

WDS Quantification in the SEM

Patrick Camus, PhD
Senior Applications Specialist



Agenda

- Advantages of WDS
- Benefits to Quantification
- Results
 - WDS Advantages
 - WDS Quantification
- Questions

- Only 15-20 minutes



Advantages of WDS Hardware

- High peak-to-background
- Low-energy x-ray intensity (cps/nA)
- Better energy spectral resolution.



Benefits to Composition Quantification

- More accurate low composition (trace) measurements.
- More precise EDS peak overlap composition measurements.
- More precise low beam energy composition measurements.



System Requirements for Full-Standards Quantification

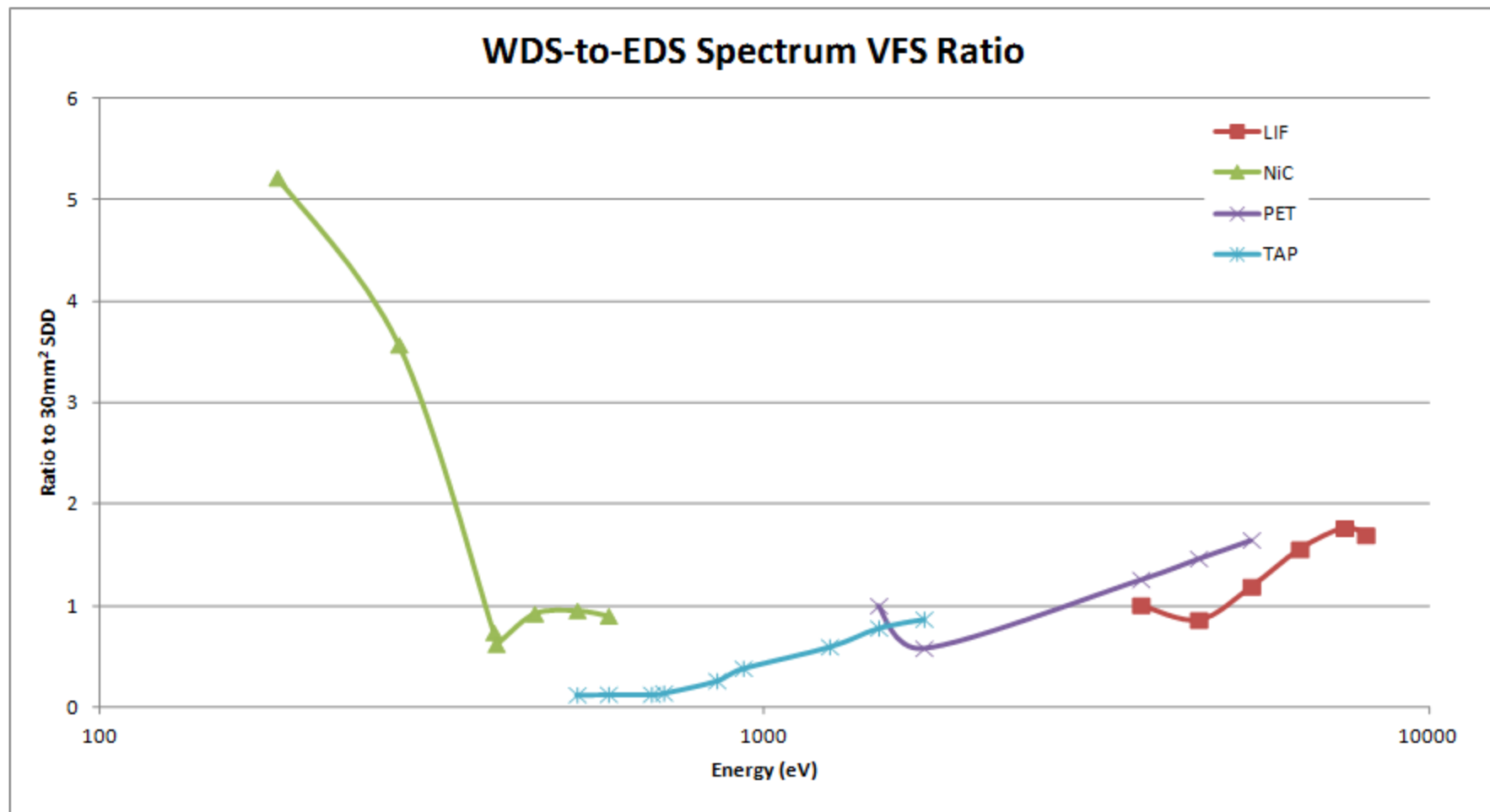
- Intensities measured for each potential element on reference materials
- Intensities measured for each potential element on sample material
- Beam current measurement hardware
- Standard reference materials



