Fe and Cu Artifact XRF Analysis

Why quantification can not be done on artifacts that have corrosion or dirt on them or the object itself is not uniform in content!

Analysis of all the spectra was done using the ARTAX software. The S1PXRF software that takes the data will also save the spectra in TXT format which the ARTAX analysis software will then utilize.

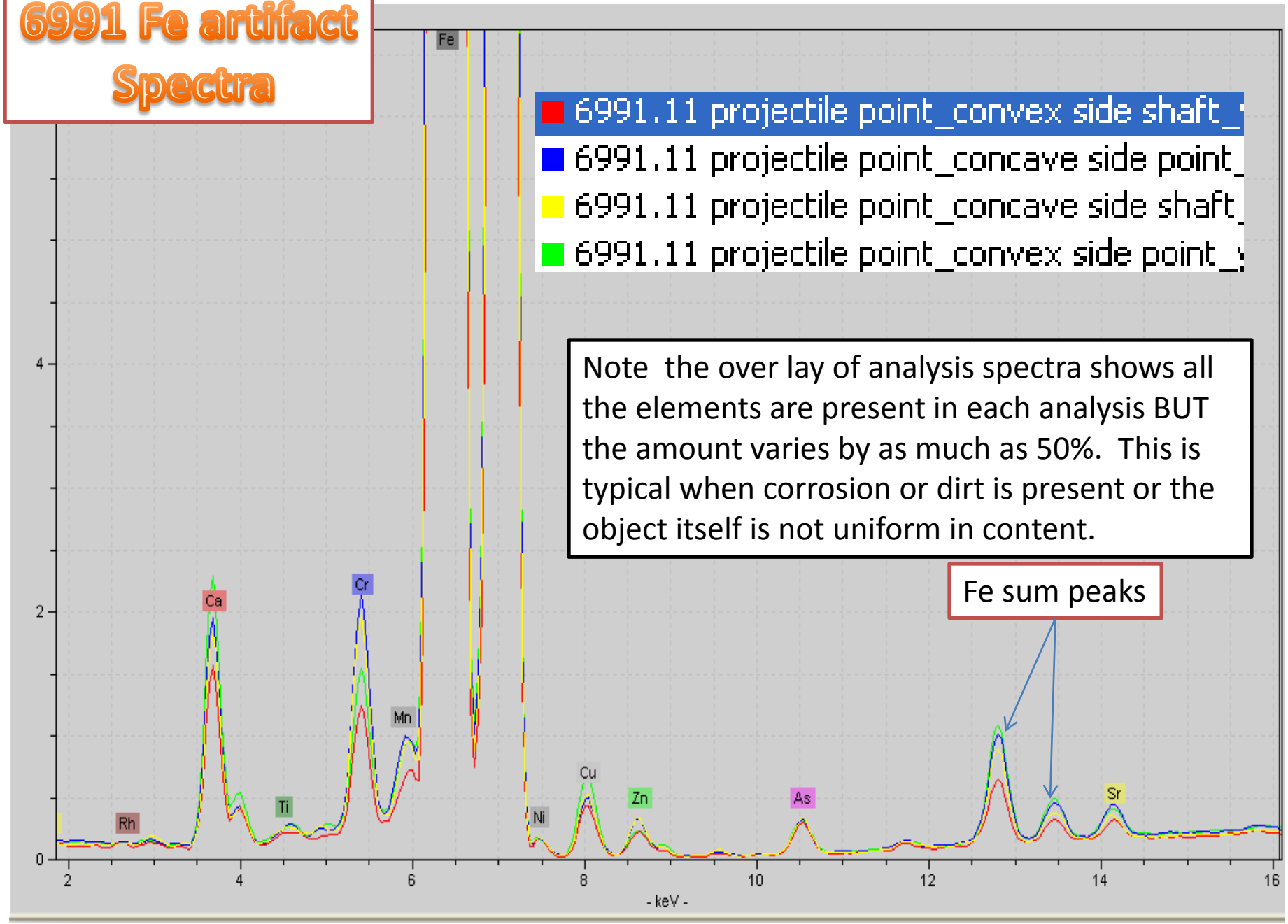
Then start up S1PXRF.
click on Setup and
then GROUP CONVERSION
click on PDZ name and go to the folder that has your data and double click on any file in the folder, *the entire folder is loaded*
CHECK THE BOXES PDZ, TXT, Replace Duration with live time.
It will ask if you want to replace the PDZ files click on YES.
Type in the values in the TXT ELin of .04 and the FWHM of 210.
Then click on Execute PDZ
It will read in all the files and do the math for you. Be sure to label each folder of spectra that you do as corrected files. It will put all the corrected files and the txt files that the Artax software can use back into you data folder.
This process will create all the Artax and S1PXRF files corrected for any dead time variations. This is the data you then want to analyze using ARTAX.

