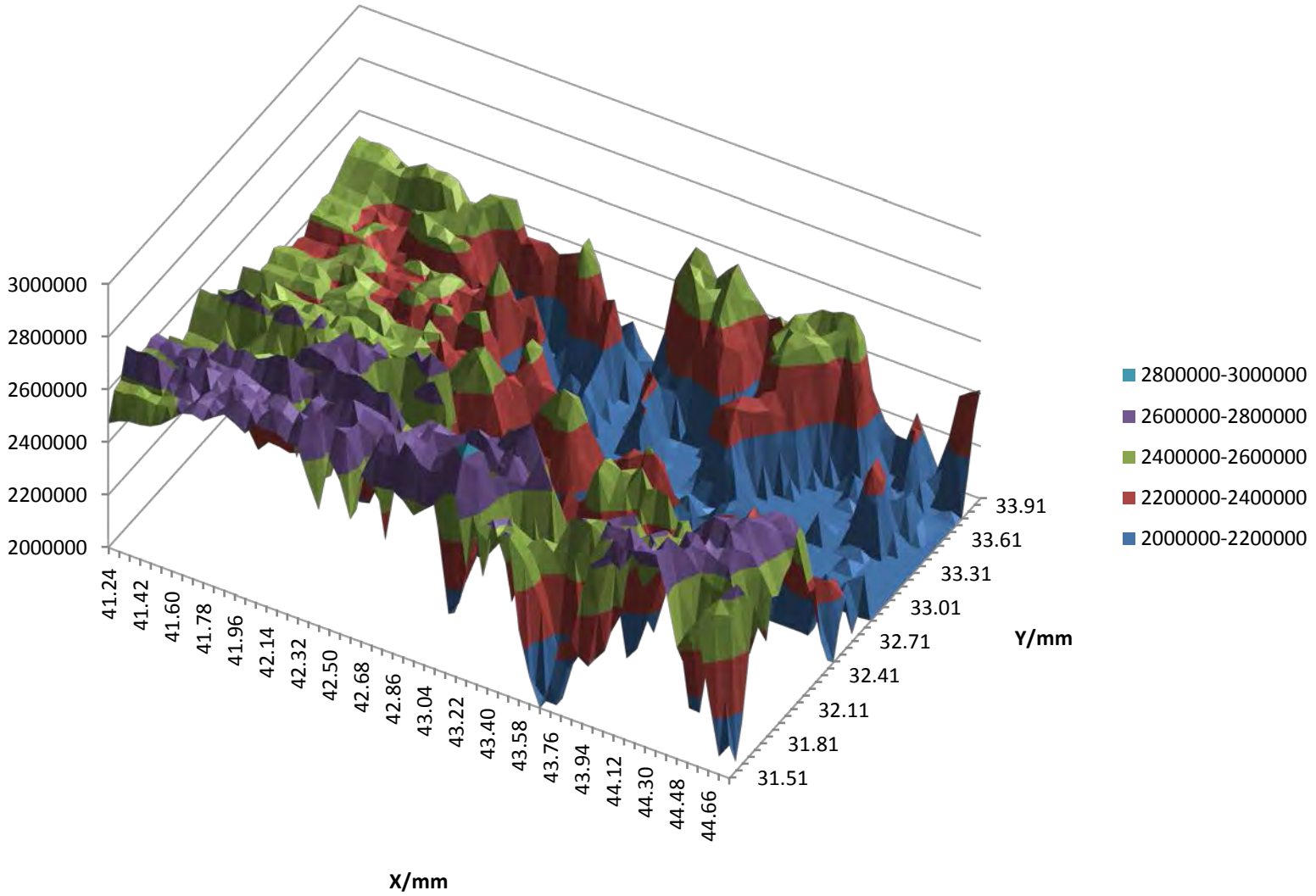
Sample BrNL011

Xrf elemental scan

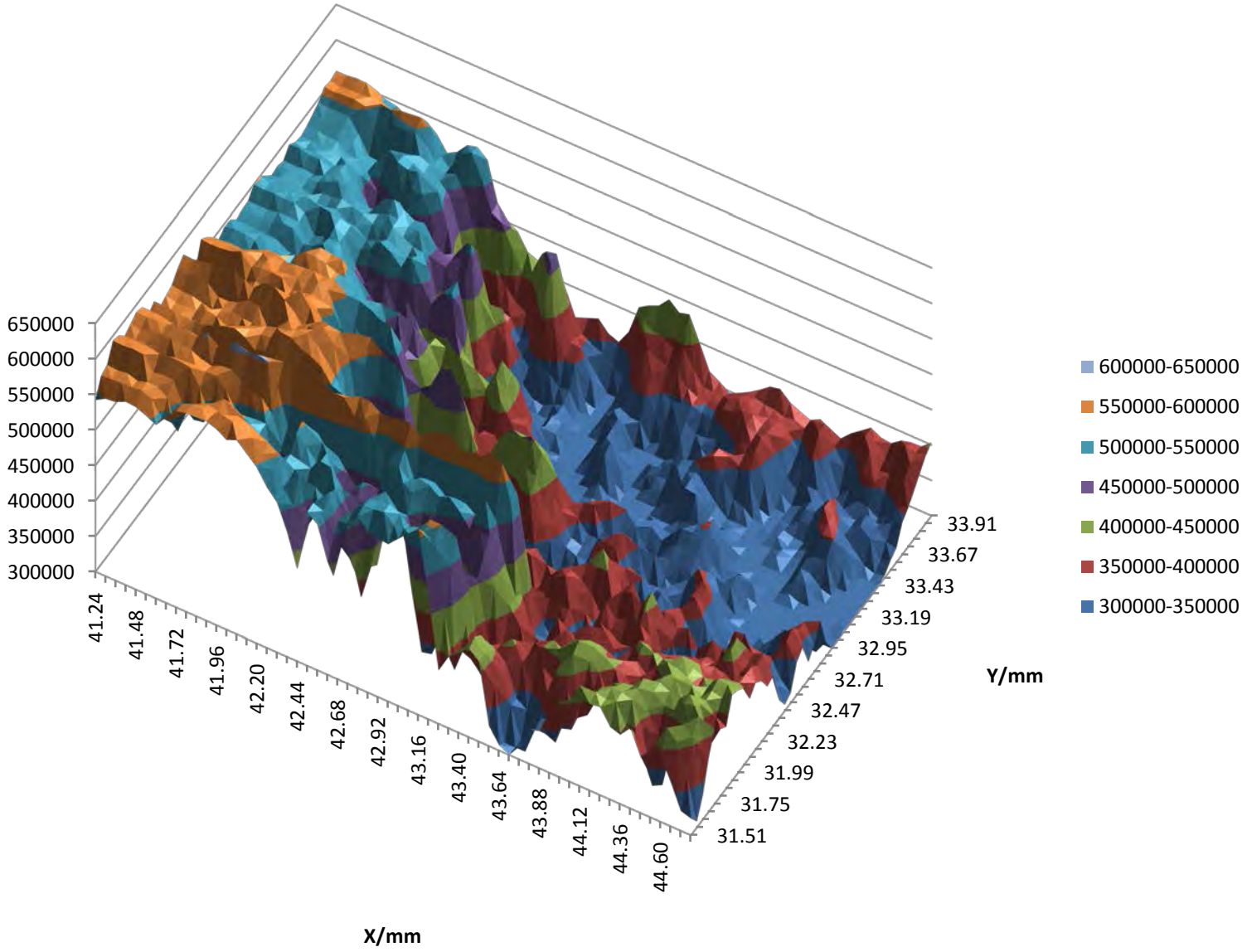
1. 2520 points
2. .065 mm spot size
3. .060 mm spacing
4. 2.5 mm by 3.5 mm area
5. 21 hours
6. 30 sec per analysis

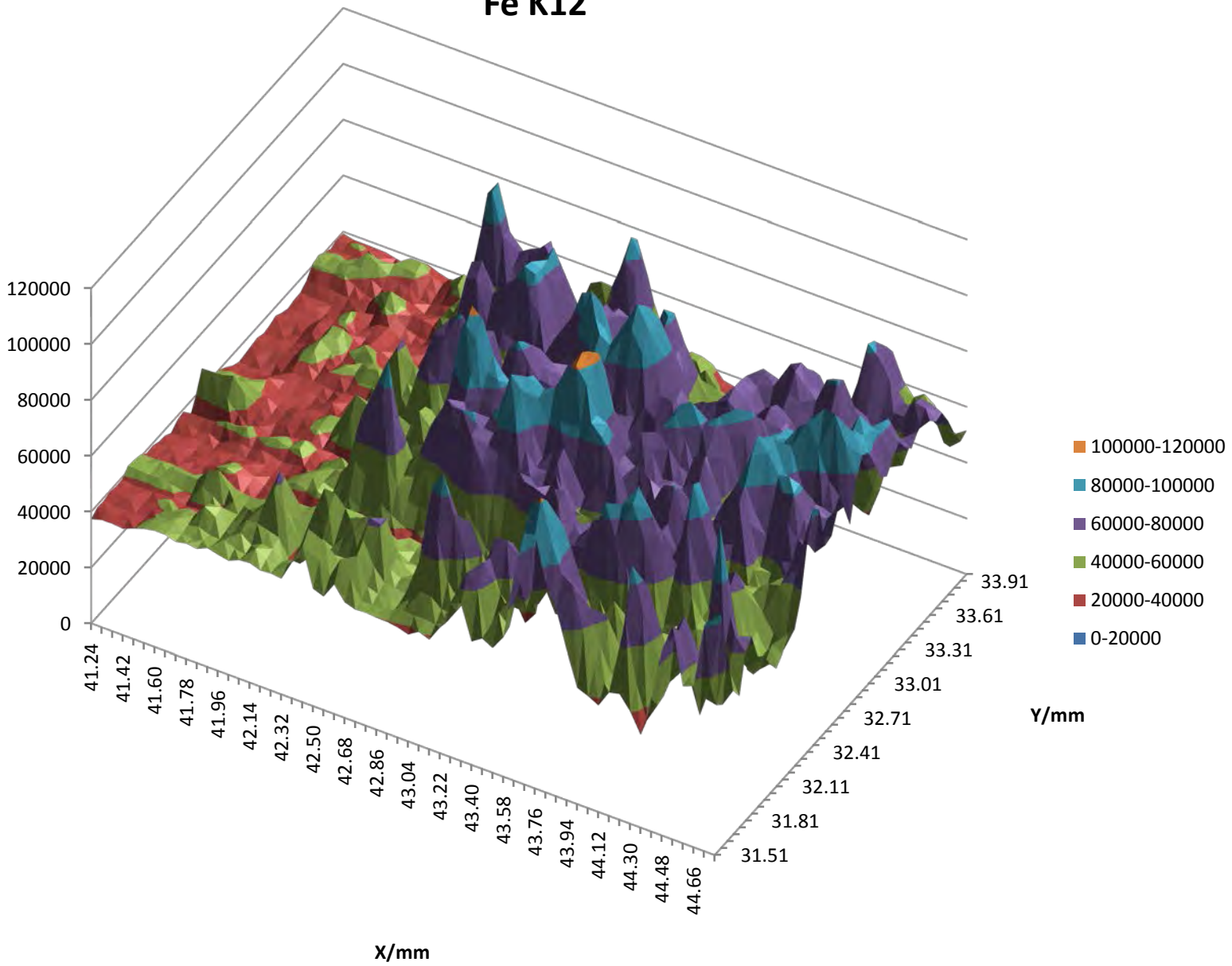


Cu K12


3000000
2800000
2600000
2400000
2200000
2000000
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.51
31.81
32.11
32.41
32.71
33.01
33.31
33.61
33.91
Y/mm
2800000-3000000
2600000-2800000
2400000-2600000
2200000-2400000
2000000-2200000

Zn K12


650000
600000
550000
500000
450000
400000
350000
300000
41.24
41.48
41.72
41.96
42.20
42.44
42.68
42.92
43.16
43.40
43.64
43.88
44.12
44.36
44.60
X/mm
33.91
33.67
33.43
33.19
32.95
32.71
32.47
32.23
31.99
31.75
31.51
Y/mm
600000-650000
550000-600000
500000-550000
450000-500000
400000-450000
350000-400000
300000-350000