Results

- Low-Energy Intensity
- Enhanced Resolution
- Trace element detection
- Geological Quantification
- Steel Quantification
- Low-energy quantification
- Low beam voltage quantification

Low-energy WDS Intensity



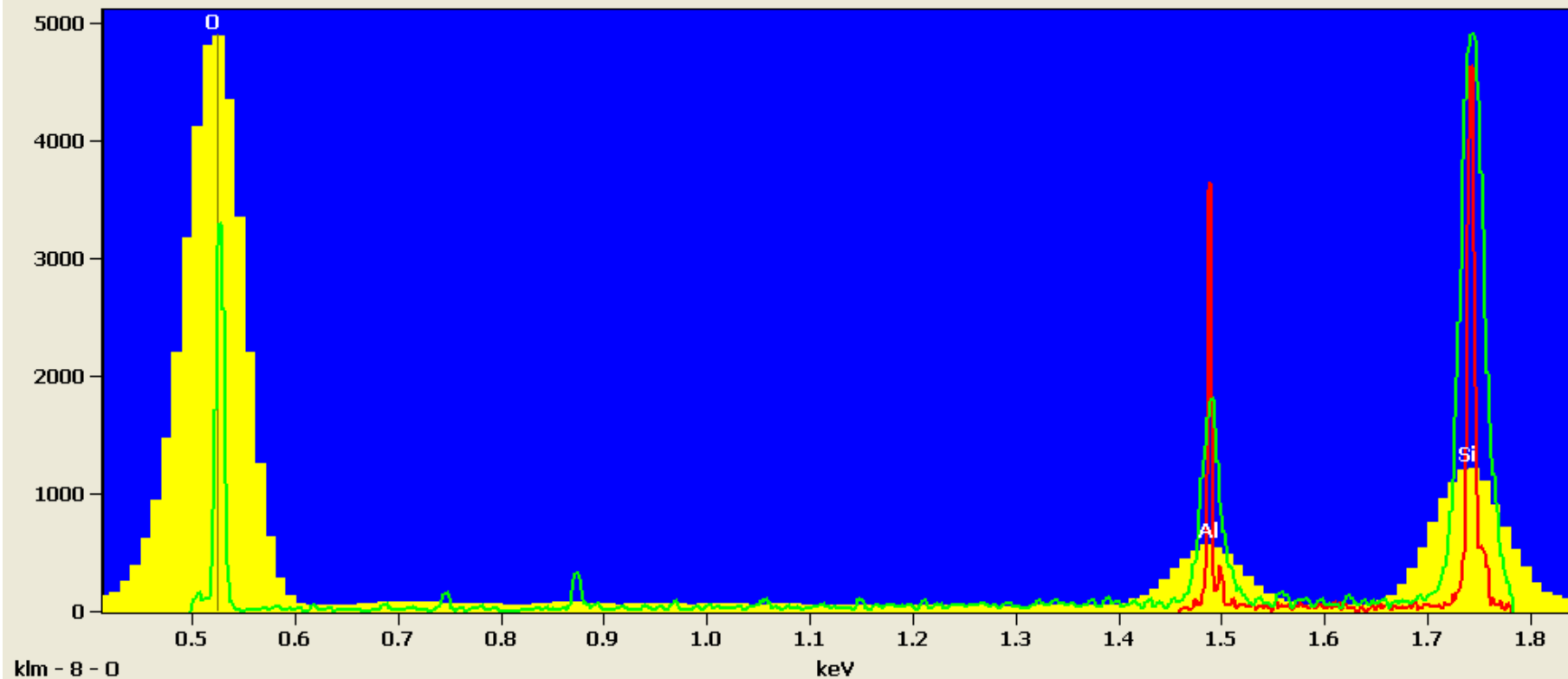
WDS: MagnaRay™

EDS: UltraDry SDD 130 eV 30mm² (Solid Angle = 10 mSr)