Then open the Artax software and click on File and then open spectra. Make sure the files of type is set on TXT. Then just navigate to the folder that has your data and then you can open one or all your data.

All plots and the numbers of the net area under the elemental lines was done using the ARTAX software.

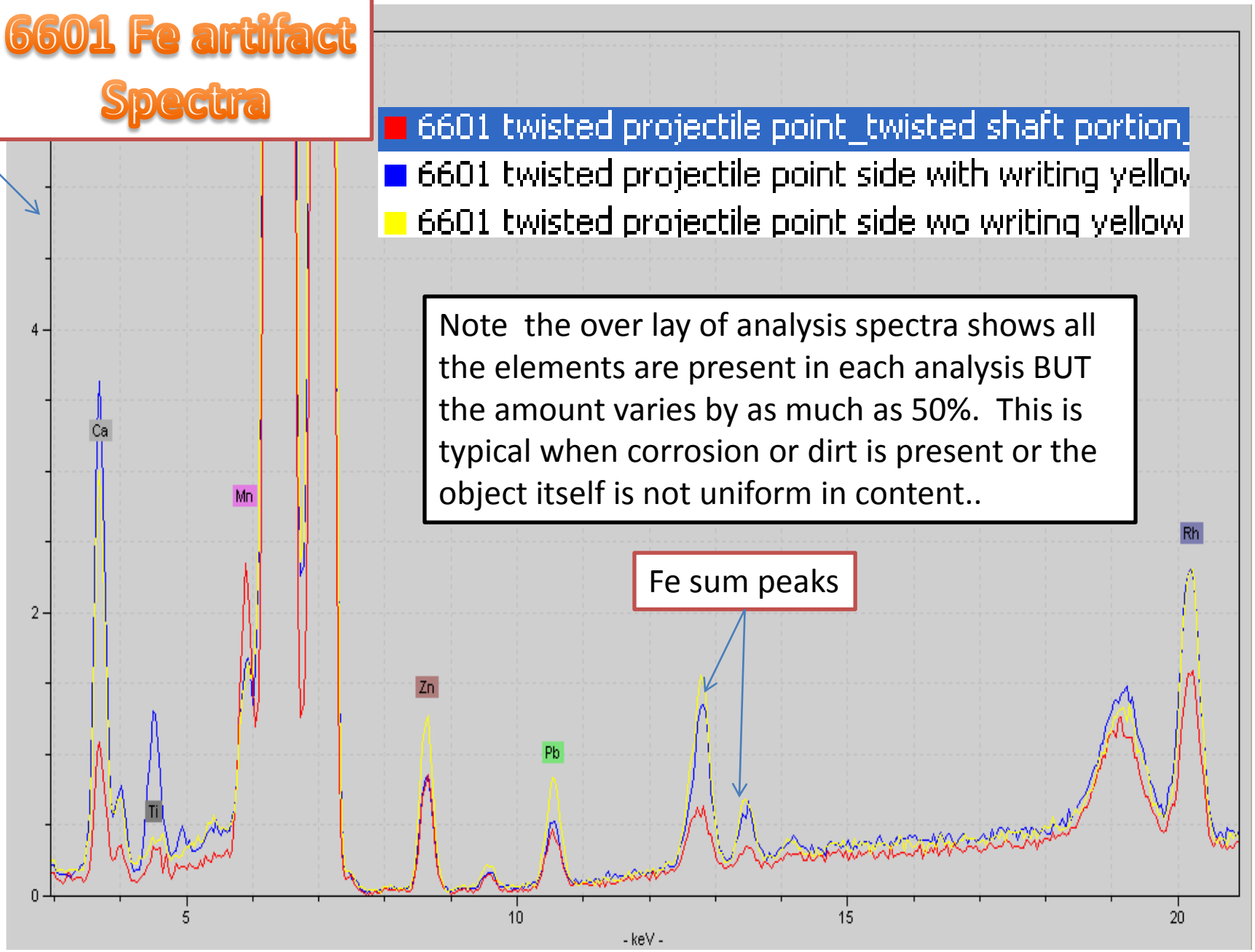
Fe artifact analysis

6991 Fe artifact Spectra

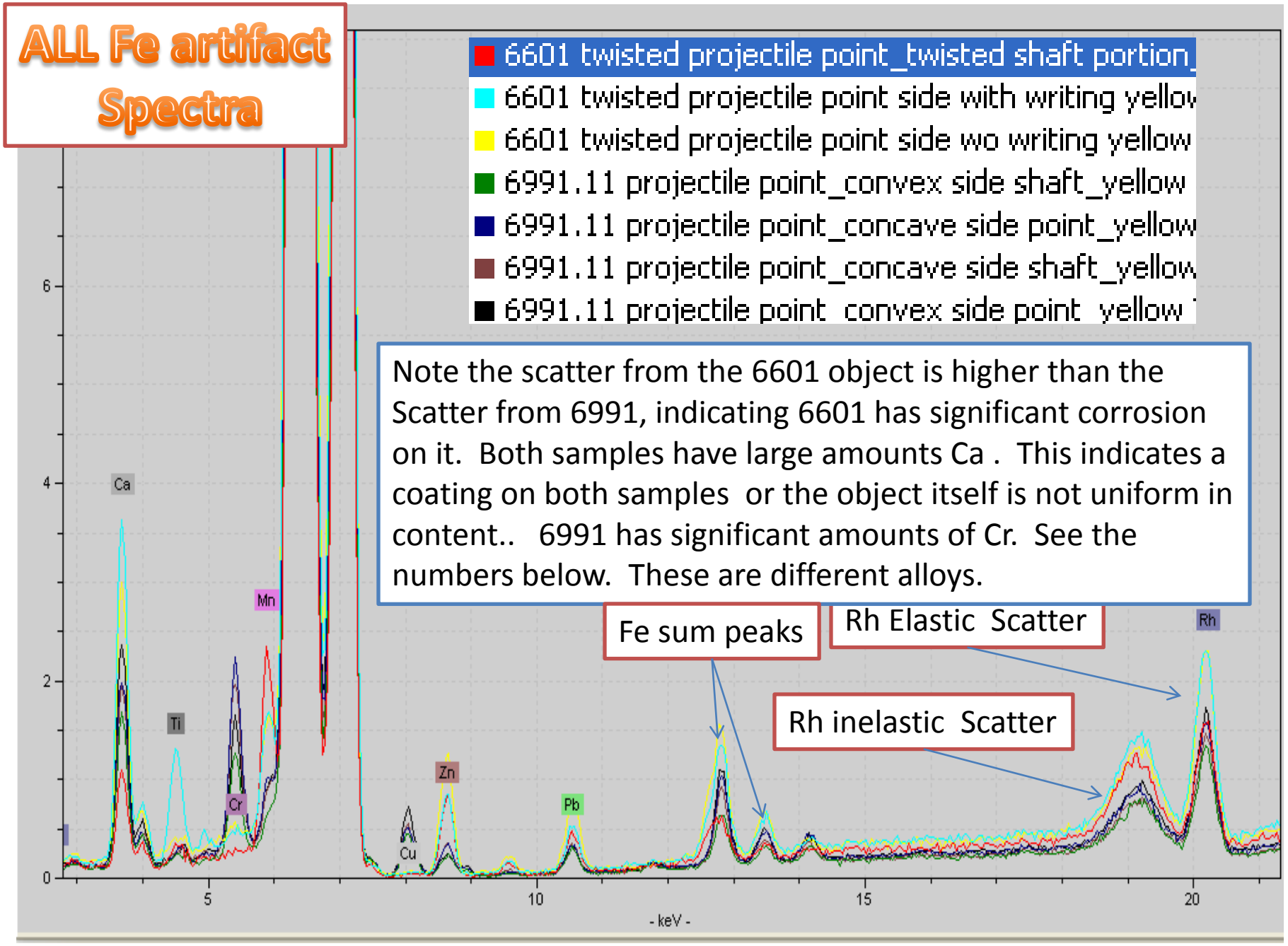


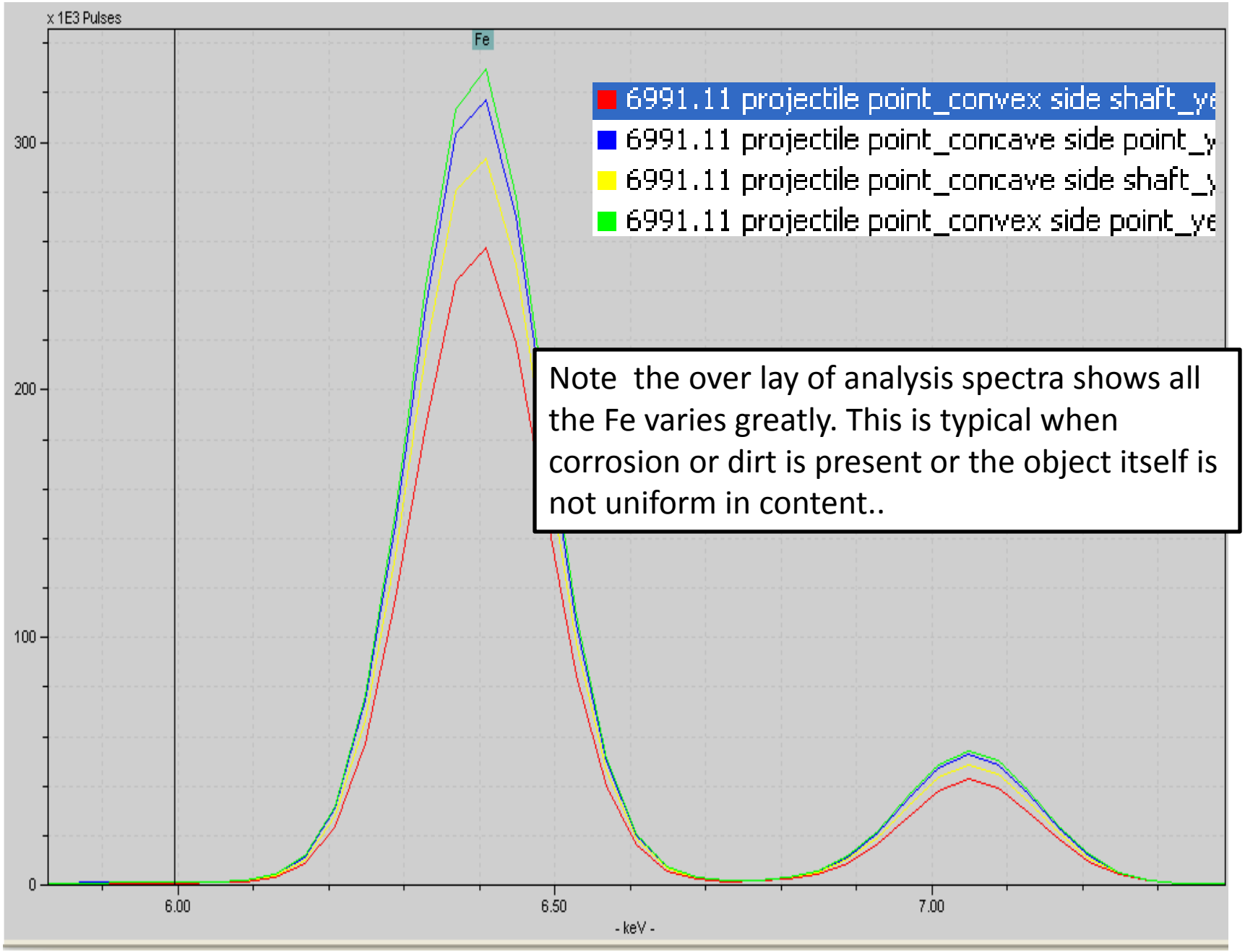
Note the over lay of analysis spectra shows all the elements are present in each analysis BUT the amount varies by as much as 50%. This is typical when corrosion or dirt is present or the object itself is not uniform in content.