Fe K12
120000
100000
80000
60000
40000
20000
0
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
33.91
33.61
33.31
33.01
32.71
32.41
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Y/mm
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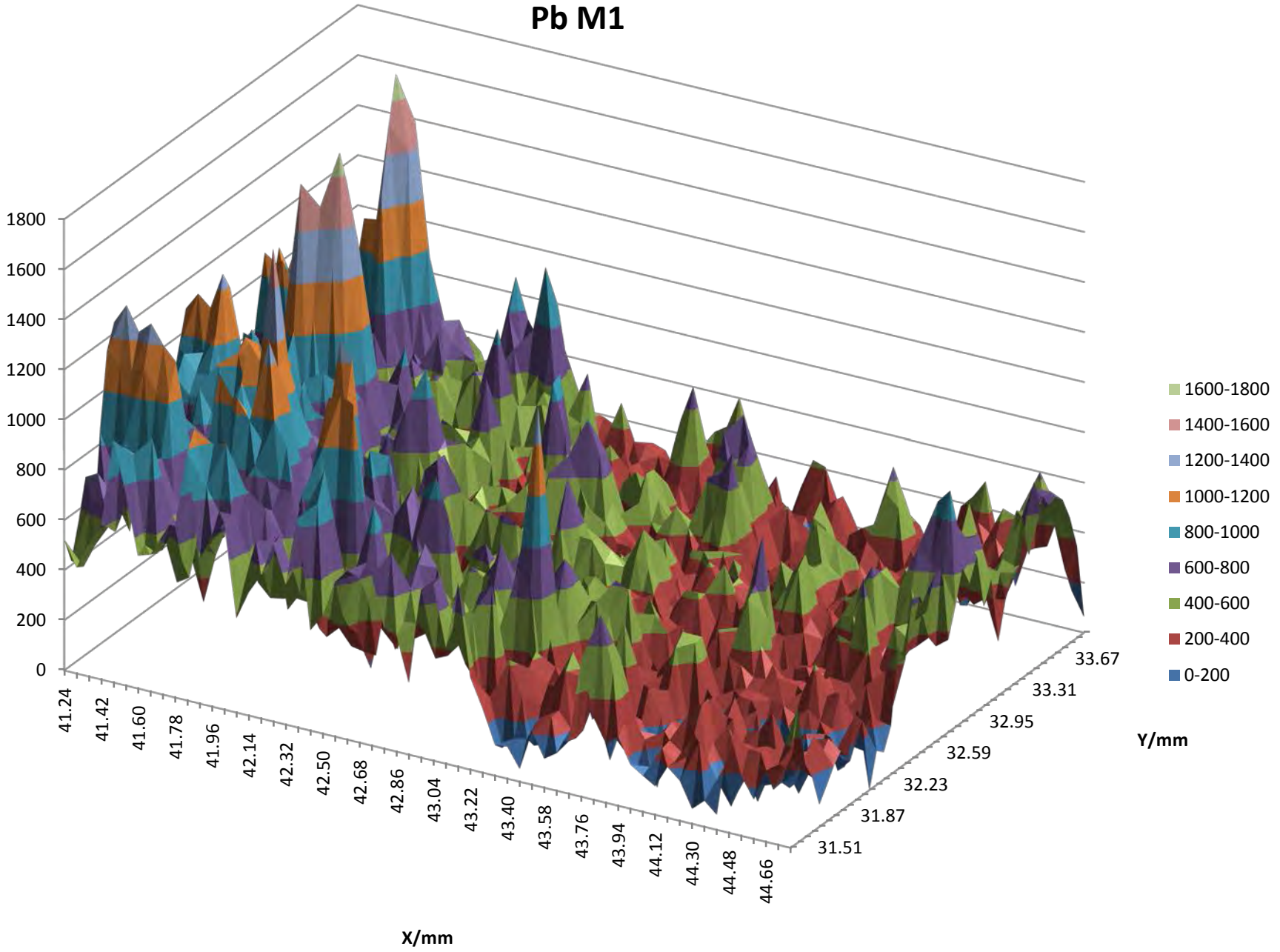
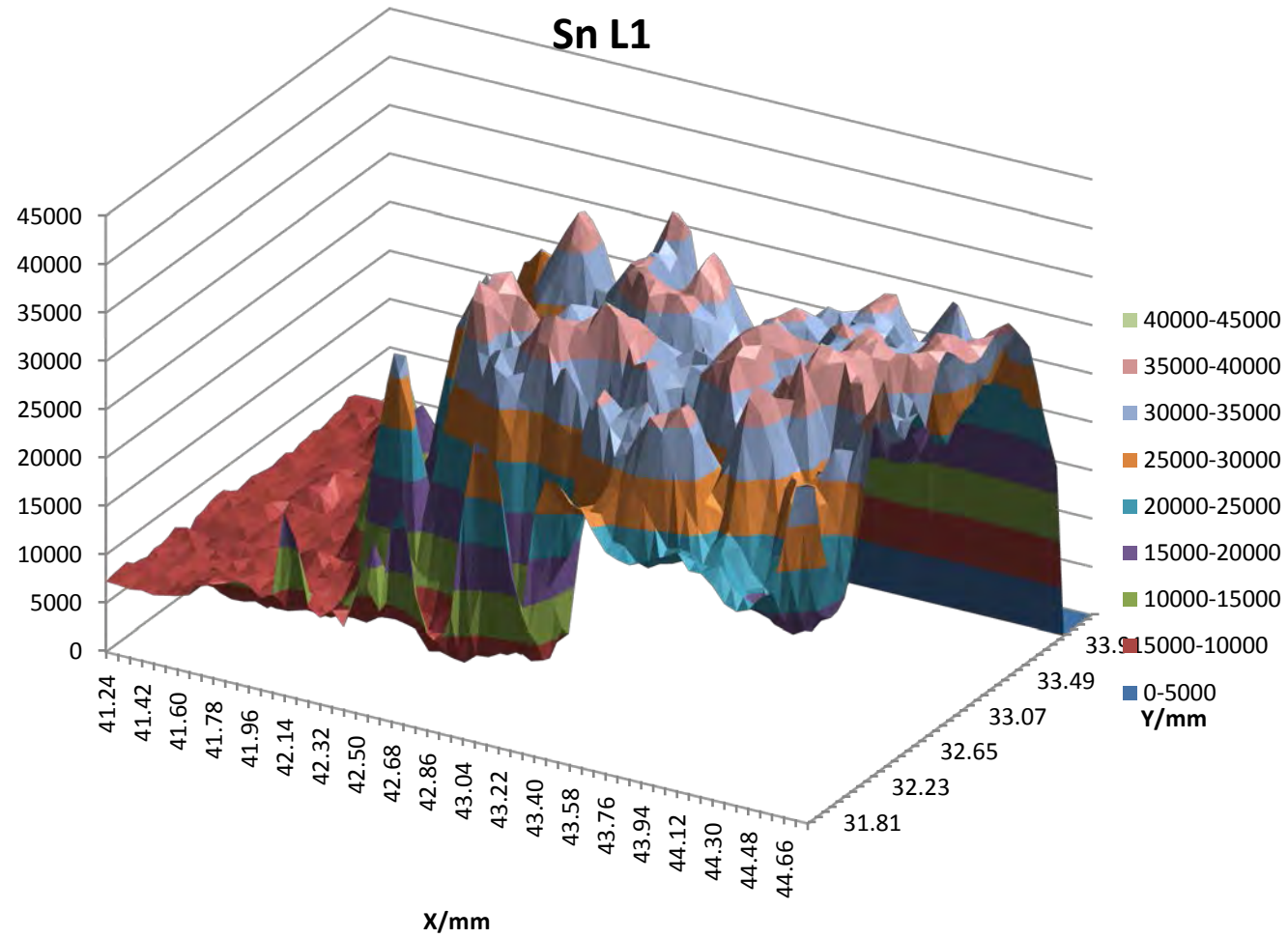
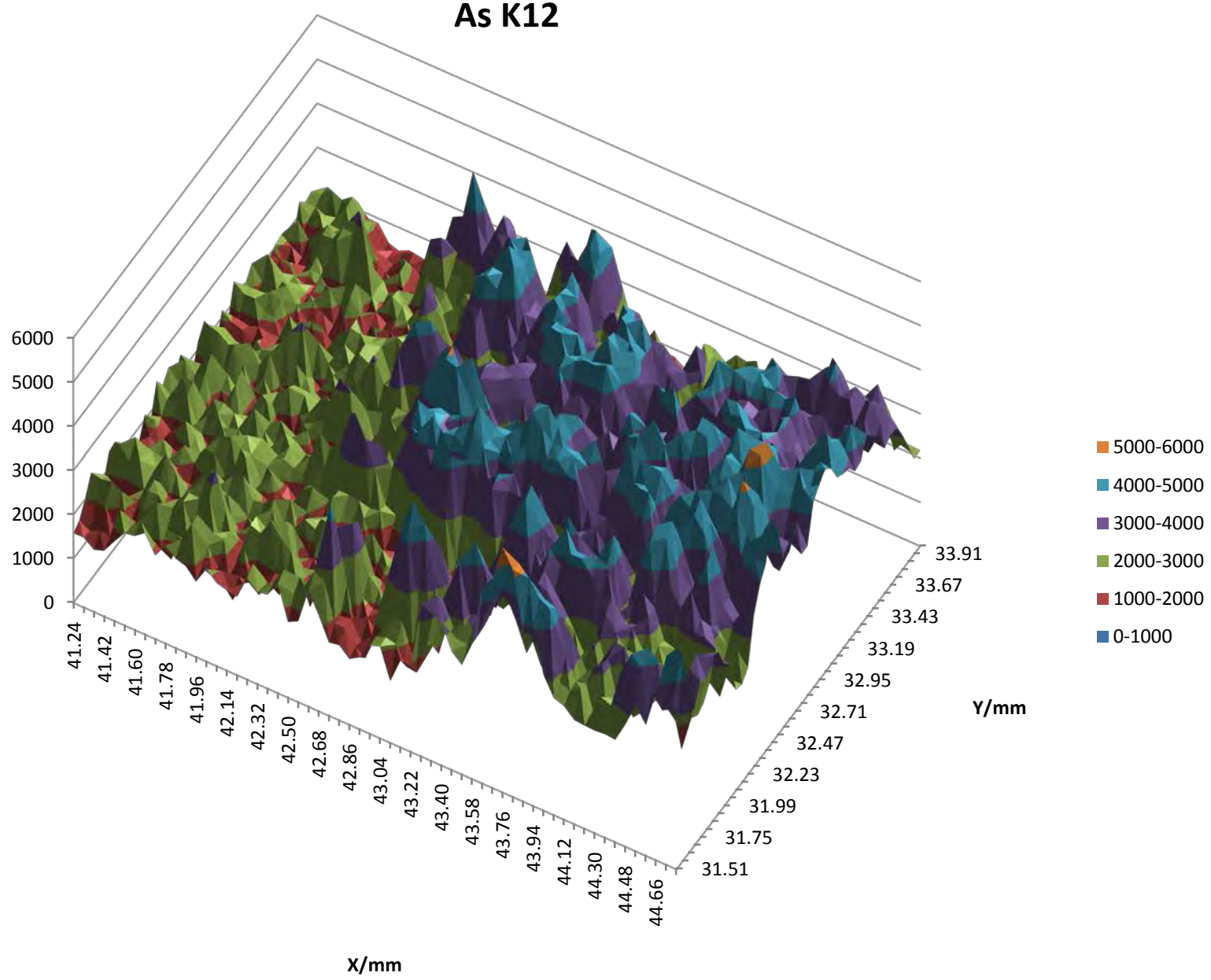
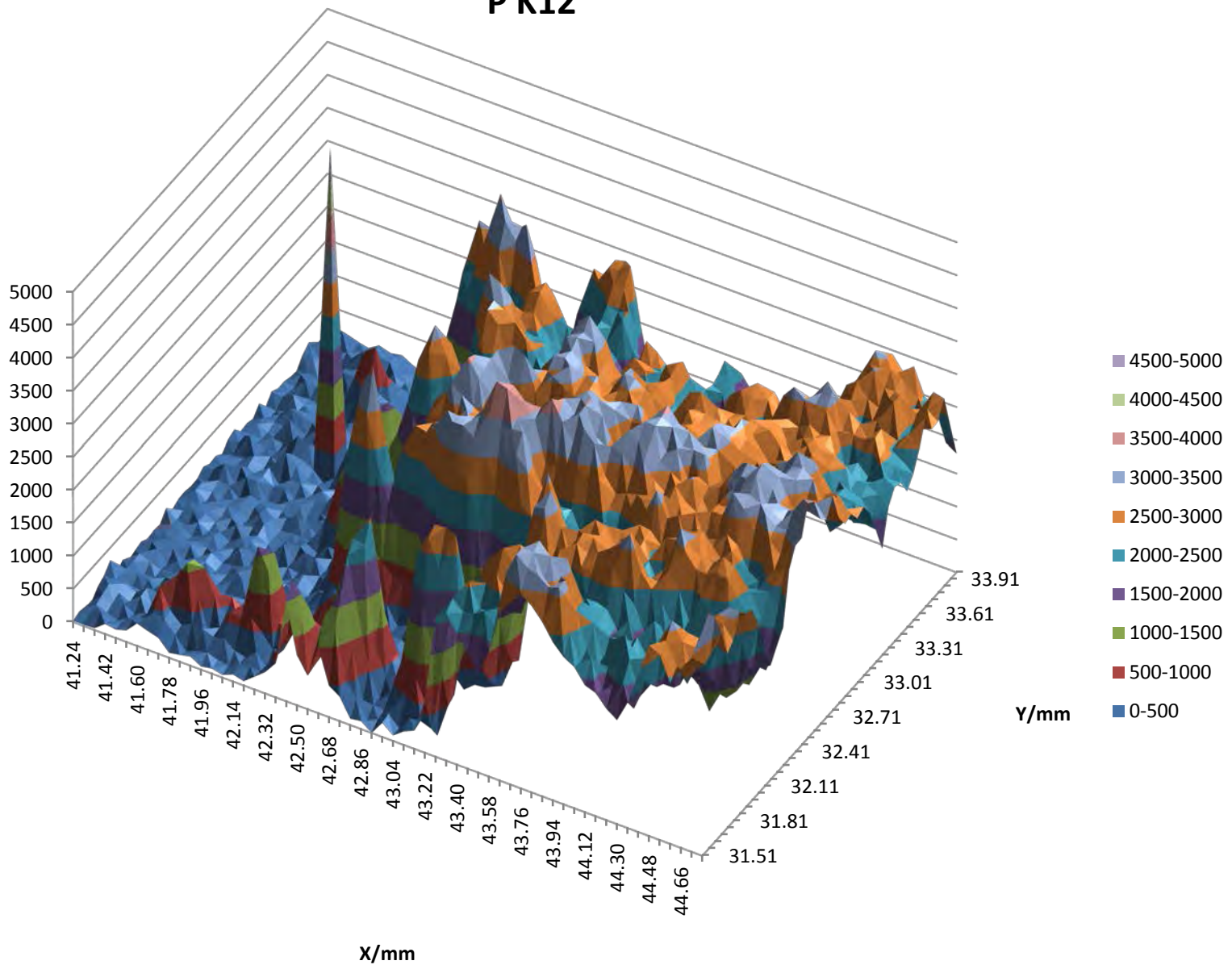
60000-80000
40000-60000
20000-40000
0-20000


Pb M1
1800
1600
1400
1200
1000
800
600
400
200
0
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.51
31.87
32.23
32.59
32.95
33.31
33.67
Y/mm
1600-1800
1400-1600
1200-1400
1000-1200
800-1000
600-800
400-600
200-400
0-200


Sn L1
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.81
32.23
32.65
33.07
33.49
Y/mm
40000-45000
35000-40000
30000-35000
25000-30000
20000-25000
15000-20000
10000-15000
0-5000


As K12
6000
5000
4000
3000
2000
1000
0
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.51
31.75
31.99
32.23
32.47
32.71
32.95
33.19
33.43
33.67
33.91
Y/mm
5000-6000
4000-5000
3000-4000
2000-3000
1000-2000
0-1000


P K12
5000
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4000
3500
3000
2500
2000
1500
1000
500
0
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41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.51
31.81
32.11
32.41
32.71
33.01
33.31
33.61
33.91
Y/mm
4500-5000
4000-4500
3500-4000
3000-3500
2500-3000
2000-2500
1500-2000
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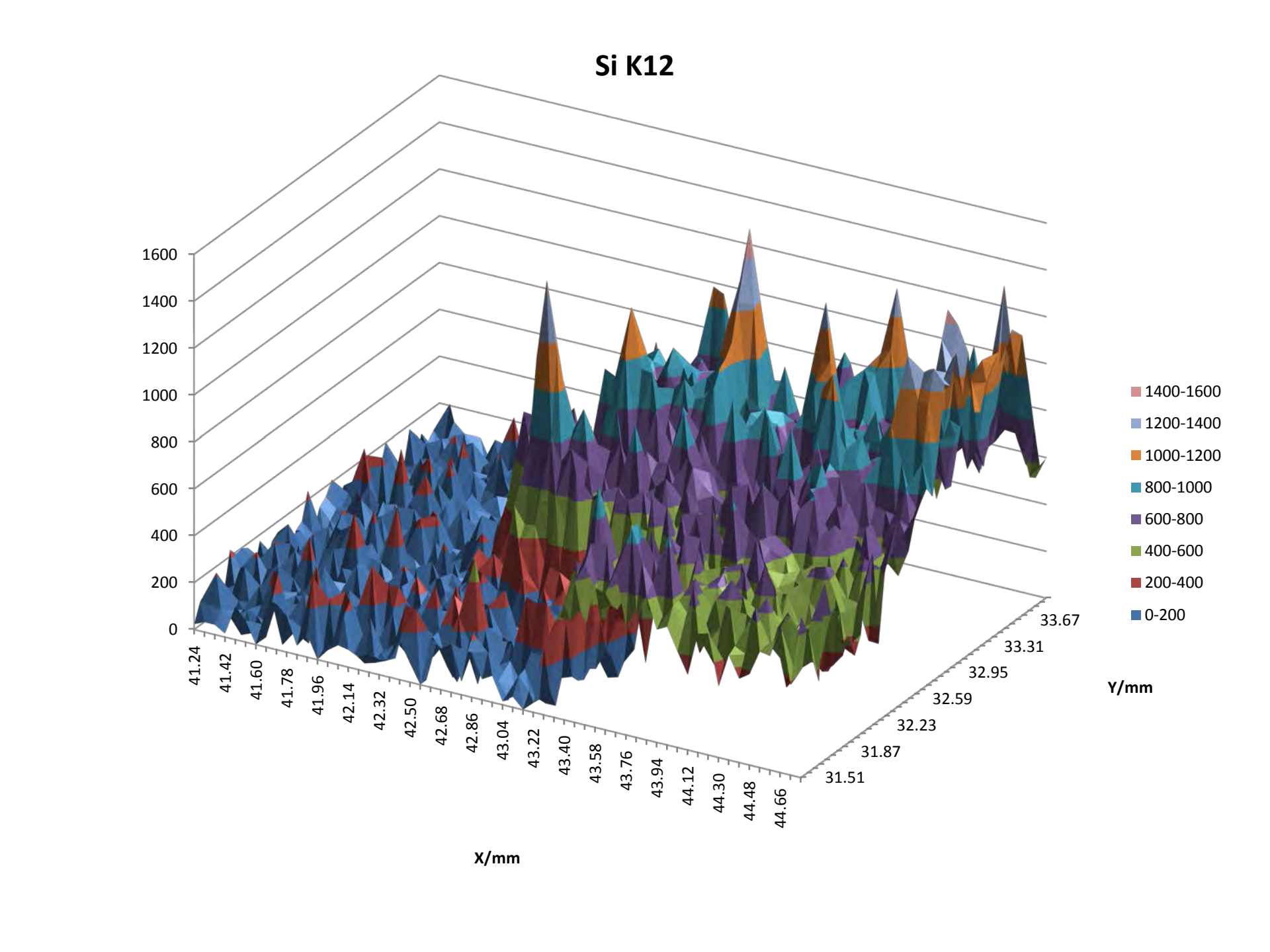
500-1000
0-500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1400
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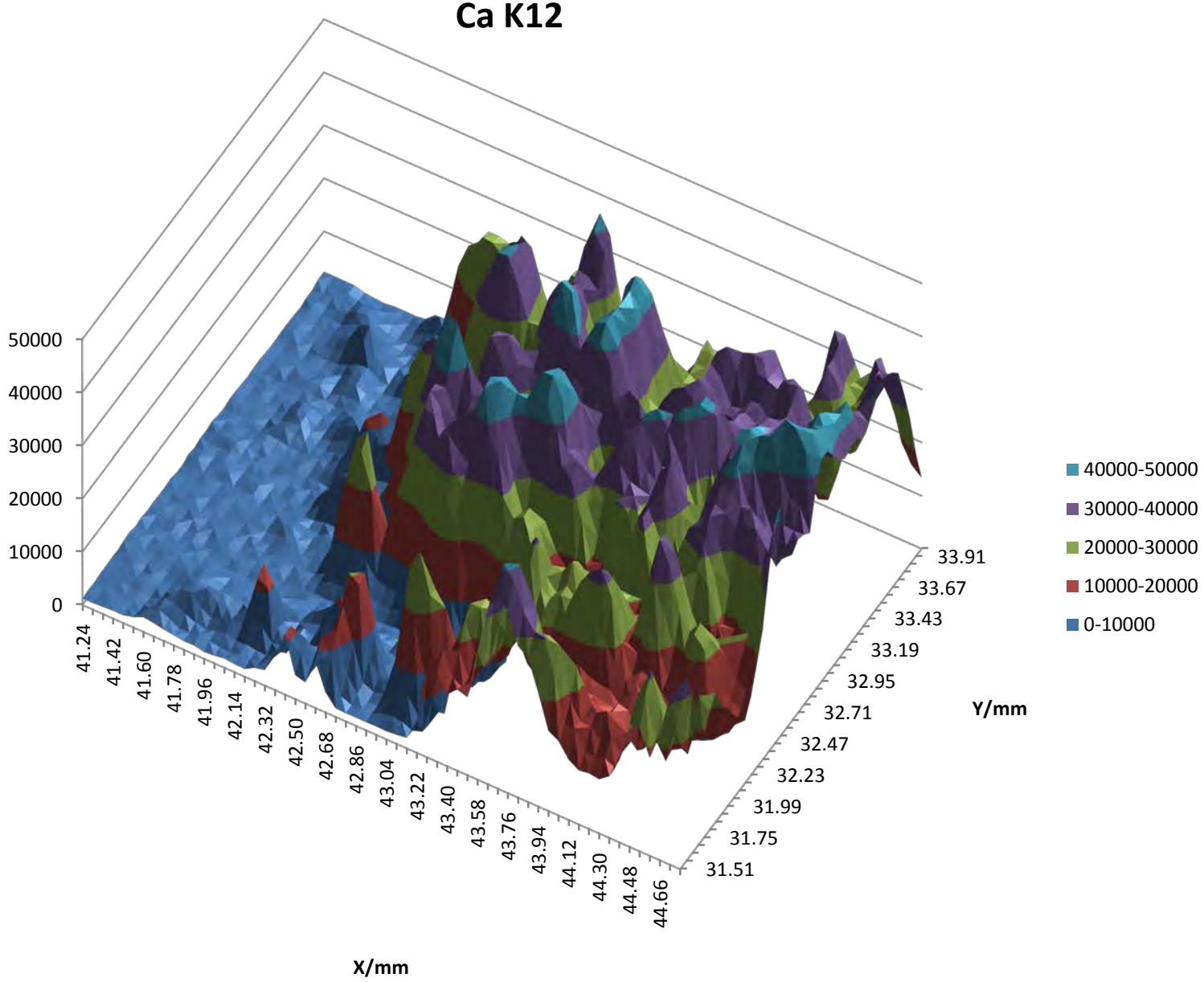
1000
800
600
400
200
0
41.24
41.42
41.60
41.78
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
31.51
31.87
32.23
32.59
32.95
33.31
33.67
Y/mm
1400-1600
1200-1400
1000-1200
800-1000
600-800
400-600
200-400
0-200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41.24
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41.60
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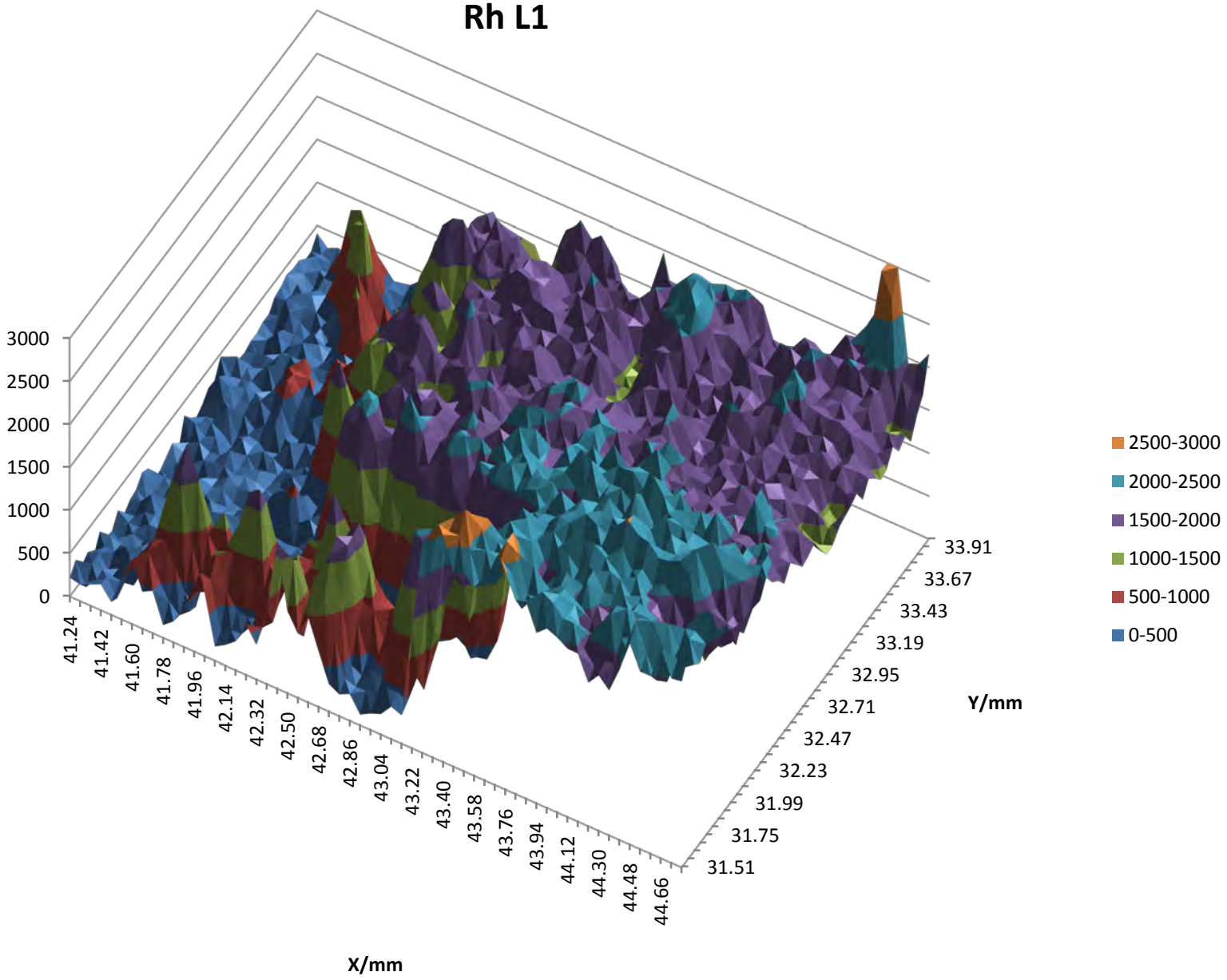
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
33.91
33.67
33.43
33.19
32.95
32.71
32.47
32.23
31.99
31.75
31.51
Y/mm
40000-50000
30000-40000
20000-30000
10000-20000
0-10000