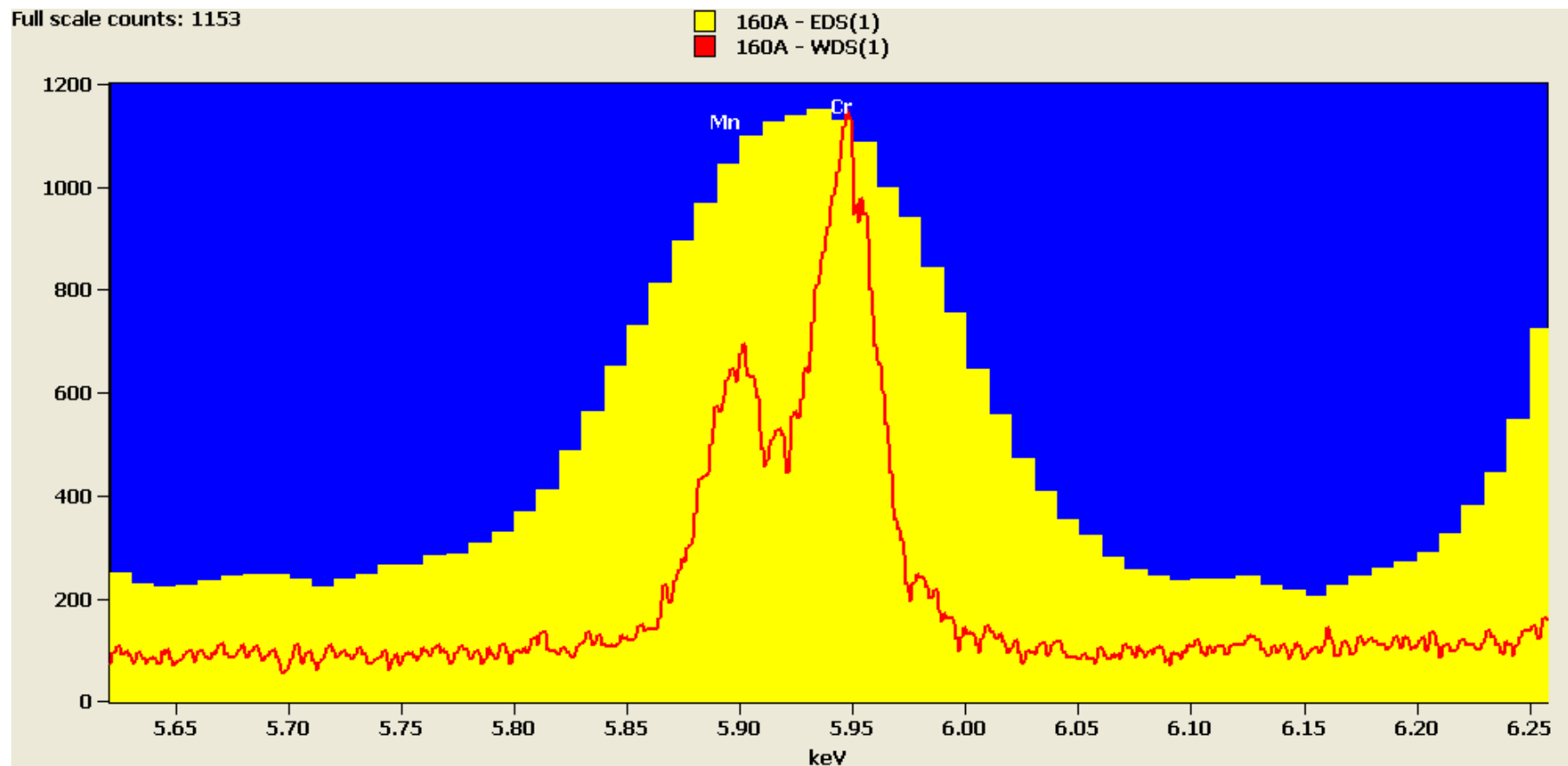
Enhanced Resolution via Diffractors

Full scale counts: 4904

- Beryl(1)
- Beryl-PET(1)
- Beryl-TAP(1)