6601 Fe artifact Spectra

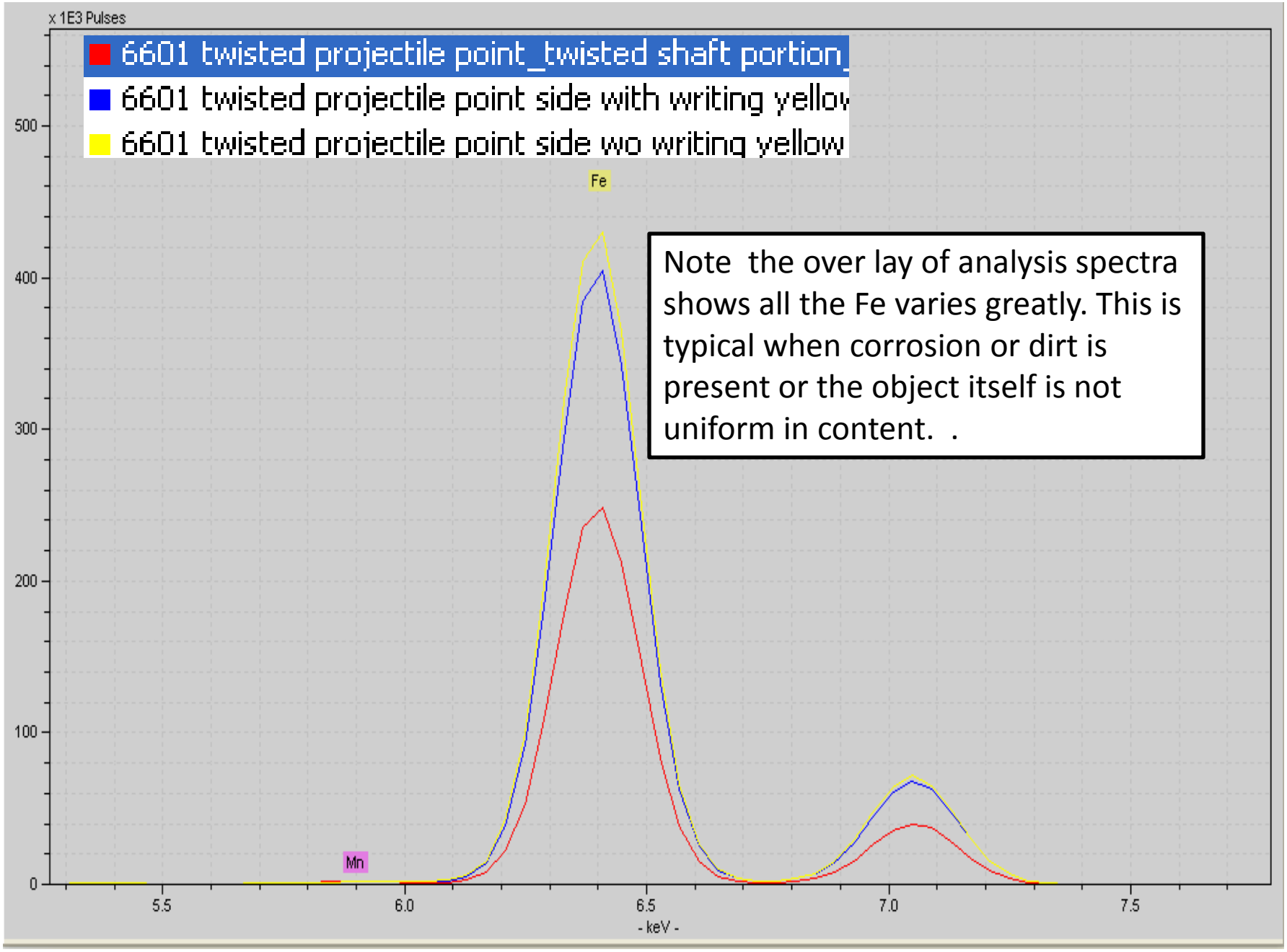


ALL Fe artifact Spectra





Note the over lay of analysis spectra shows all the Fe varies greatly. This is typical when corrosion or dirt is present or the object itself is not uniform in content..


x 1E3 Pulses
6601 twisted projectile point_twisted shaft portion_
6601 twisted projectile point side with writing yellow
6601 twisted projectile point side wo writing yellow
500
400
300
200
100
0
Fe
Mn
5.5
6.0
6.5
7.0
7.5
- keV -
Note the over lay of analysis spectra shows all the Fe varies greatly. This is typical when corrosion or dirt is present or the object itself is not uniform in content. .

The net area under the elemental lines shown on the next slides was gotten using the Gaussian curve fitting option in the Artax analysis software. This allows one to do semi quantitative evaluation of the spectra data.

net area under the elemental lines

Rh K Normalized

The variation as indicated by the % STD Dev between analysis shows that 6991 is covered by some corrosion. Xrf quantification is not possible.

Element	6991.11 projectile point_convex PT	6991.11 projectile point_concav PT	6991.11 projectile point_concav Shaft	6991.11 projectile point_convex Shaft	6991.1 AVE	STD Dev	%SD	Ratio to Fe 6991.1
Ca	11444	10255	10419	10169	10572	591	5.6	0.00573
Cr	6689	10636	10859	6883	8767	2290	26.1	0.00475
Mn	1340	1502	1443	1053	1335	199	14.9	0.00072
Fe	1814848	1847948	1873242	1839124	1843791	24112	1.3	1.00000
Cu	3893	2961	3437	3273	3391	388	11.5	0.00184
Zn	1163	1779	2052	1576	1643	375	22.8	0.00089
As	1757	1903	2095	2185	1985	192	9.7	0.00108
Sr	2604	2771	2272	2094	2435	308	12.6	0.00132
Rh	12374	12374	12374	12374	12374	0	0.0	

Rh K Normalized

The great variation as indicated by the % STD Dev between analysis shows that 6601 is covered by corrosion. Xrf quantification is not possible

Element	6601 twisted proj point w label	6601 twisted proj point wo	6601 twisted proj point shaft	6601 AVE	STD Dev	% STD Dev	Ratio to Fe
Ca	17404	13785	7857	13015	4820	37.0	0.00579
Ti	5871	993	1910	2925	2592	88.6	0.00130
Cr	426	575	285	429	145	33.8	0.00019
Mn	5869	5532	16299	9233	6121	66.3	0.00411
Fe	2220304	2374491	2143141	2245979	117793	5.2	1.00000
Cu	135	158	307	200	94	46.7	0.00009
Zn	4829	7318	7692	6613	1556	23.5	0.00294
Sr	1903	1965	1368	1745	328	18.8	0.00078
Rh	17638	17638	17638	17638	0	0.0	0.00785
Pb	2935	5050	4245	4077	1067	26.2	0.00182