Rh L1
3000
2500
2000
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500
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41.24
41.42
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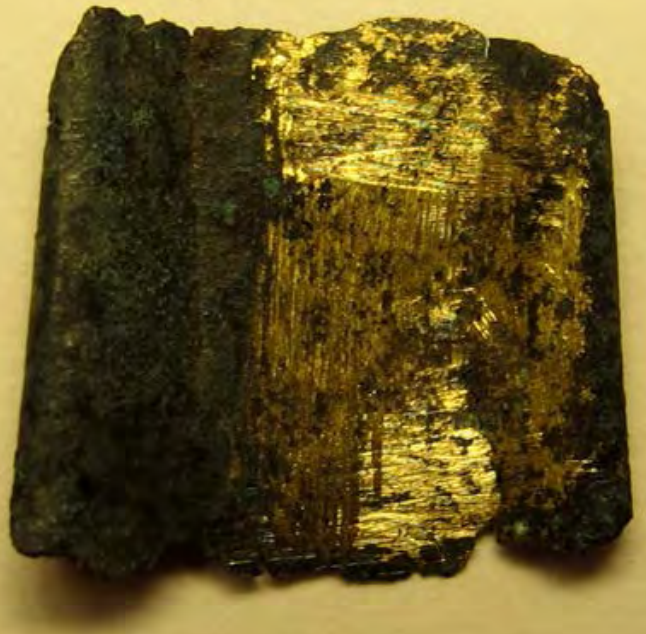
41.96
42.14
42.32
42.50
42.68
42.86
43.04
43.22
43.40
43.58
43.76
43.94
44.12
44.30
44.48
44.66
X/mm
33.91
33.67
33.43
33.19
32.95
32.71
32.47
32.23
31.99
31.75
31.51
Y/mm
2500-3000
2000-2500
1500-2000
1000-1500
500-1000
0-500

XRF 3/B/07

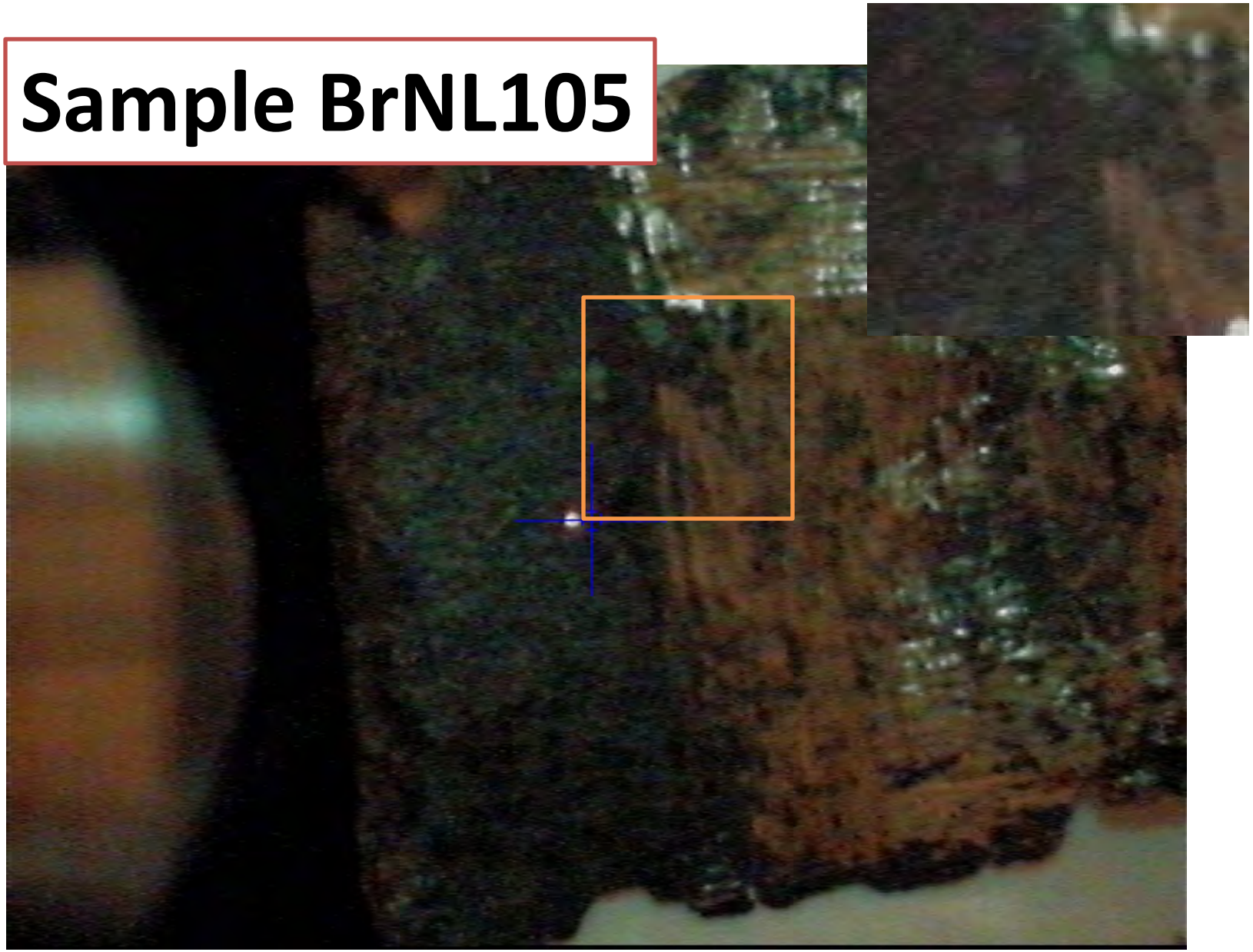


NL6

NL6b

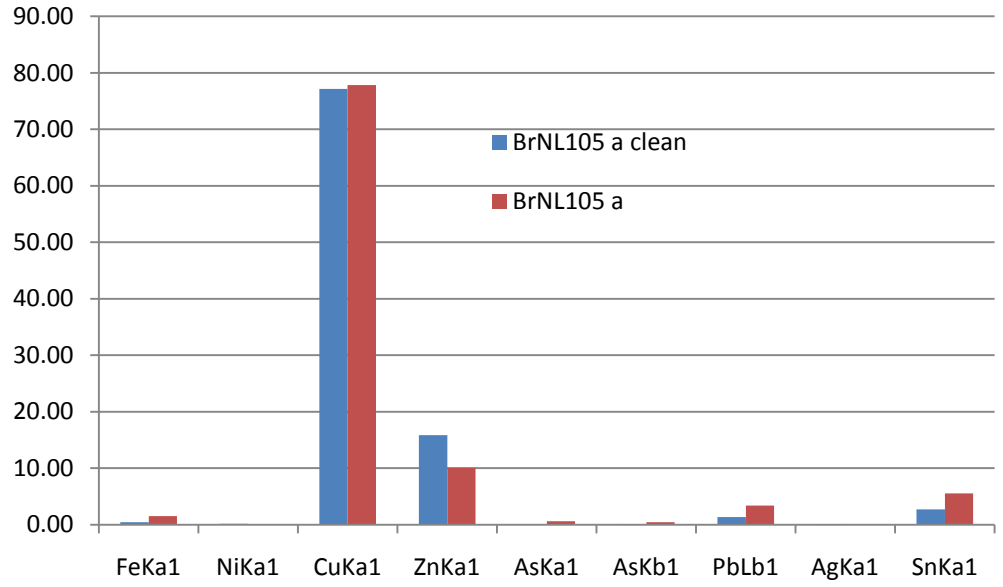
Br NL105

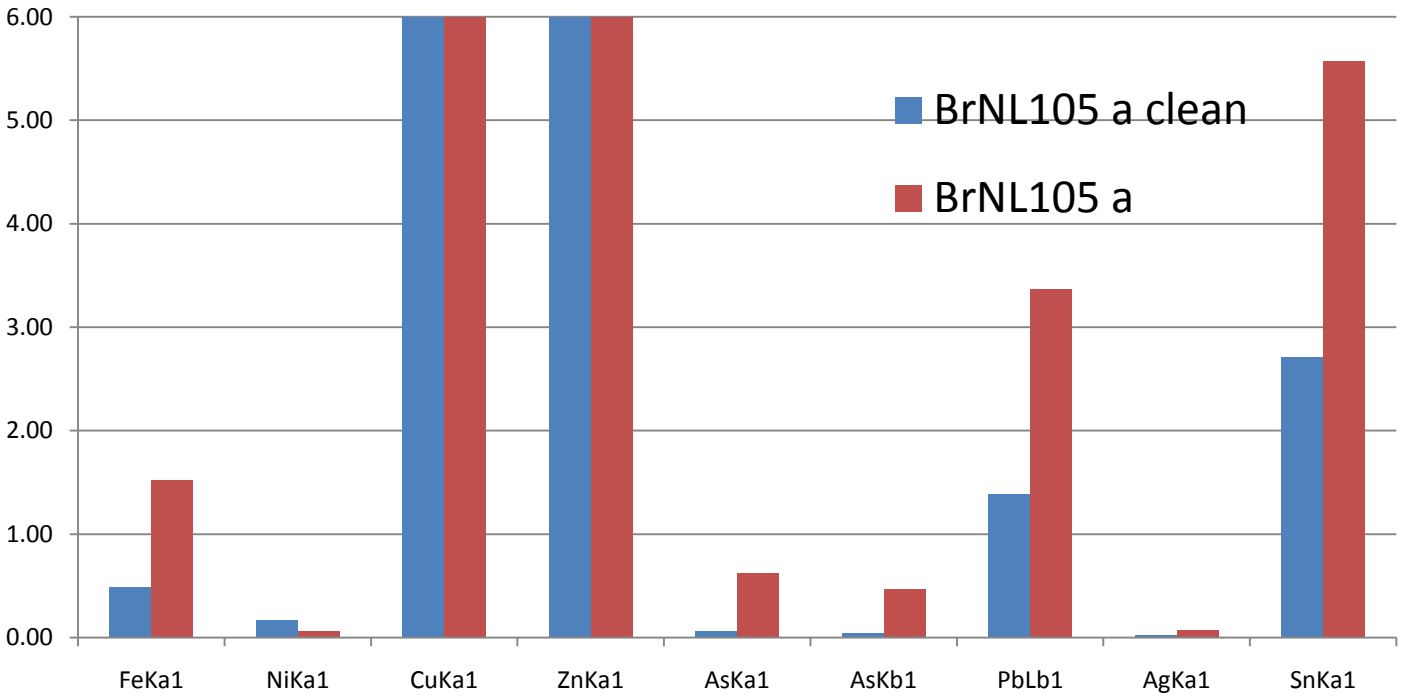
Sample BrNL105



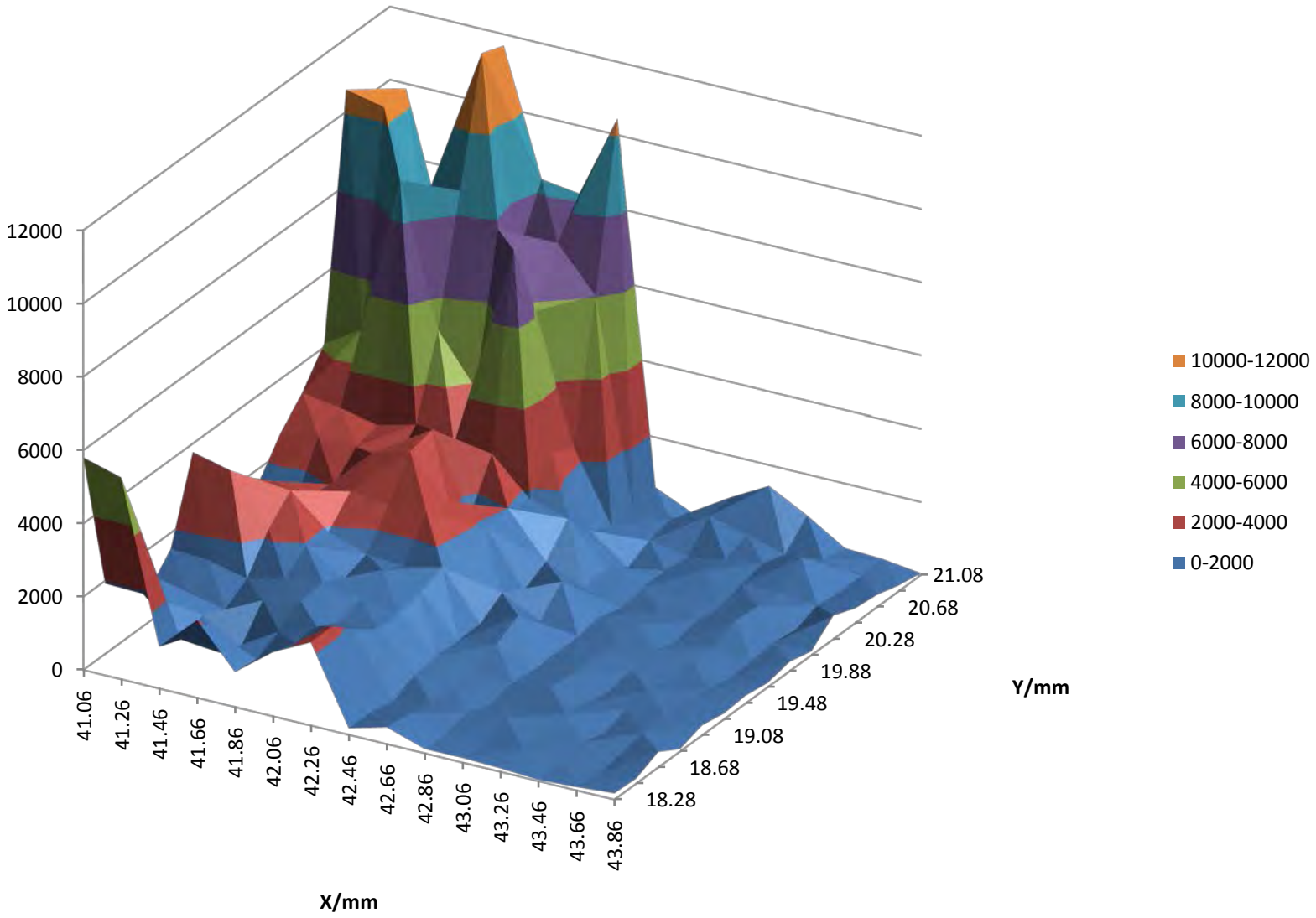
Quantification done with the Tracer III V +
Area 3 mm 4mm on each surface