Enhanced Resolution for Peak Separation

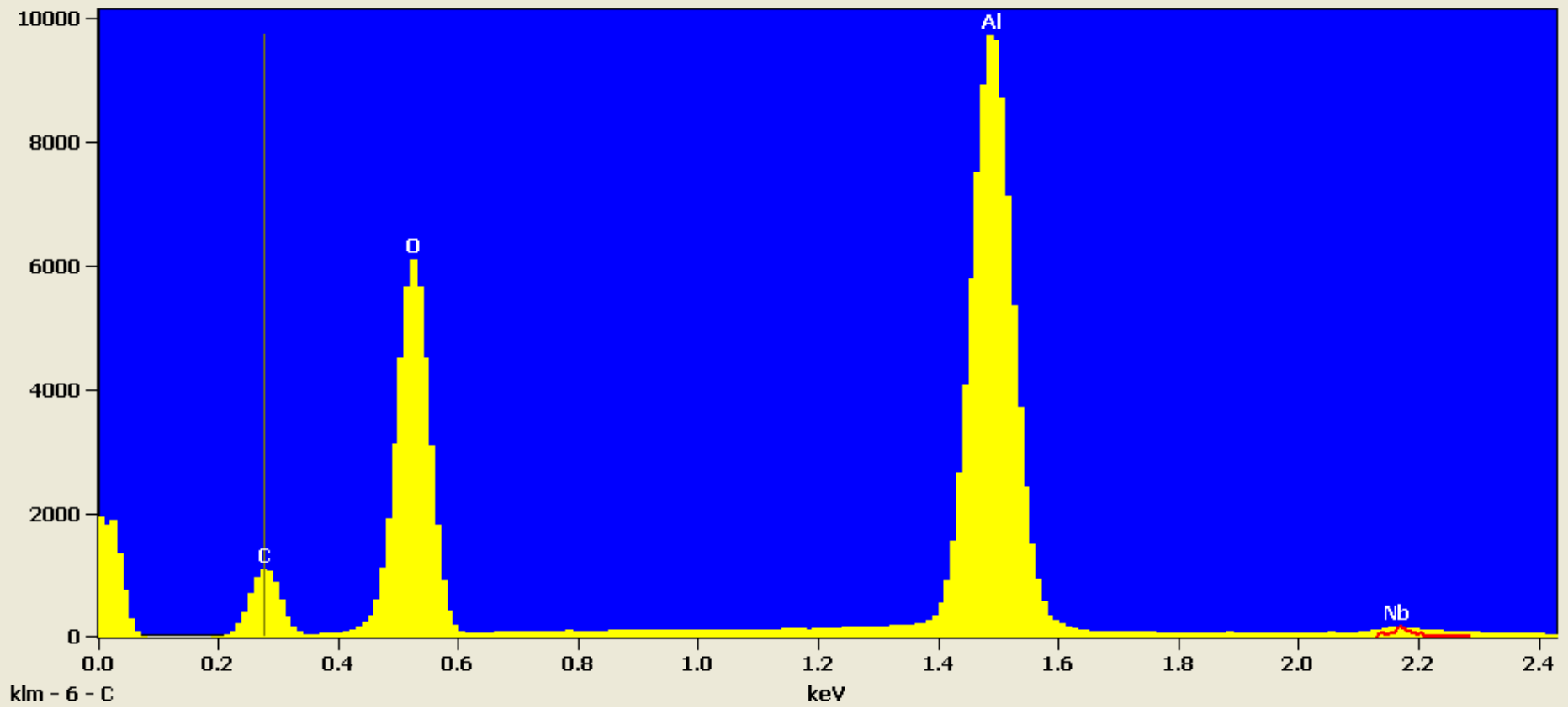




Trace Element Detection

Full scale counts: 9730

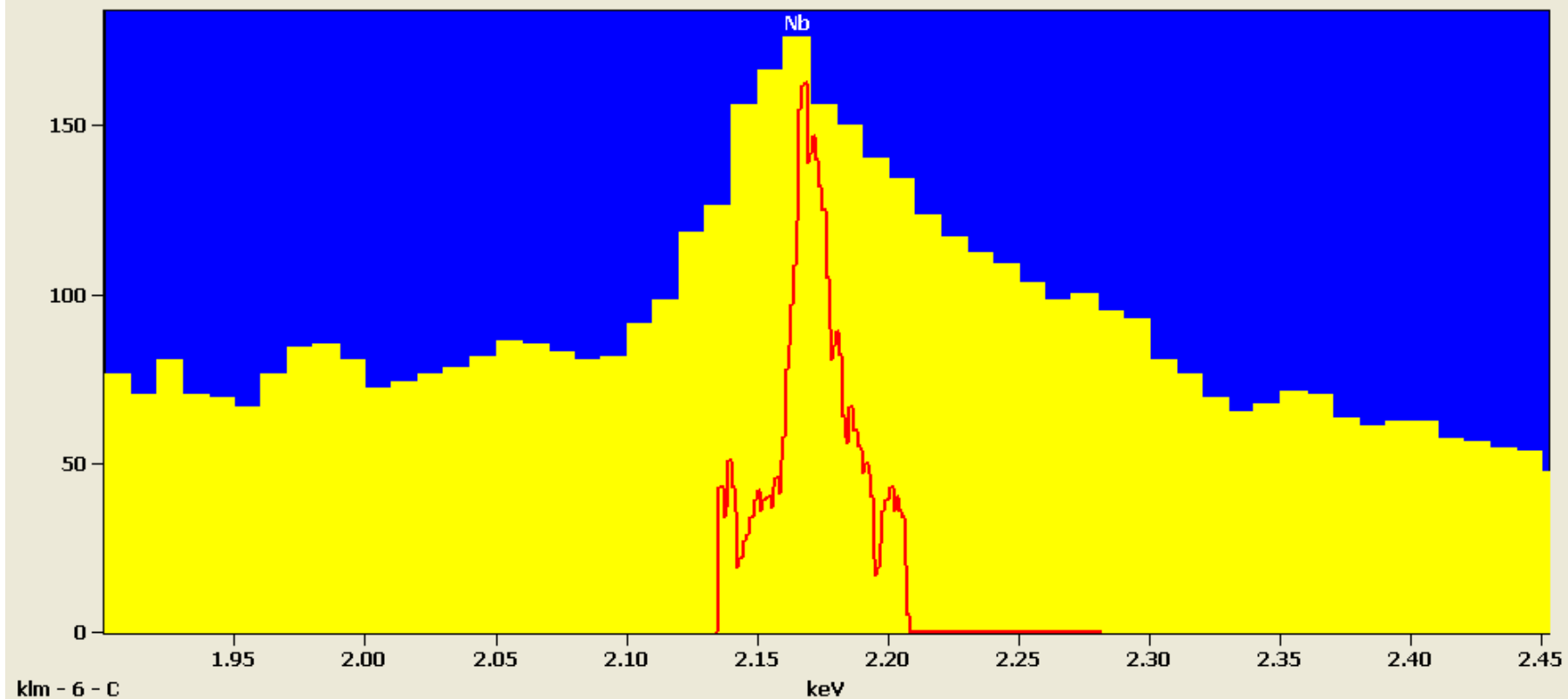