net area under the elemental lines

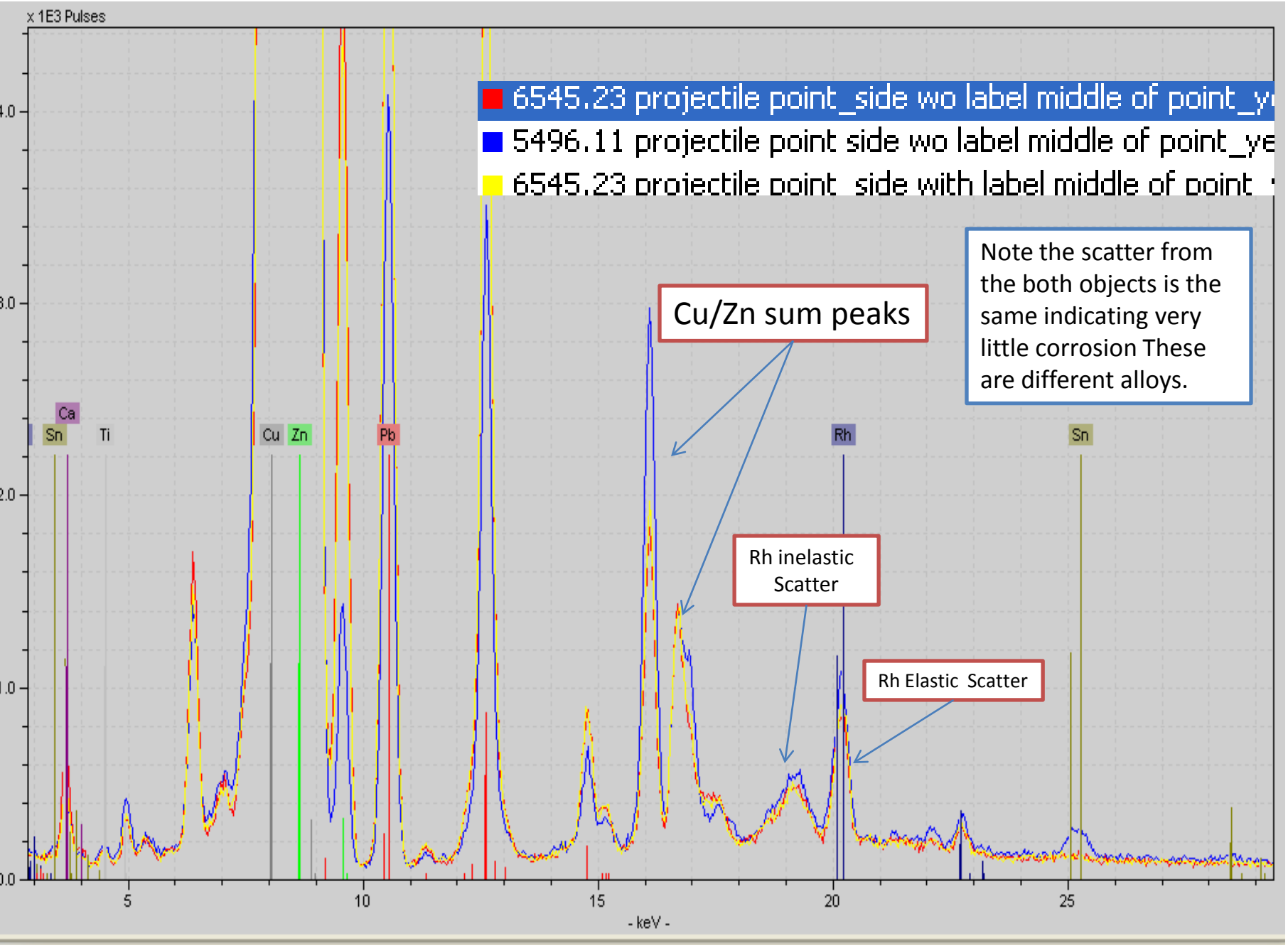
Fe artifact analysis

Summary analysis

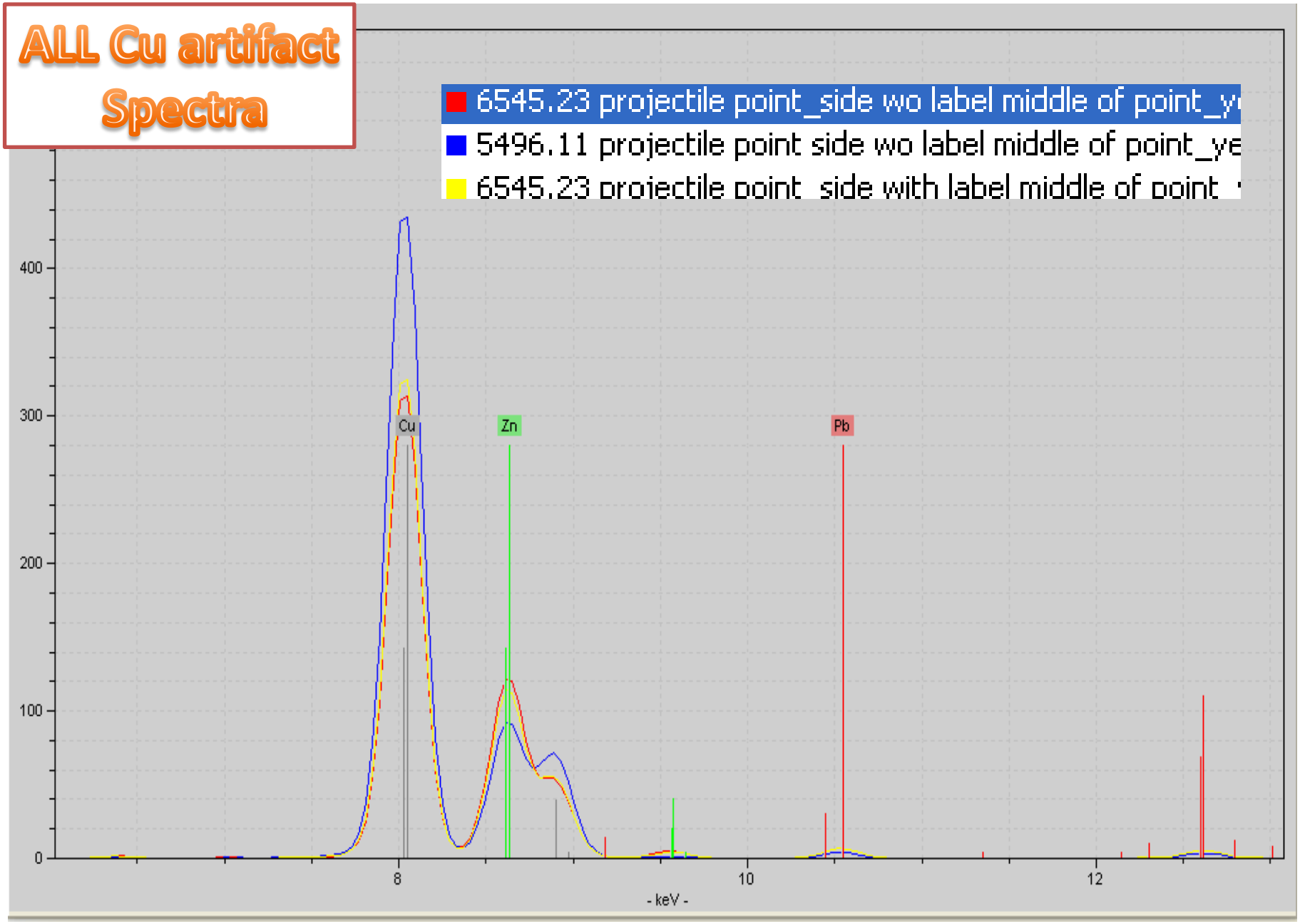
Element	*6991.1 AVE*	*Ratio Fe*	*6601 AVE*	*Ratio Fe*
Ca	10571.9	0.00573	13015.2	0.0058
Ti	0.0	0.00000	2924.8	0.0013
Cr	8766.9	0.00475	428.7	0.0002
Mn	1334.6	0.00072	9233.1	0.0041
Fe	1843790.6	1.00000	2245978.5	1.0000
Cu	3391.0	0.00184	200.2	0.0001
Zn	1642.5	0.00089	6613.0	0.0029
As	1984.9	0.00108	0.0	0.0000
Sr	2435.1	0.00132	1745.2	0.0008
Rh	12374.0	0.00671	17638.0	0.0079
Ag	0	0.00000	0	0.0000
Sn	0	0.00000	0	0.0000
Pb	0	0.00000	4076.5	0.0018

The great variation in the area under each element peaks as the analysis shows, indicates that 6601 and 6991 are different either in the corrosion layer or the alloy itself. Xrf quantification is not possible. To be sure the alloy is deferent you would have to analyze, “clean” samples.