	BrNL105 a clean	BrNL105 a
FeKa1	0.49	1.52
NiKa1	0.17	0.06
CuKa1	77.16	77.80
ZnKa1	15.89	10.10
AsKa1	0.06	0.62
AsKb1	0.04	0.47
PbLb1	1.39	3.37
AgKa1	0.02	0.08
SnKa1	2.71	5.57





Si K12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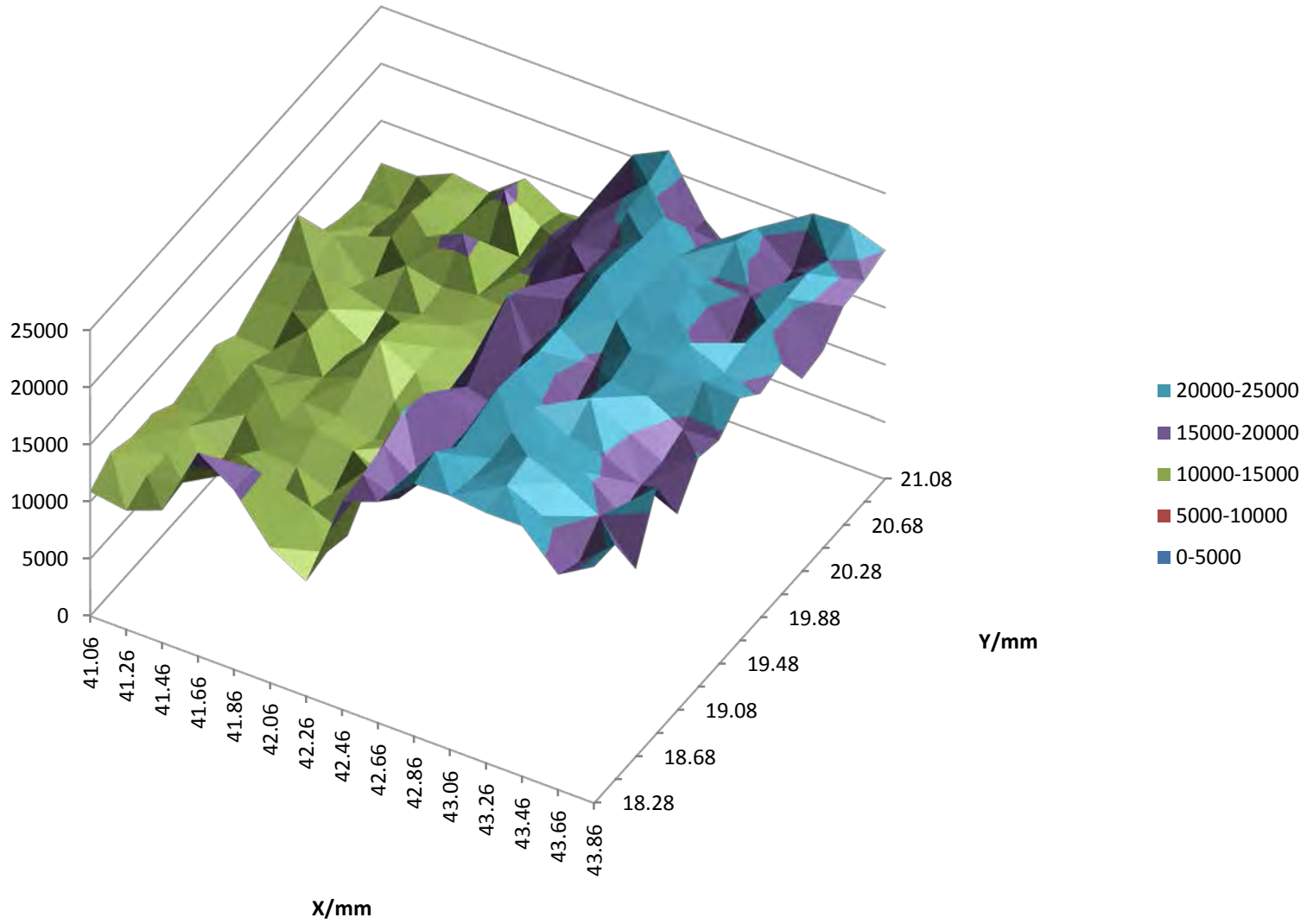
41.46
41.66
41.86
42.06
42.26
42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.68
19.08
19.48
19.88
20.28
20.68
21.08
Y/mm
10000-12000
8000-10000
6000-8000
4000-6000
2000-4000
0-2000

Ni K12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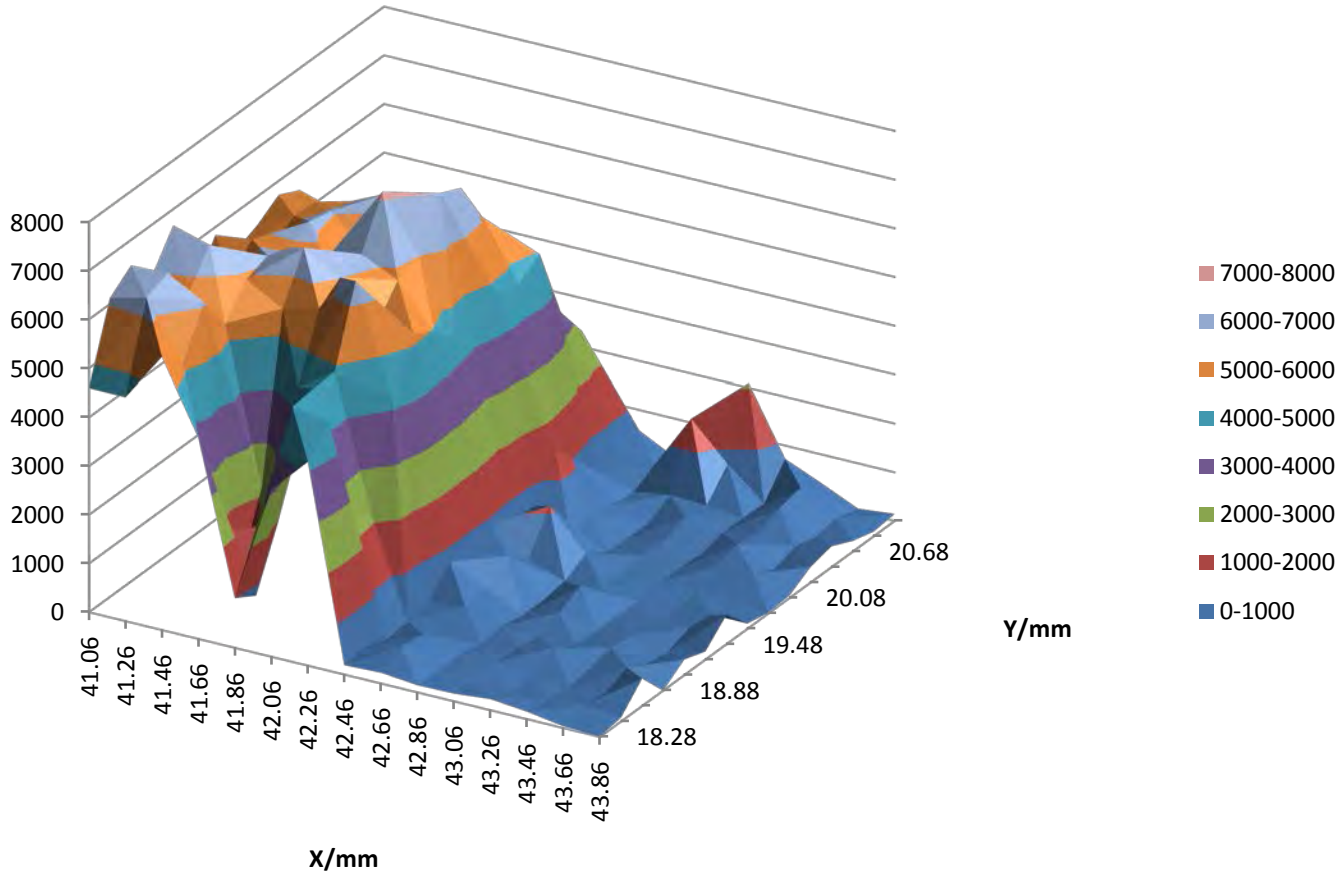
41.46
41.66
41.86
42.06
42.26
42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.68
19.08
19.48
19.88
20.28
20.68
21.08
Y/mm
20000-25000
15000-20000
10000-15000
5000-10000
0-5000

P K12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5000
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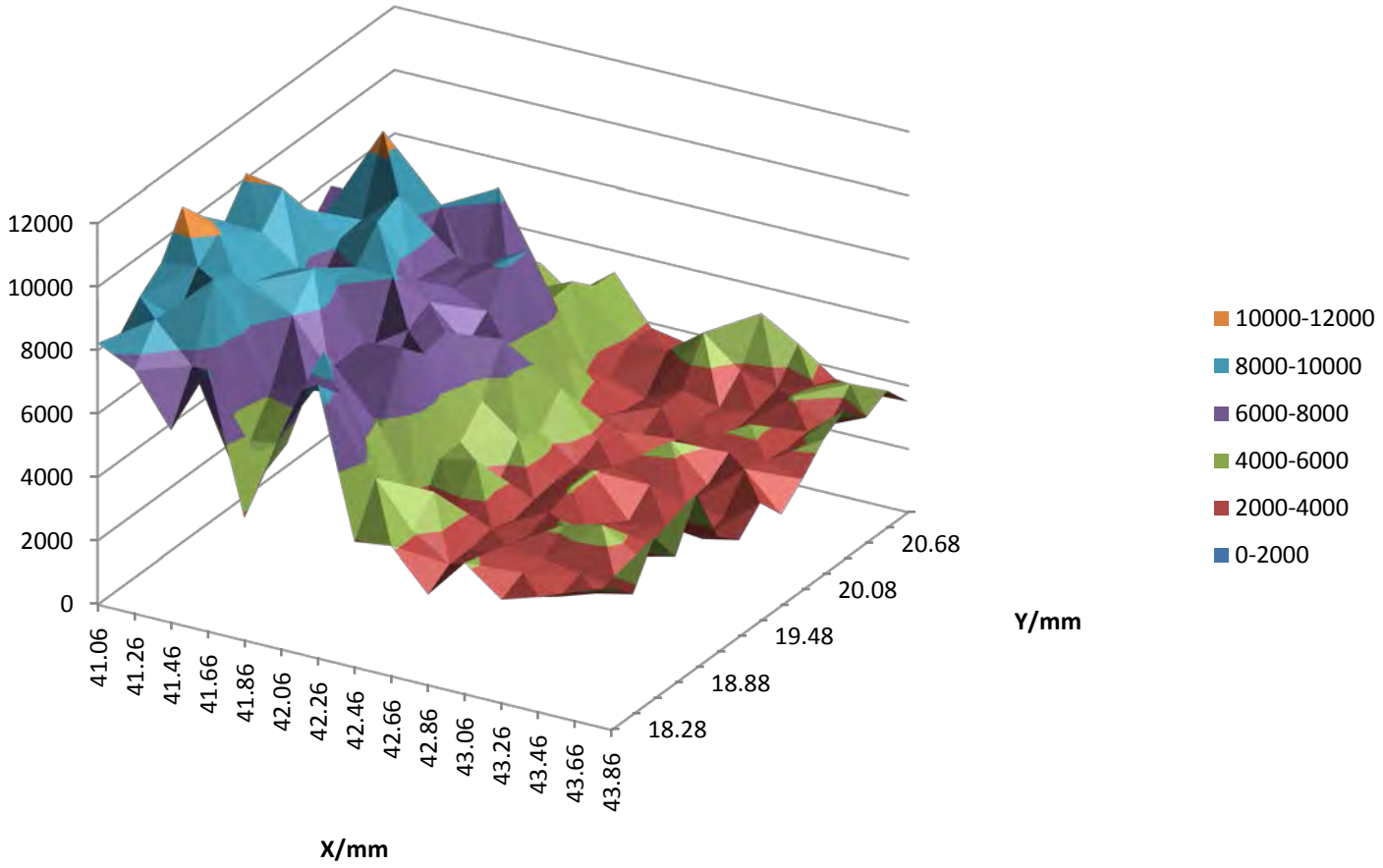
41.26
41.46
41.66
41.86
42.06
42.26
42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.88
19.48
20.08
20.68
Y/mm
7000-8000
6000-7000
5000-6000
4000-5000
3000-4000
2000-3000
1000-2000
0-1000

As K12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2000
0
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41.46
41.66
41.86
42.06
42.26
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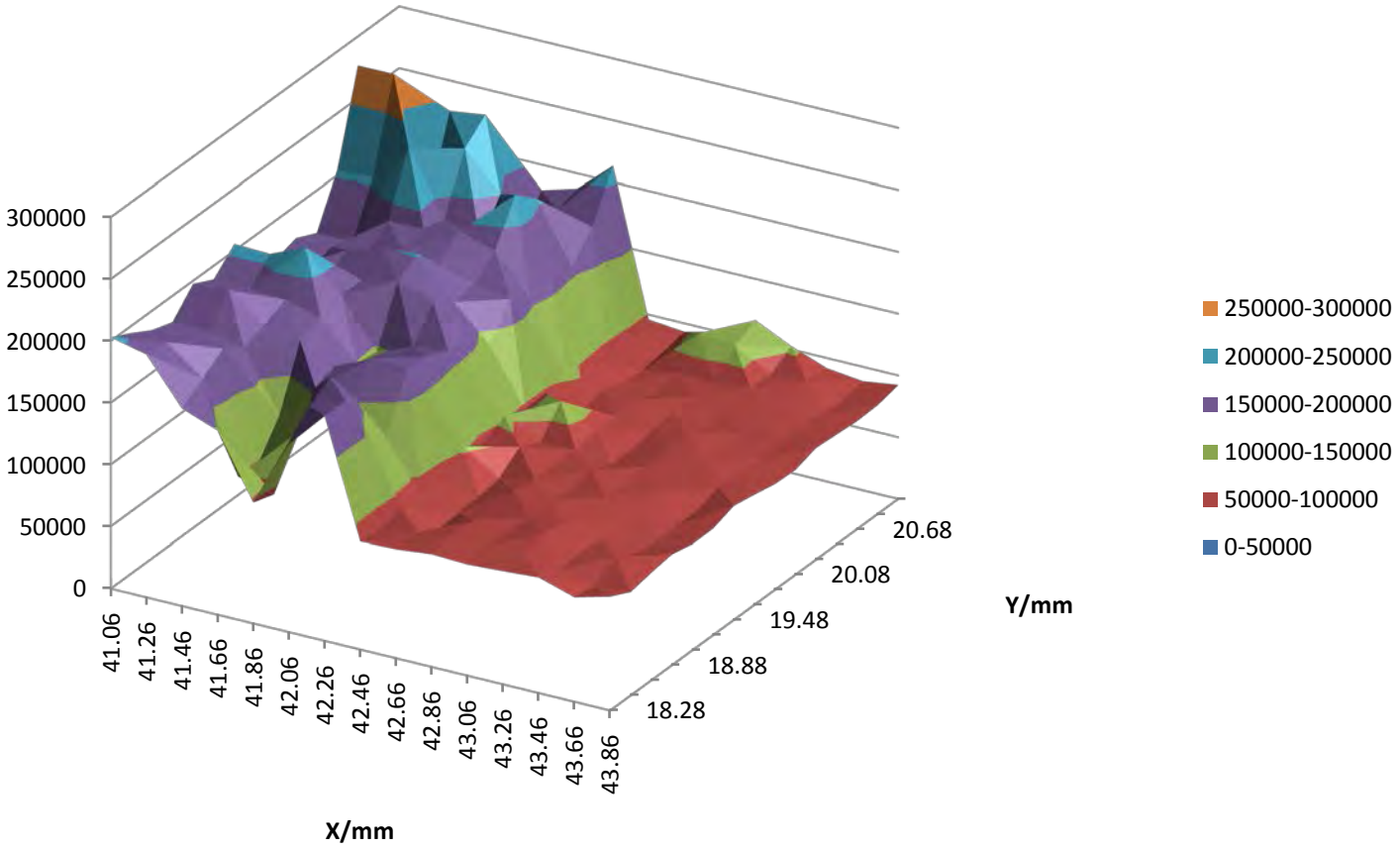
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.88
19.48
20.08
20.68
Y/mm
10000-12000
8000-10000
6000-8000
4000-6000
2000-4000
0-2000

Fe K12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41.86
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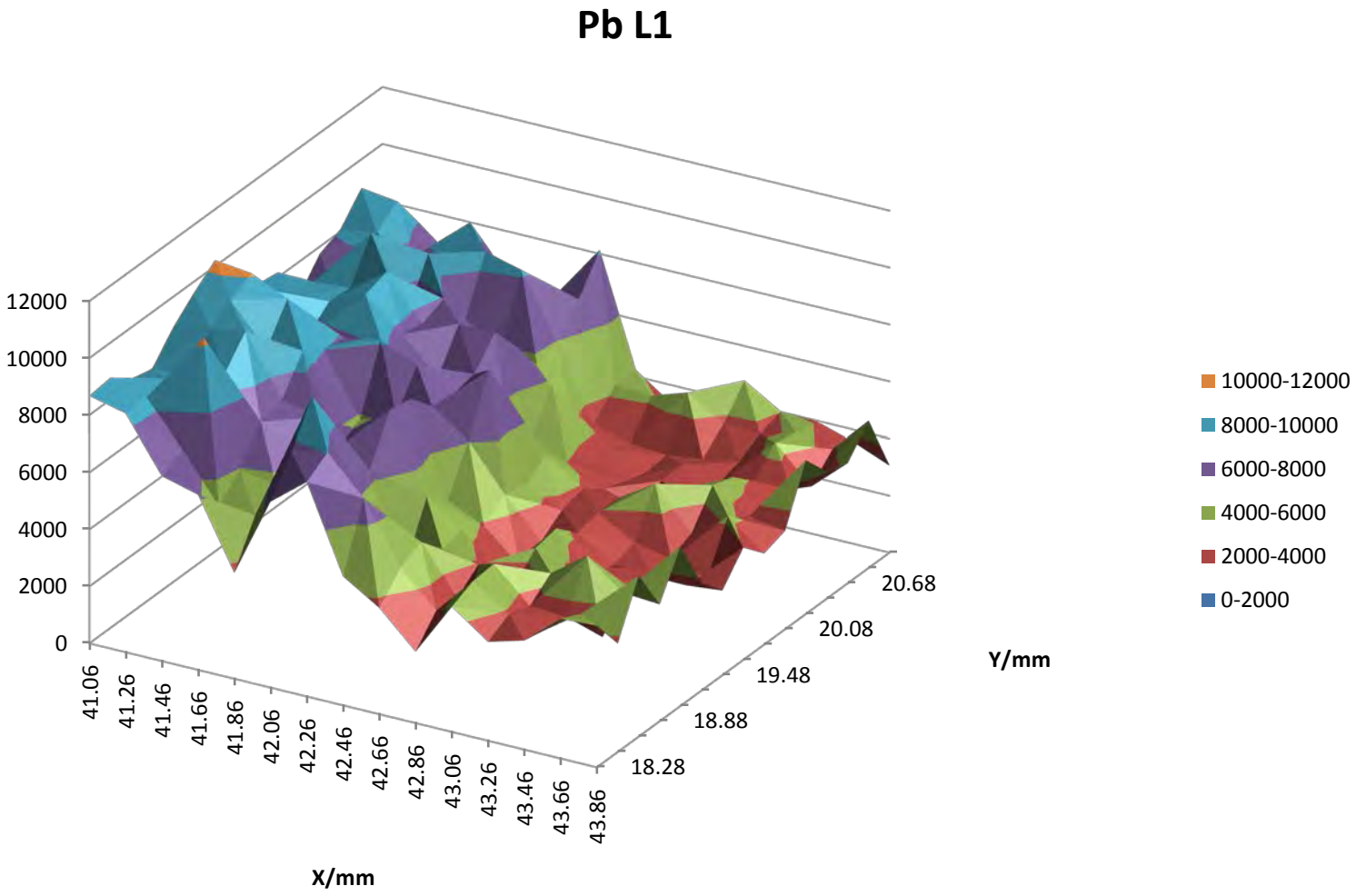
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.88
19.48
20.08
20.68
Y/mm
250000-300000
200000-250000
150000-200000
100000-150000
50000-100000
0-50000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41.86
42.06
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42.46
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42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
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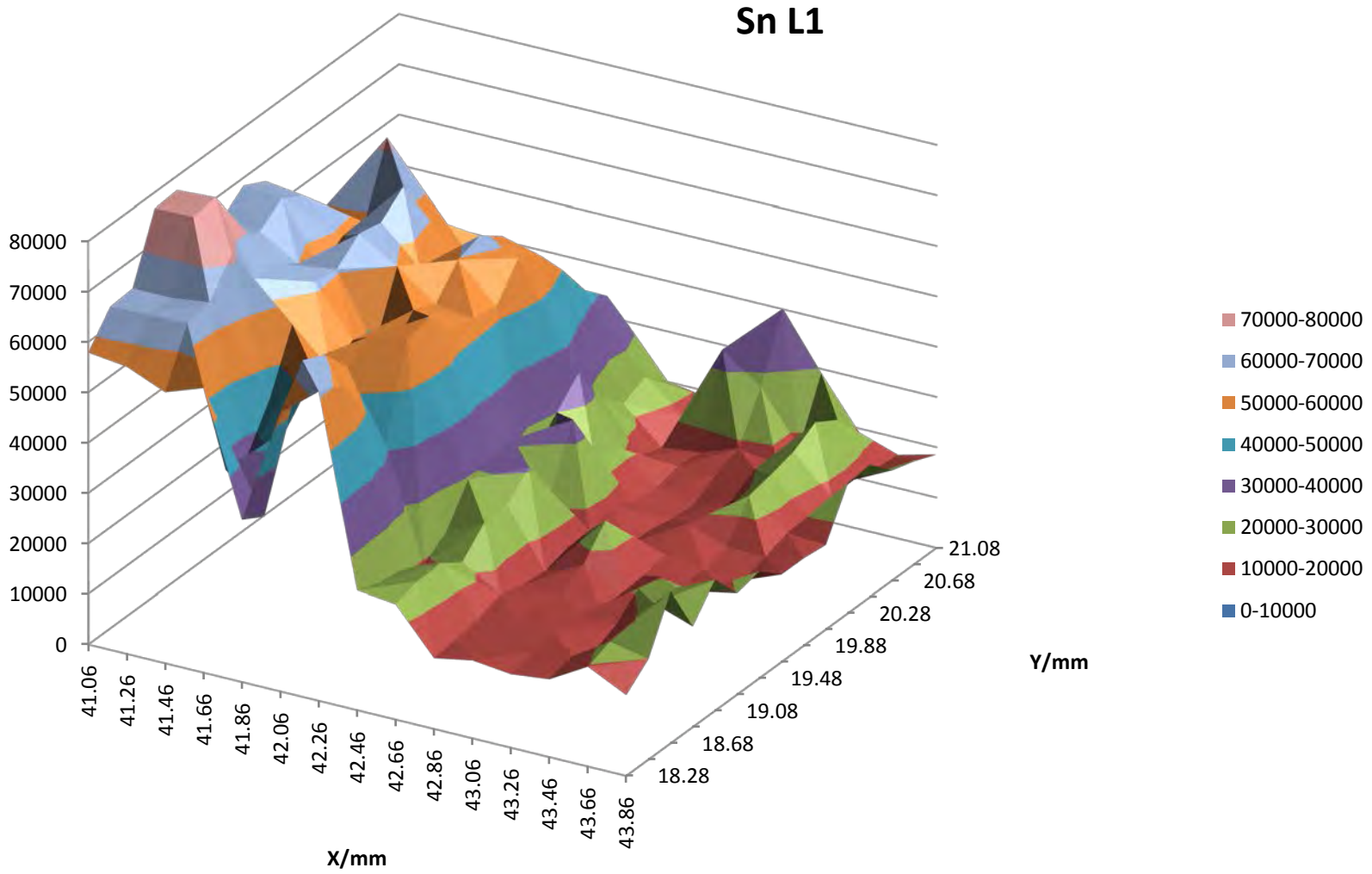
20.08
20.68
Y/mm
10000-12000
8000-10000
6000-8000
4000-6000
2000-4000
0-2000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50000
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30000
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10000
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42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.68
19.08
19.48
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20.28
20.68
21.08
Y/mm
70000-80000
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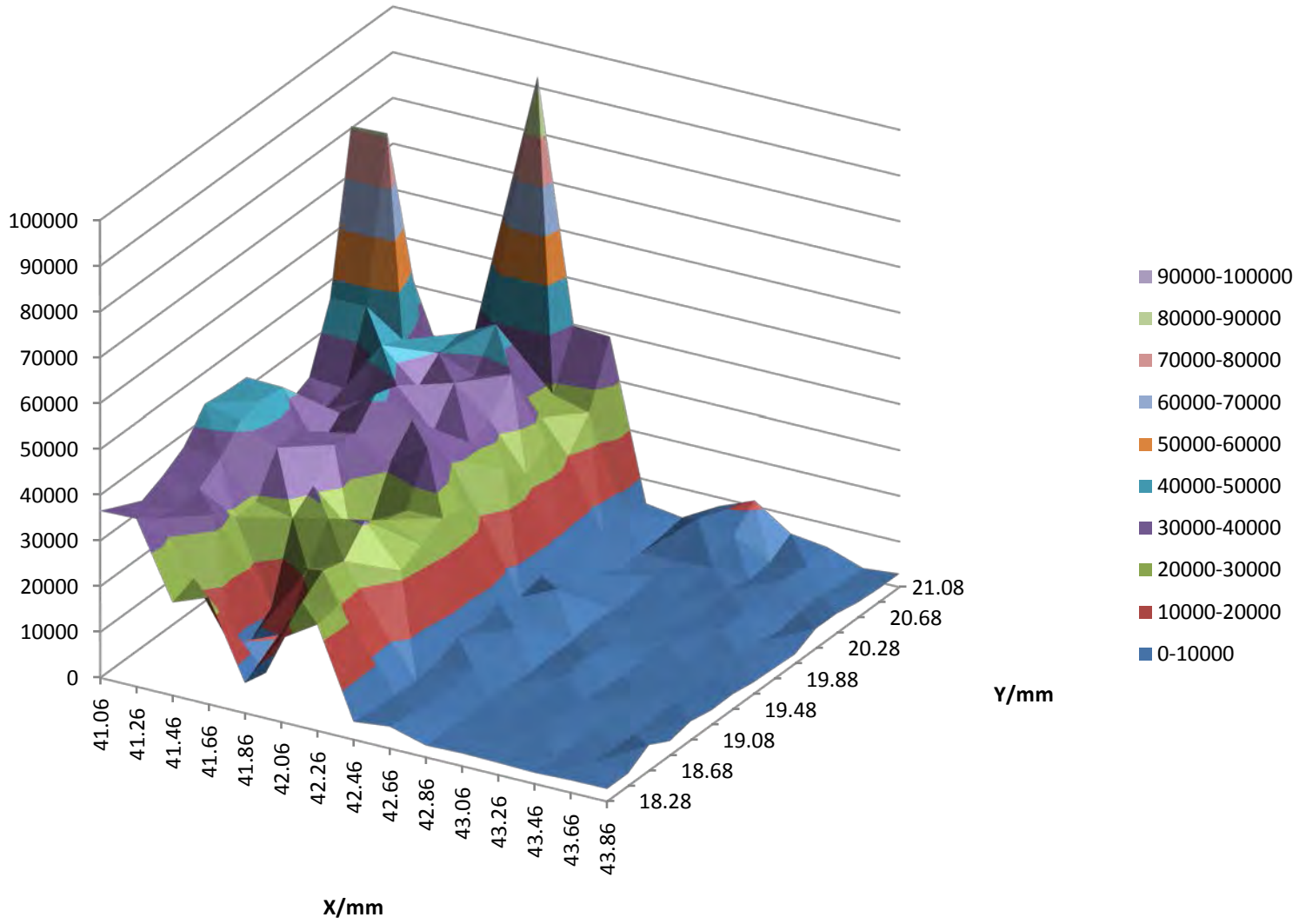
50000-60000
40000-50000
30000-40000
20000-30000
10000-20000
0-10000

Ca K12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42.06
42.26
42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.68
19.08
19.48
19.88
20.28
20.68
21.08
Y/mm
90000-100000
80000-90000
70000-80000
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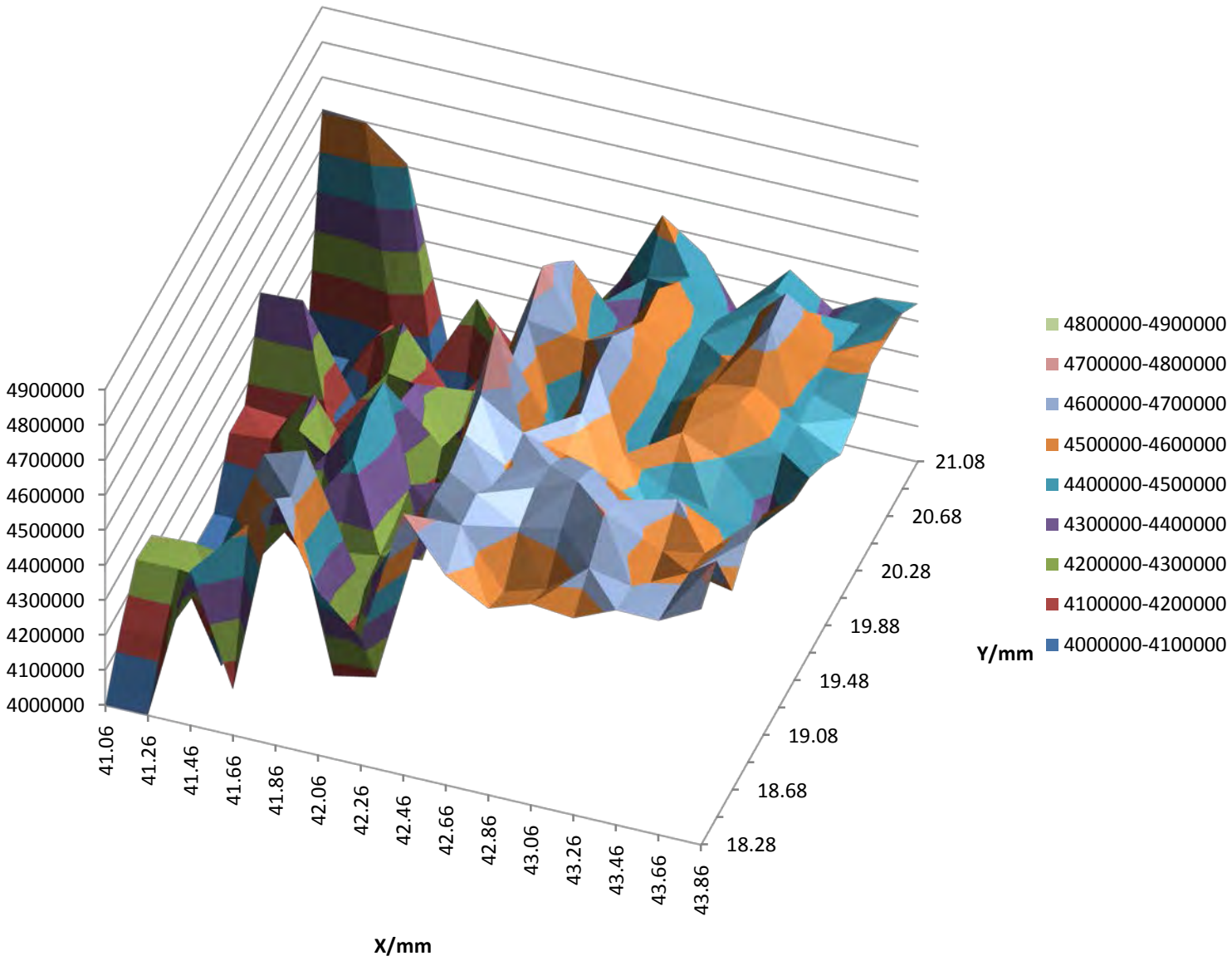
50000-60000
40000-50000
30000-40000
20000-30000
10000-20000
0-10000