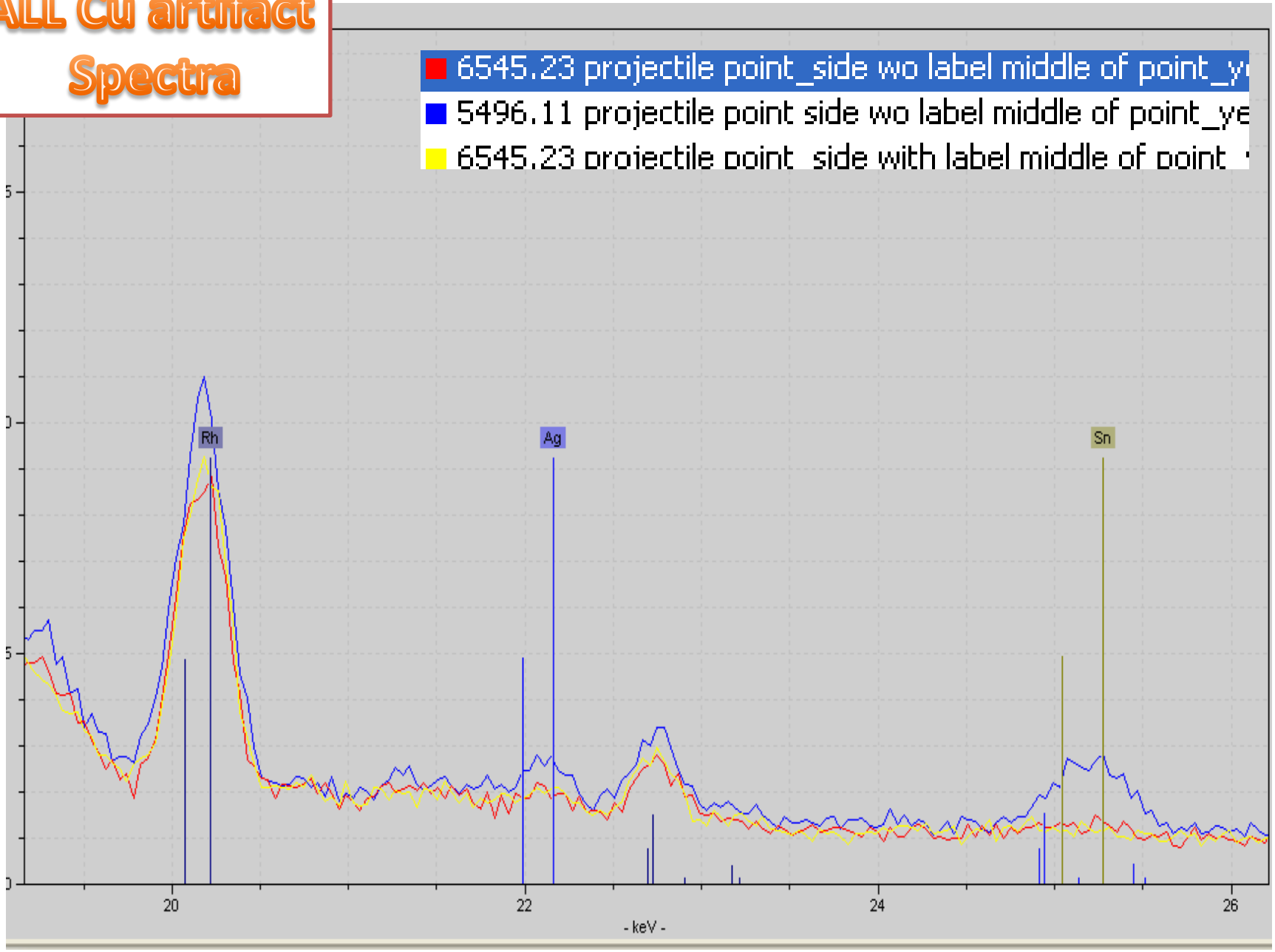
Cu artifact analysis


x 1E3 Pulses
6545.23 projectile point_side wo label middle of point_y
5496.11 projectile point side wo label middle of point_ye
6545.23 projectile point_side with label middle of point
Note the scatter from the both objects is the same indicating very little corrosion These are different alloys.
Cu/Zn sum peaks
Rh inelastic Scatter
Rh Elastic Scatter
Ca
Sn
Ti
Cu
Zn
Pb
Rh
Sn
4.0
3.0
2.0
1.0
0.0
5
10
15
20
25
- keV -

ALL Cu artifact Spectra



ALL Cu artifact Spectra



net area under the elemental lines

ALL Cu artifact Spectra

Looking at all the plots of the spectra and the analysis of the area under the peaks clearly shows these are different alloys of Cu with variation in all key elemental components; Zn, Pb and Sn.

Element	6545.23 projectile point_side wo label	6545.23 projectile point_side w label	6545.2 Ave	Ratio to Cu	Element	5496.11 proj point side wo label	Ratio to Cu
Ca	2965	1975	2470	0.001	Ca	1843	0.0007
Ti	339	294	317	0.000	Ti	459	0.0002
Fe	8633	7325	7979	0.004	Fe	6933	0.0026
Cu	1905701	1984771	1945236	1.000	Cu	2667684	1.0000
Zn	739623	687643	713633	0.367	Zn	549517	0.2060
Rh	6217	6215	6216	0.003	Rh	7914	0.0030
Ag	0	0	0	0	Ag	982	0.0004
Sn	0	0	0	0	Sn	1679	0.0006
Sn	0	0	0	0	Sn	277	0.0001
Pb	44664	44781	44723	0.023	Pb	27142	0.0102