Cu K12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4300000
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4100000
4000000
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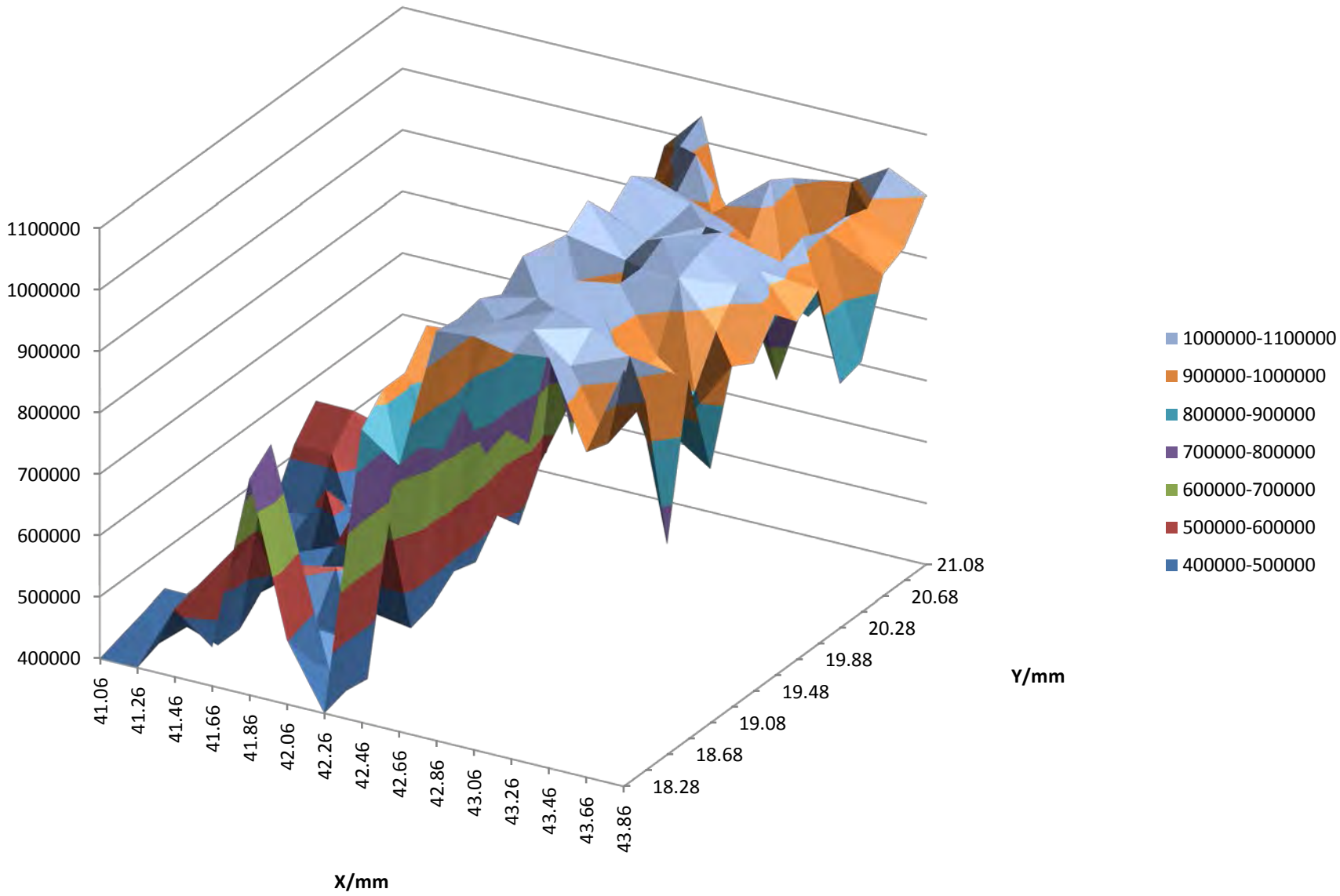
41.26
41.46
41.66
41.86
42.06
42.26
42.46
42.66
42.86
43.06
43.26
43.46
43.66
43.86
X/mm
21.08
20.68
20.28
19.88
19.48
19.08
18.68
18.28
Y/mm
4800000-4900000
4700000-4800000
4600000-4700000
4500000-4600000
4400000-4500000
4300000-4400000
4200000-4300000
4100000-4200000
4000000-4100000

Zn K12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42.46
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42.86
43.06
43.26
43.46
43.66
43.86
X/mm
18.28
18.68
19.08
19.48
19.88
20.28
20.68
21.08
Y/mm
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900000-1000000
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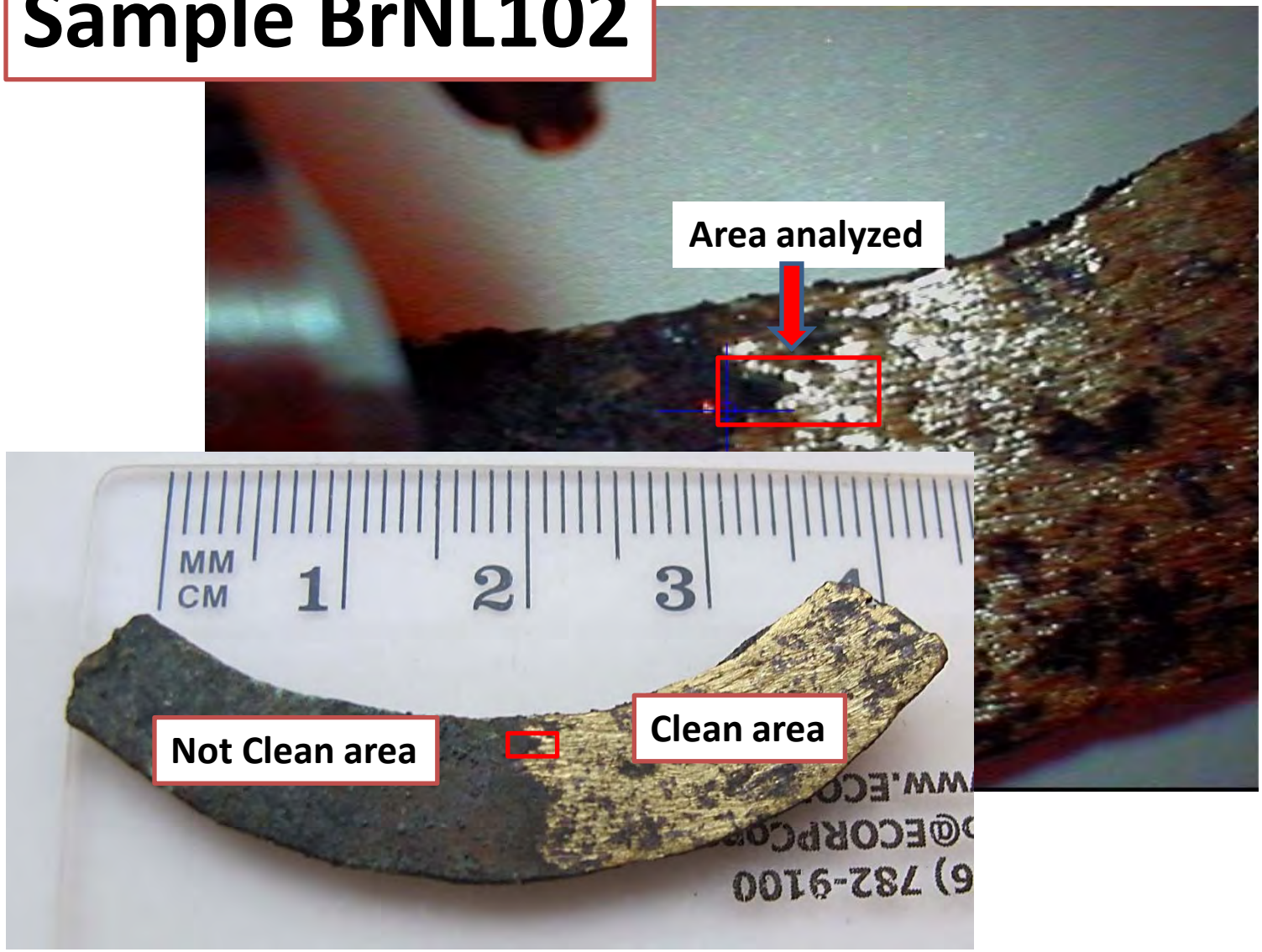
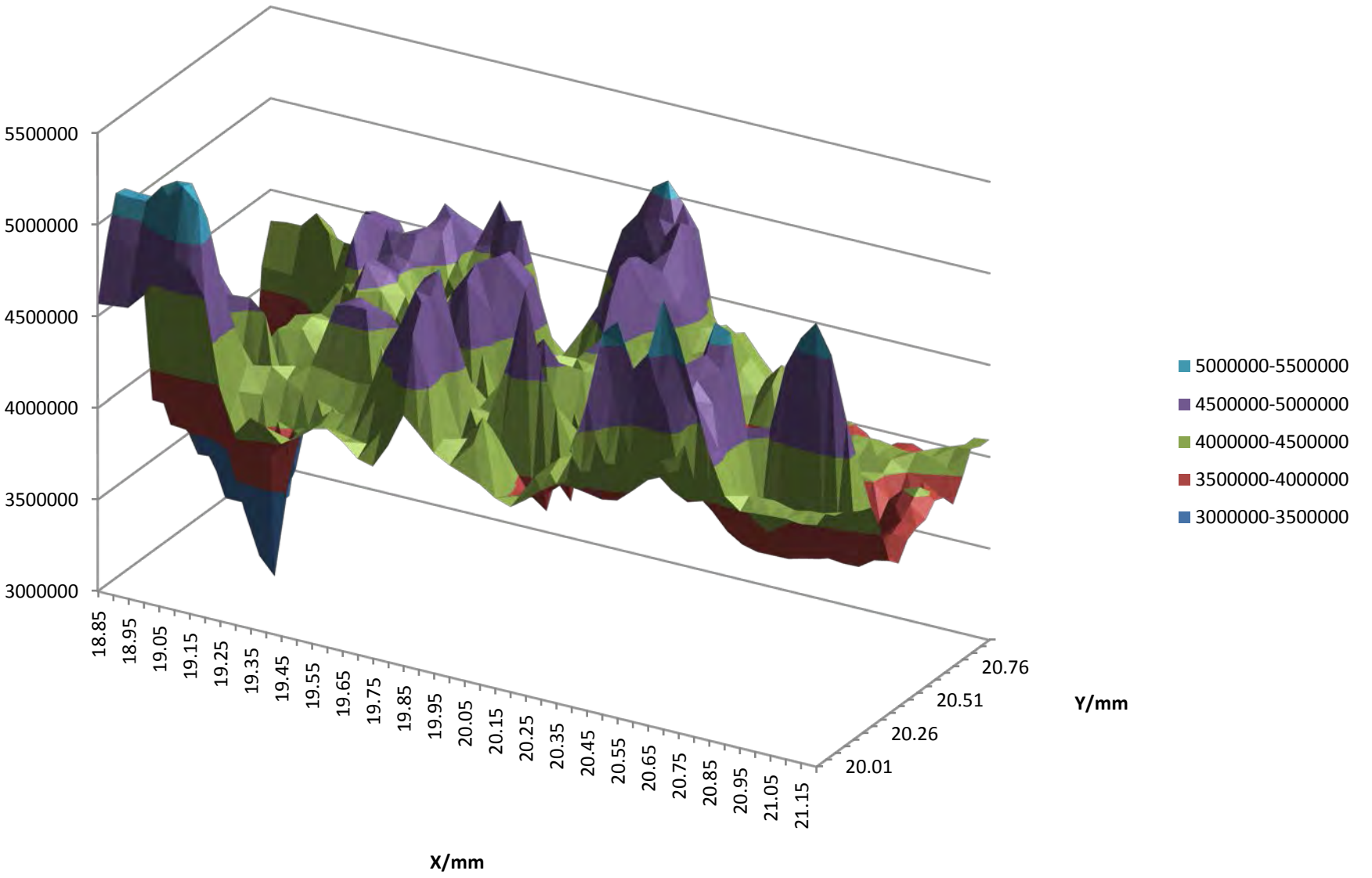
600000-700000
500000-600000
400000-500000

Sample BrNL102



Cu K12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19.65
19.75
19.85
19.95
20.05
20.15
20.25
20.35
20.45
20.55
20.65
20.75
20.85
20.95
21.05
21.15
X/mm
20.76
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Y/mm
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4000000-4500000
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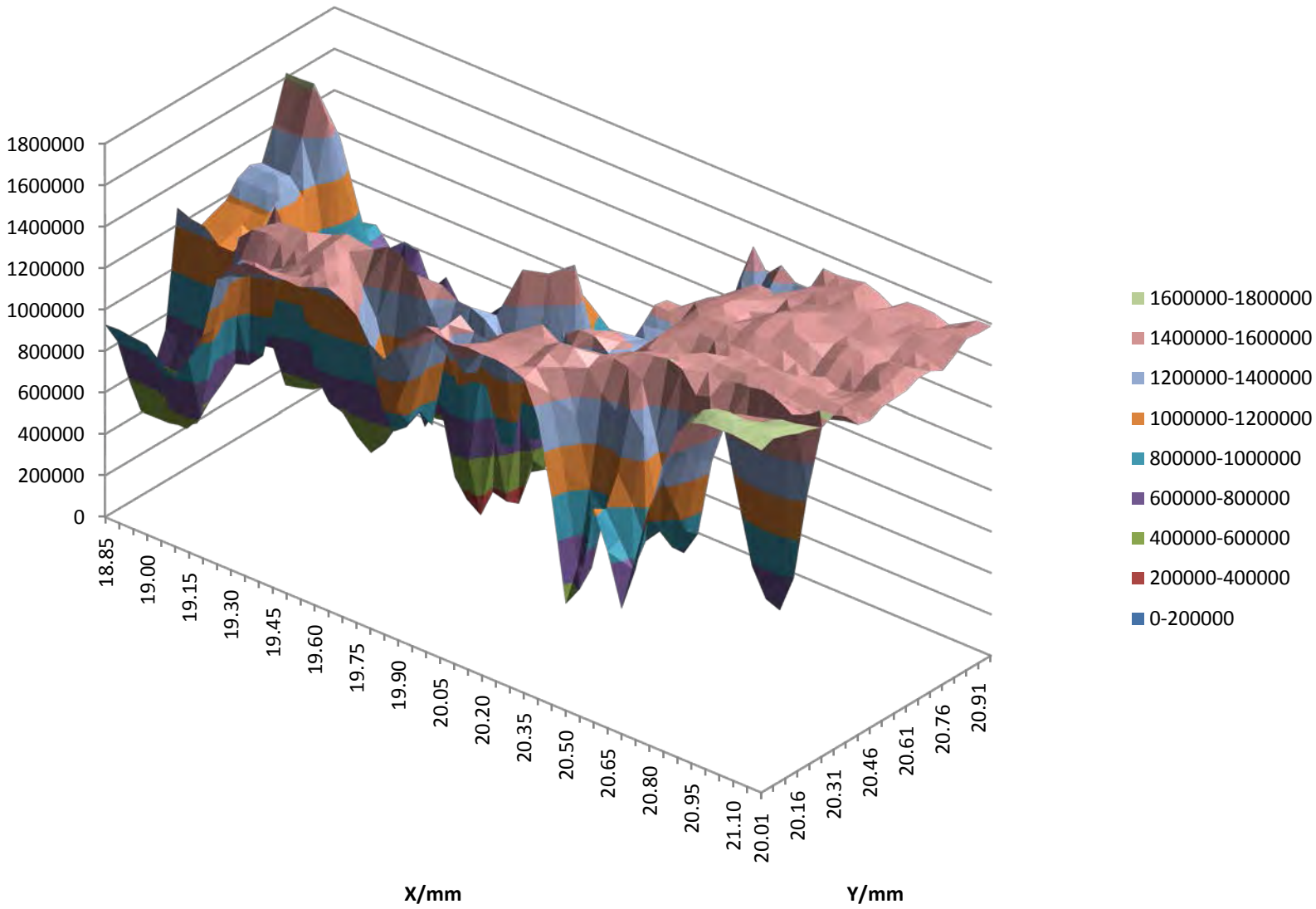
3000000-3500000

Zn K12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19.60
19.75
19.90
20.05
20.20
20.35
20.50
20.65
20.80
20.95
21.10
20.01
20.16
20.31
20.46
20.61
20.76
20.91
X/mm
Y/mm
1600000-1800000
1400000-1600000
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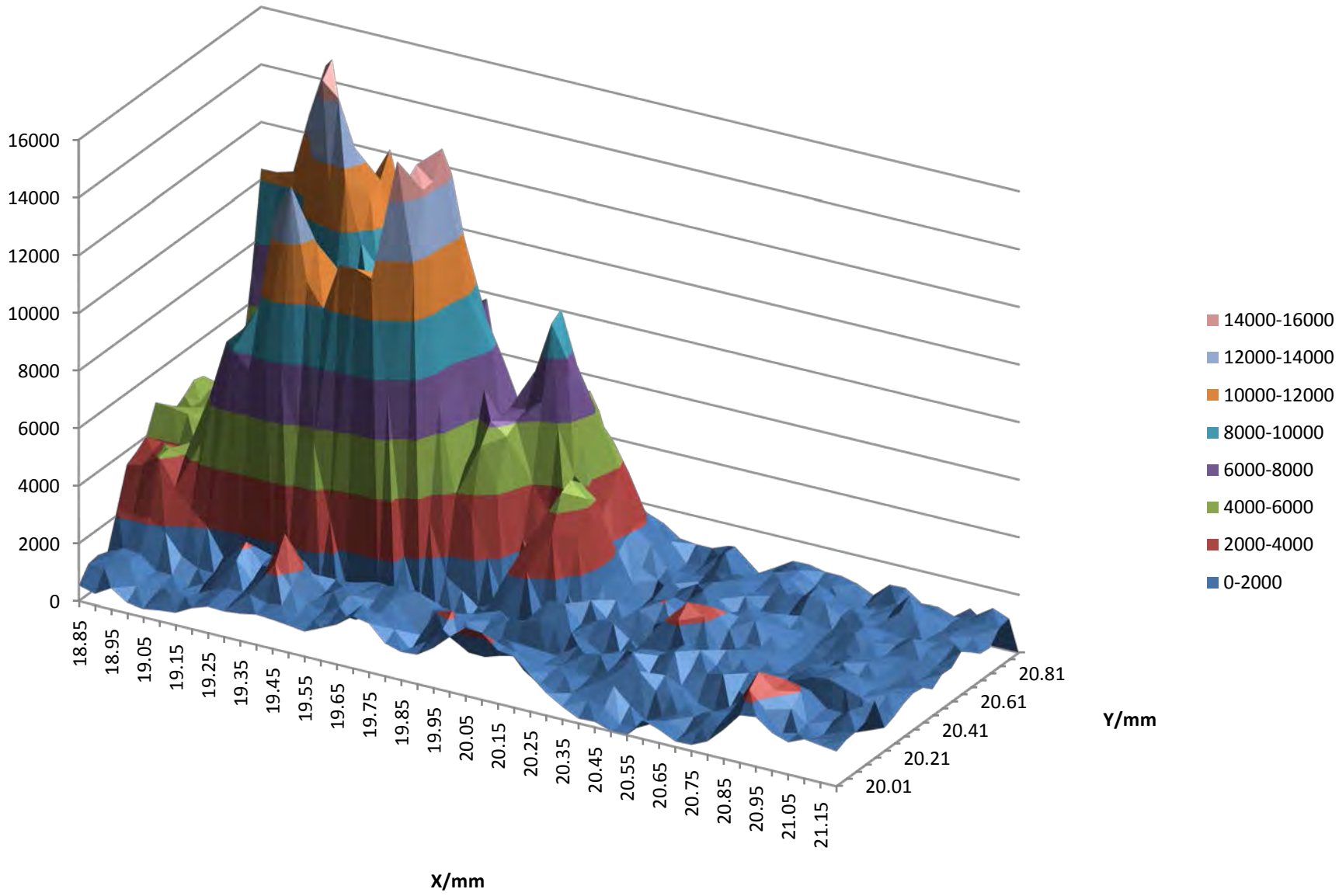
1000000-1200000
800000-1000000
600000-800000
400000-600000
200000-400000
0-200000

Pb M1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19.45
19.55
19.65
19.75
19.85
19.95
20.05
20.15
20.25
20.35
20.45
20.55
20.65
20.75
20.85
20.95
21.05
21.15
X/mm
20.01
20.21
20.41
20.61
20.81
Y/mm
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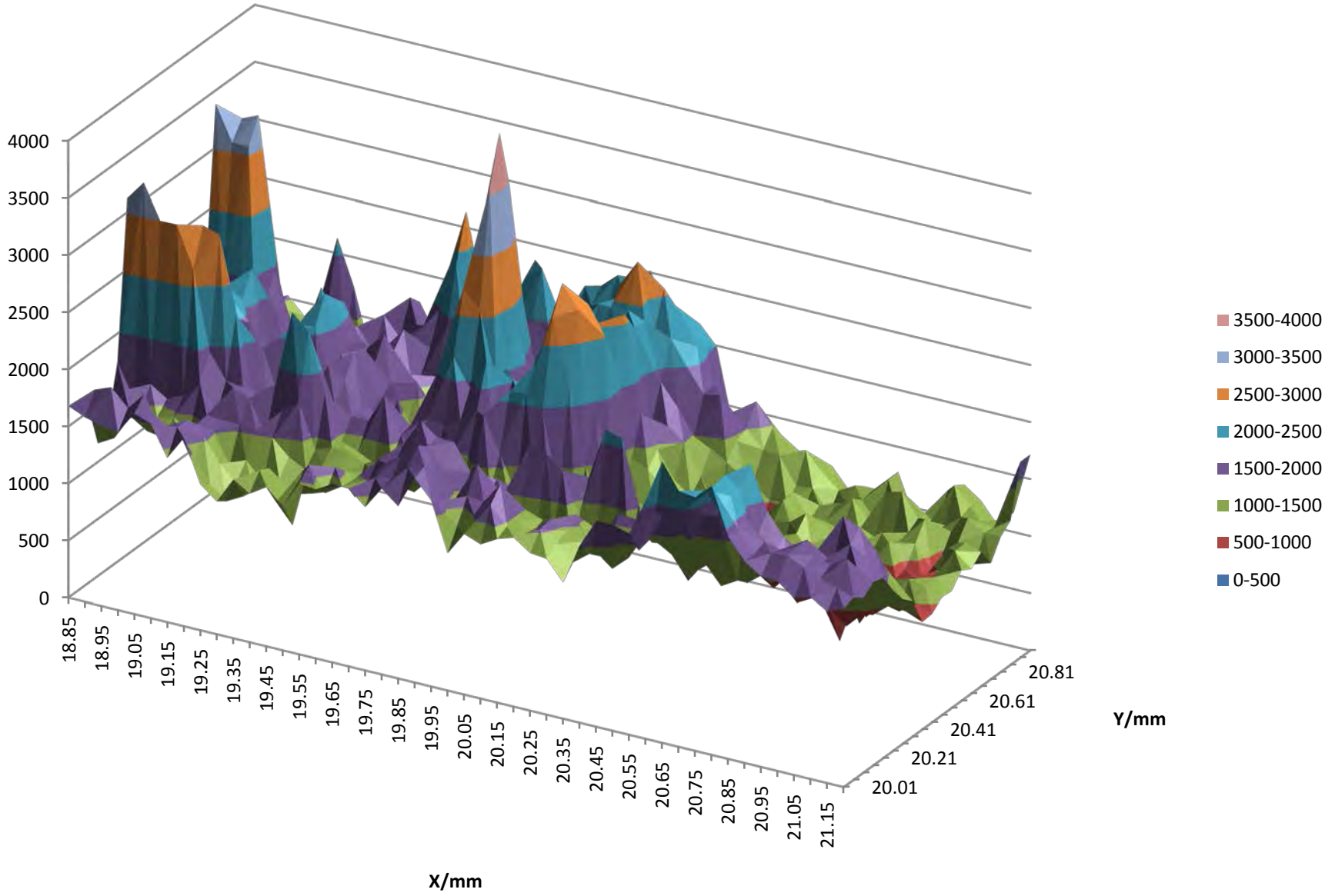
12000-14000
10000-12000
8000-10000
6000-8000
4000-6000
2000-4000
0-2000

Sn L1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19.25
19.35
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19.85
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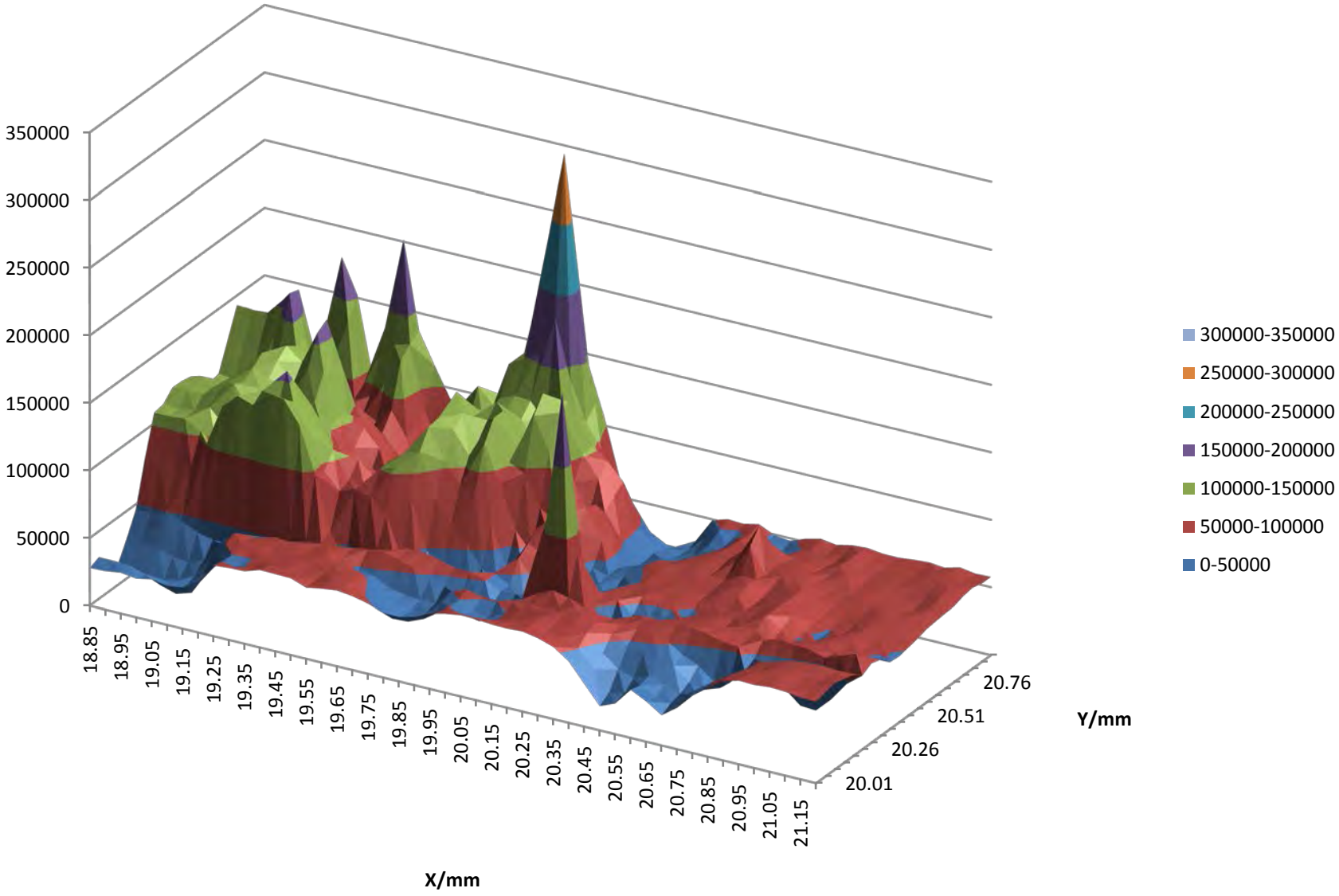
20.75
20.85
20.95
21.05
21.15
X/mm
20.01
20.21
20.41
20.61
20.81
Y/mm
3500-4000
3000-3500
2500-3000
2000-2500
1500-2000
1000-1500
500-1000
0-500

Fe K12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19.85
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20.05
20.15
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20.35
20.45
20.55
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20.75
20.85
20.95
21.05
21.15
X/mm
20.01
20.26
20.51
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Y/mm
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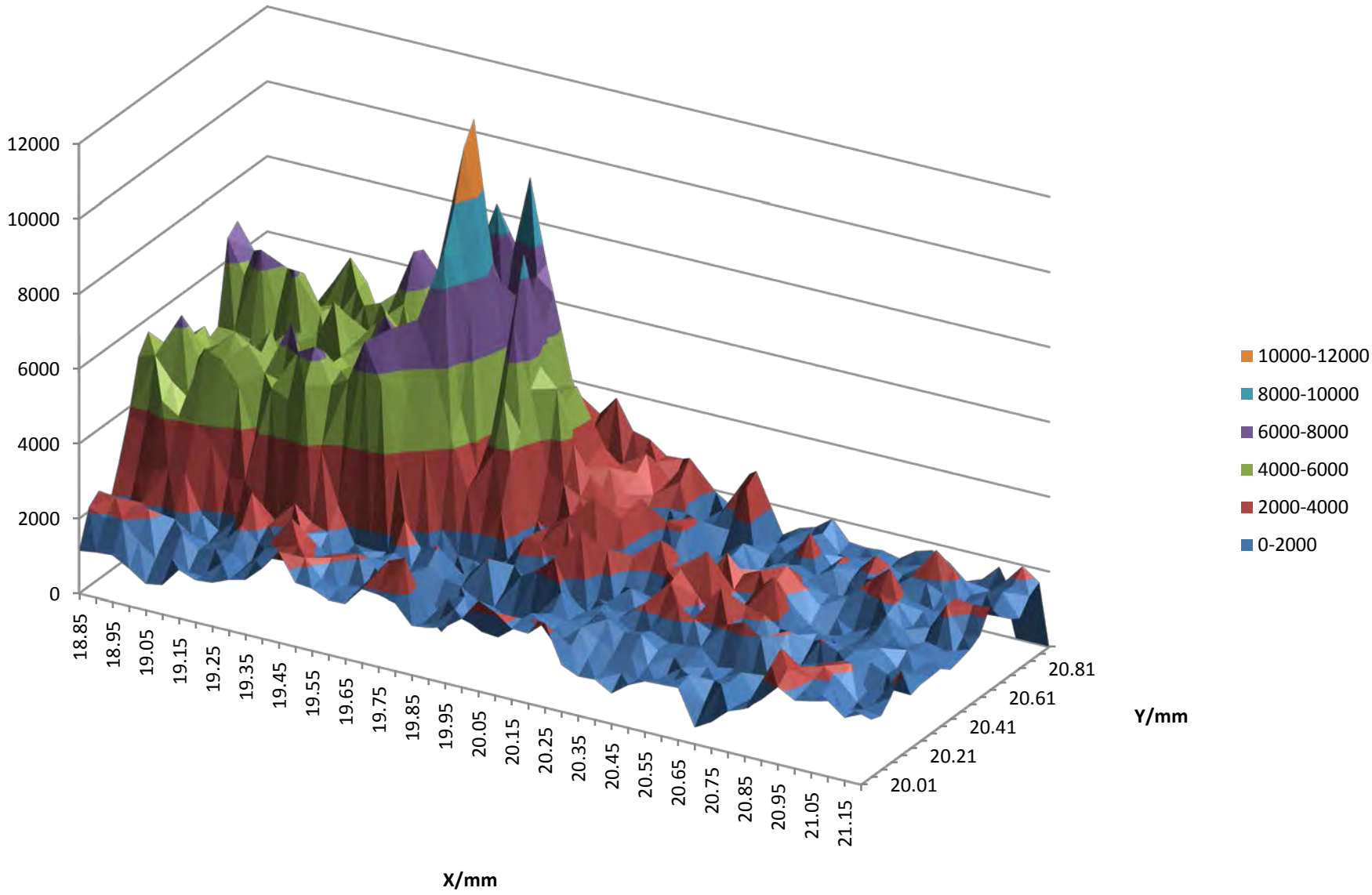
250000-300000
200000-250000
150000-200000
100000-150000
50000-100000
0-50000

As K12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19.35
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19.65
19.75
19.85
19.95
20.05
20.15
20.25
20.35
20.45
20.55
20.65
20.75
20.85
20.95
21.05
21.15
X/mm
20.01
20.21
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20.81
Y/mm
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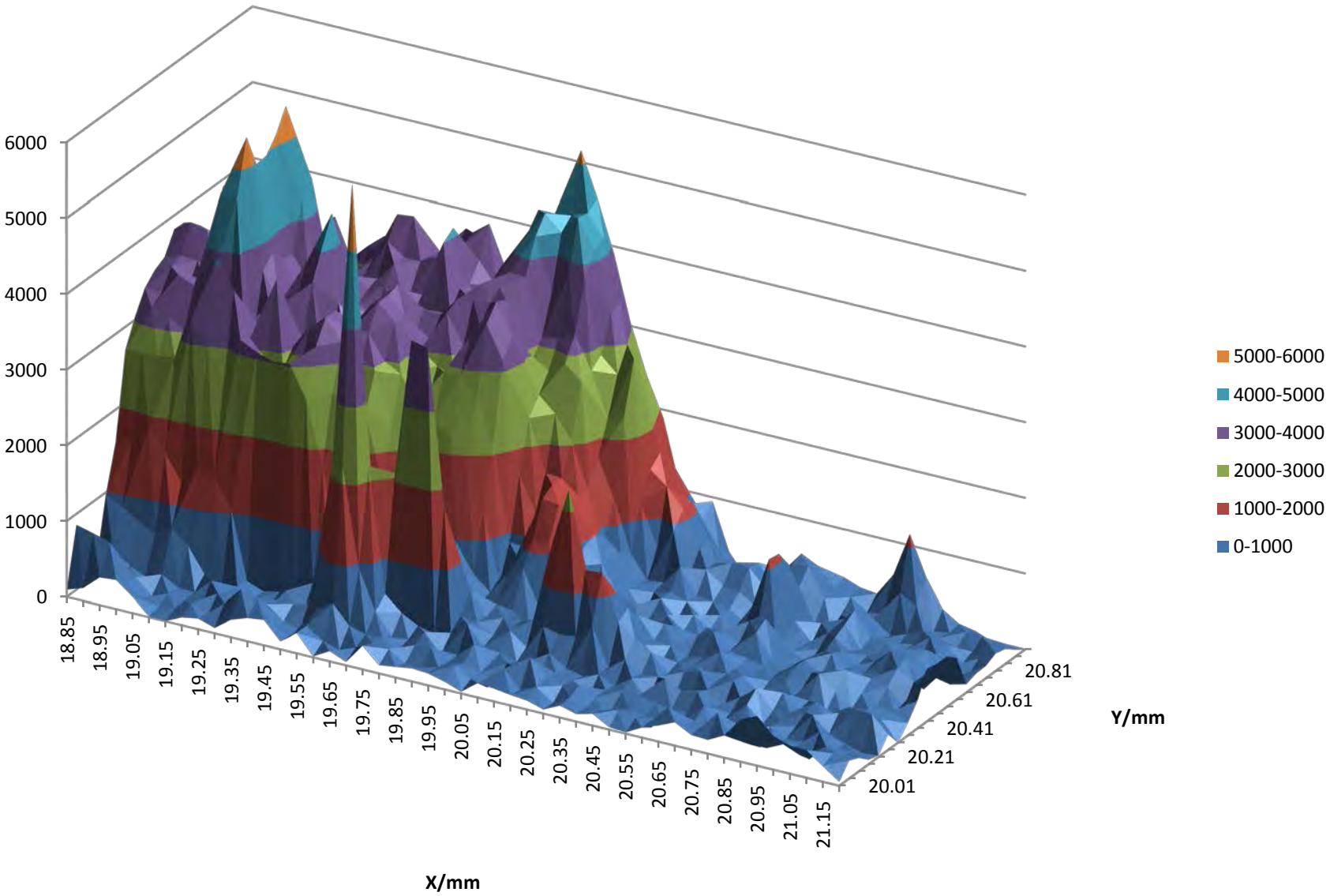
8000-10000
6000-8000
4000-6000
2000-4000
0-2000

Si K12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19.75
19.85
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20.15
20.25
20.35
20.45
20.55
20.65
20.75
20.85
20.95
21.05
21.15
X/mm
20.01
20.21
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20.81
Y/mm
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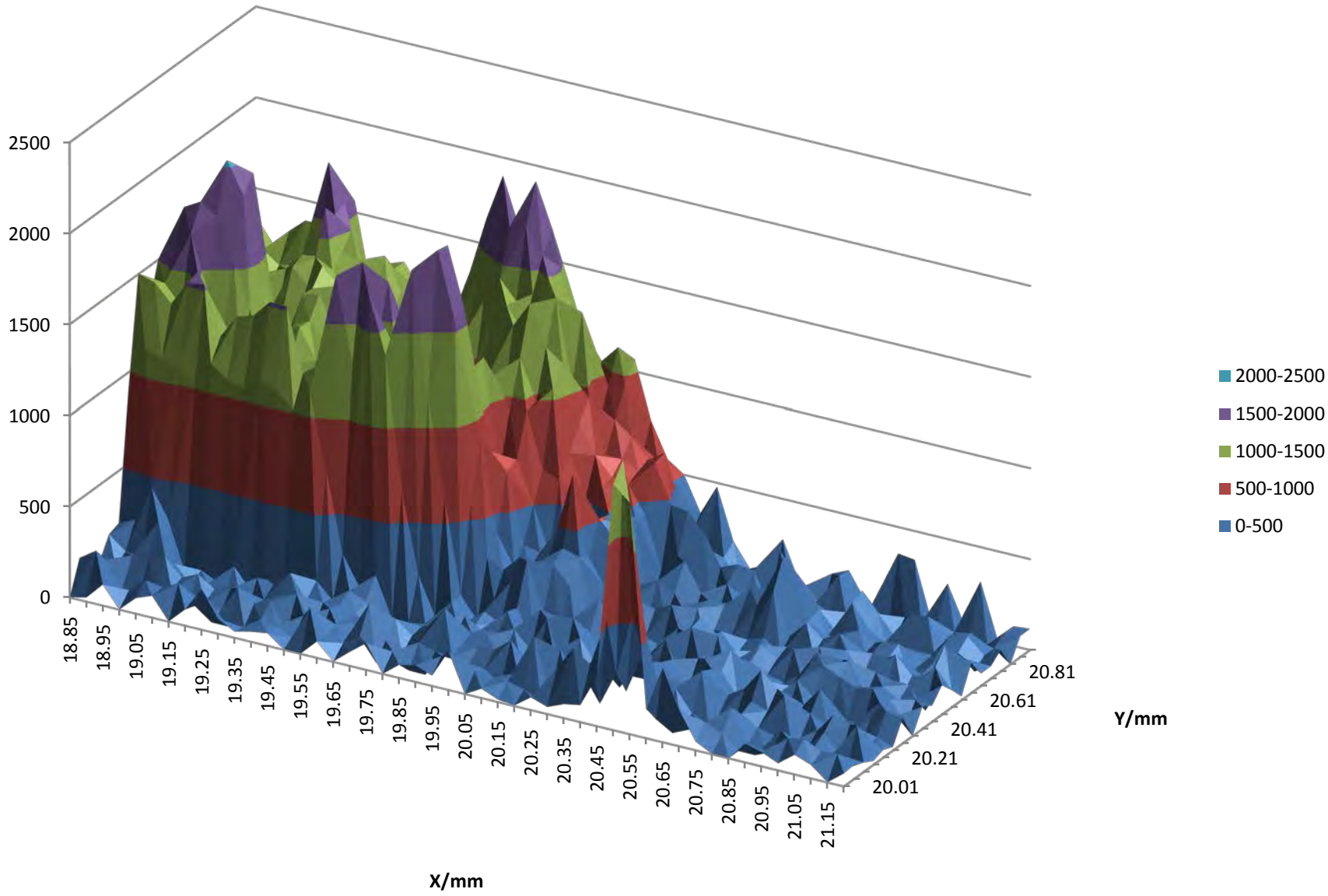
4000-5000
3000-4000
2000-3000
1000-2000
0-1000

P K12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19.55
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19.75
19.85
19.95
20.05
20.15
20.25
20.35
20.45
20.55
20.65
20.75
20.85
20.95
21.05
21.15
X/mm
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Y/mm
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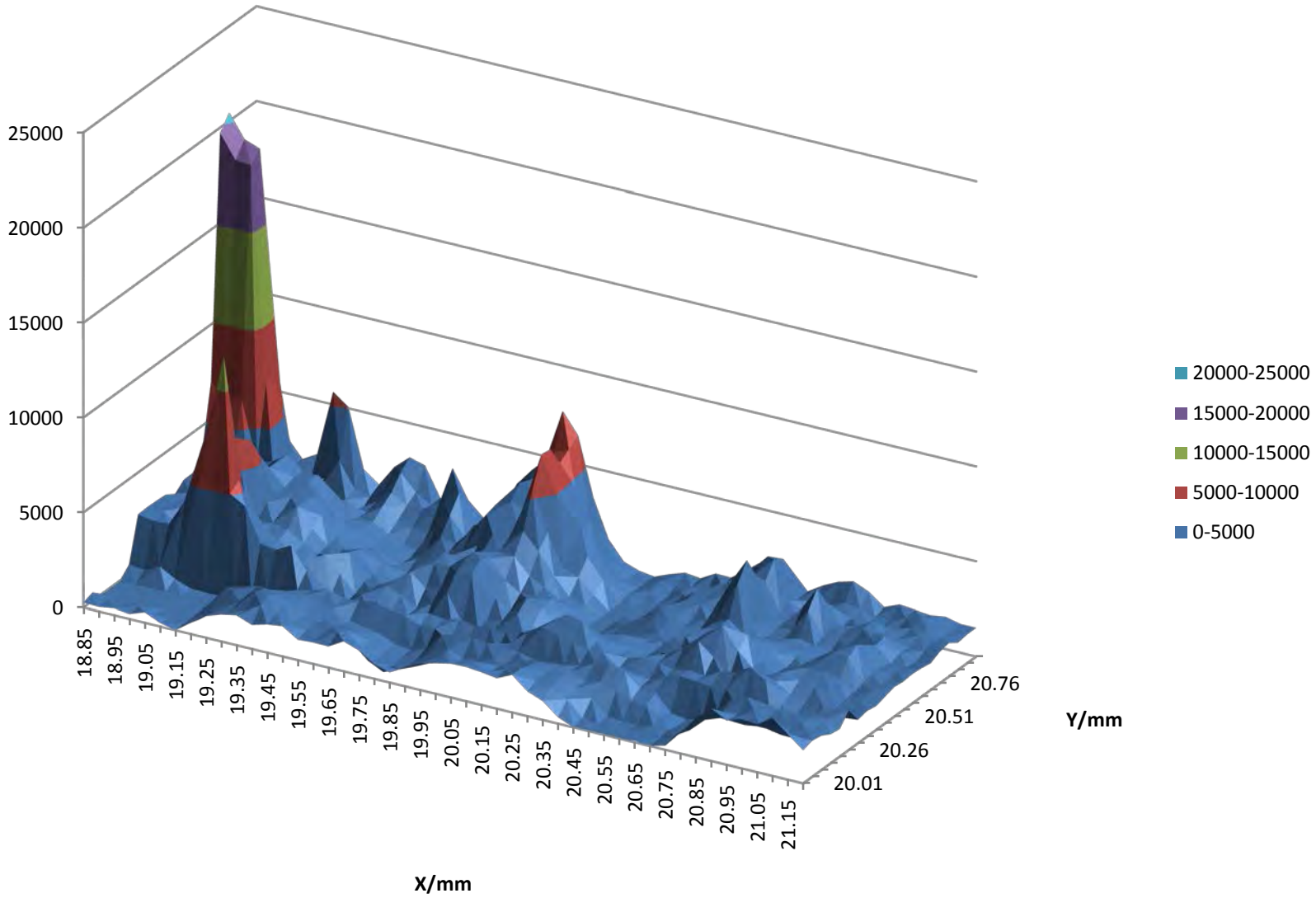
K K12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20.45
20.55
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20.75
20.85
20.95
21.05
21.15
X/mm
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20.76
Y/mm
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15000-20000
10000-15000
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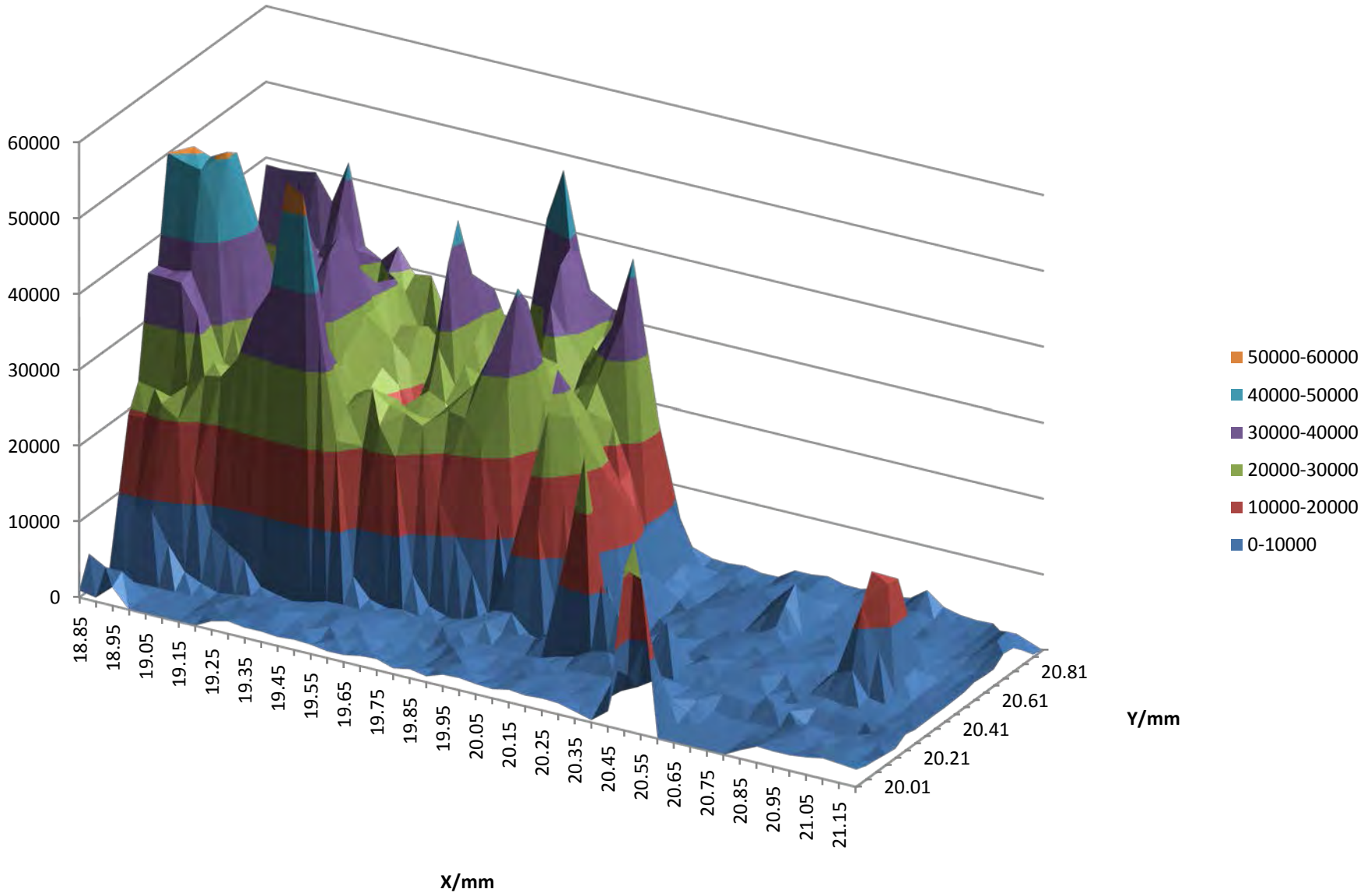
Ca K12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20.95
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21.15
X/mm
20.01
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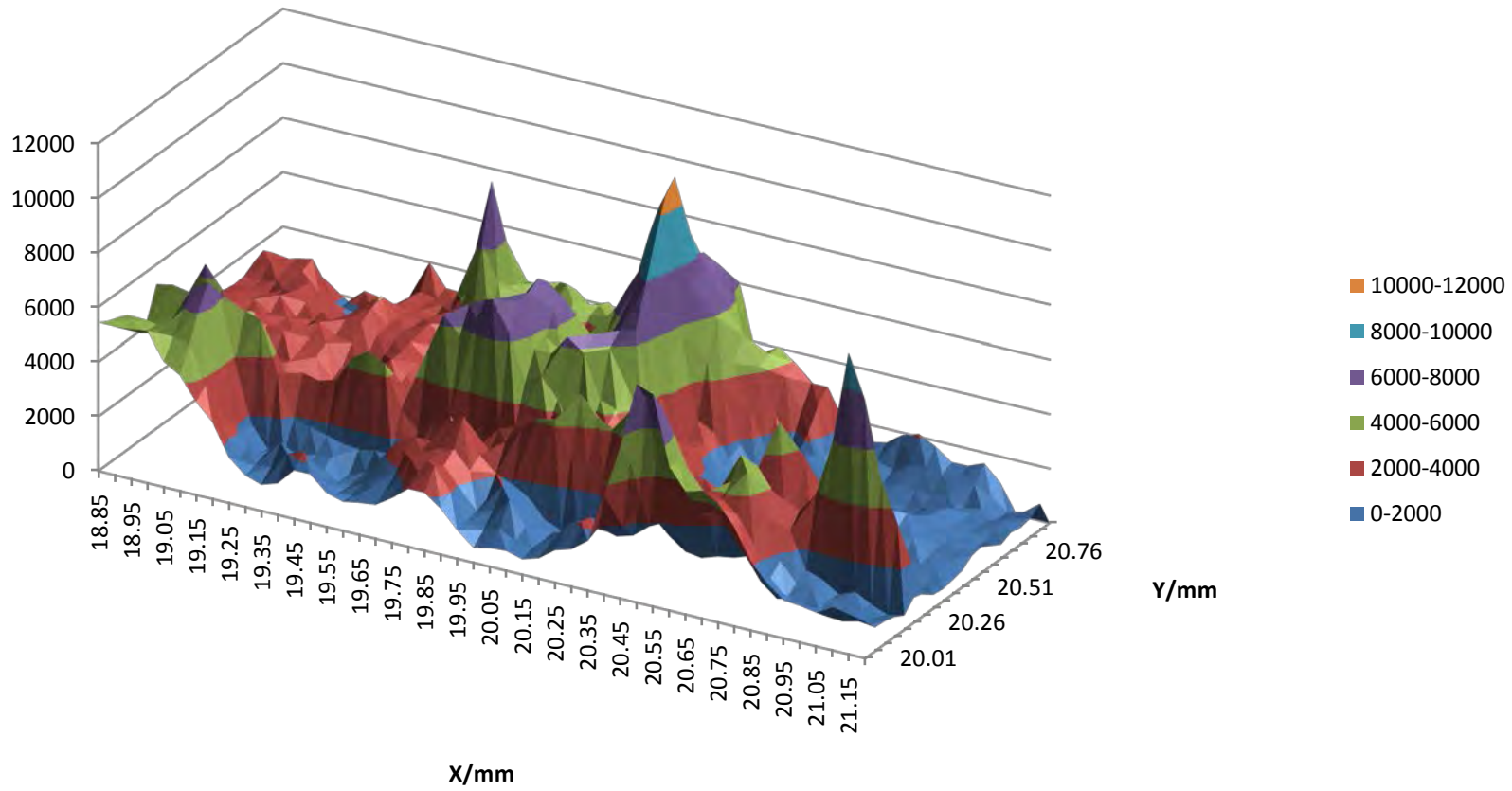
Rh L1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X/mm
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Y/mm
10000-12000
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