139635(1)
139635 - PET



Trace Element Detection – 2

Full scale counts: 177

139635(1)
139635 - PET

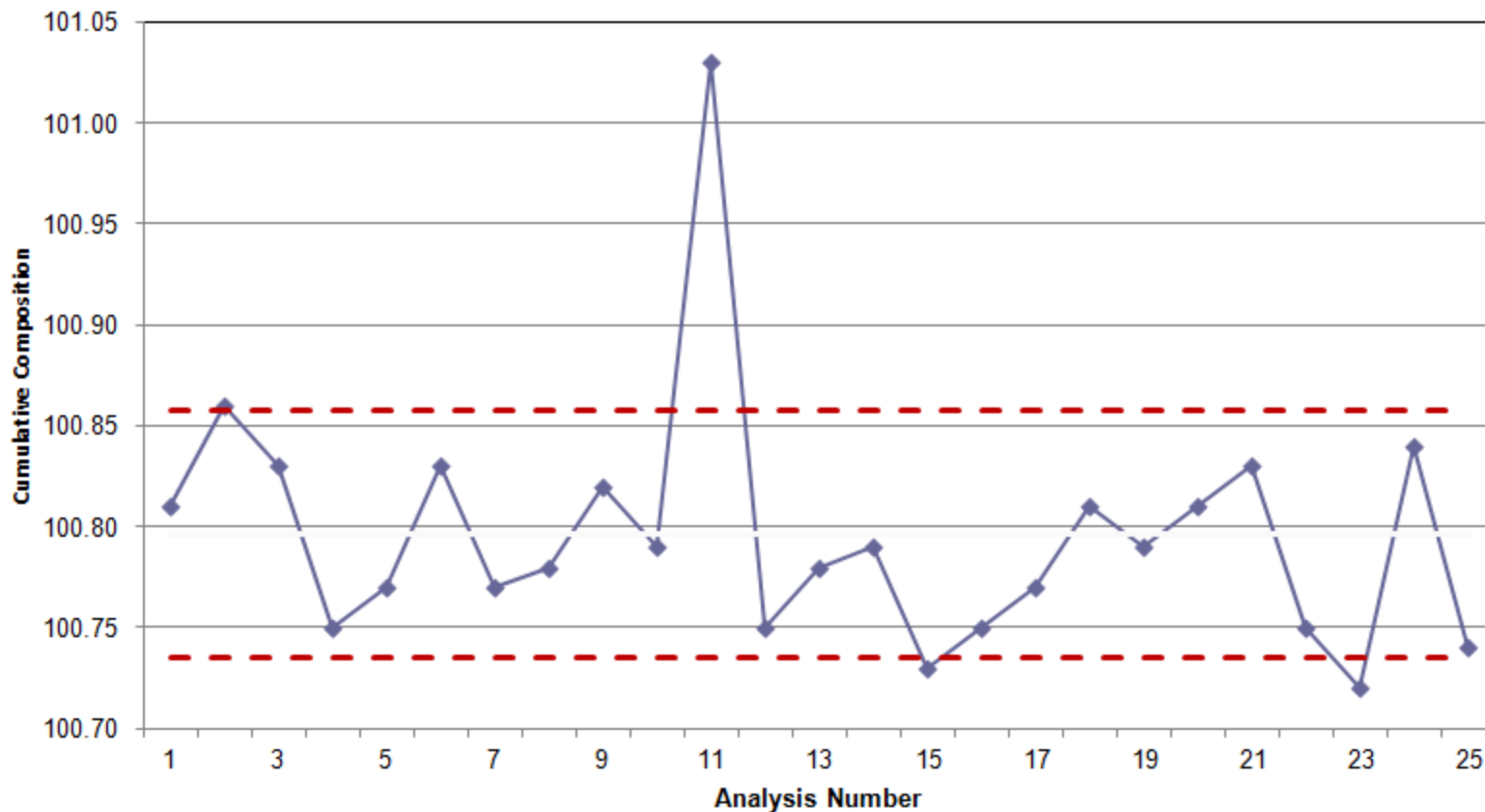


Geological Quantification

Wt%	Phlogopite	Diopside	Pyrite	Barite	Hematite
O	45.92	45.39	0.00	27.46	32.39
Mg	14.50	9.17	0.00	0.00	0.01
Al	10.80	3.68	0.00	0.00	0.01
Si	17.41	22.81	0.00	0.00	0.00
S	0.00	0.02	52.57	13.67	0.1
K	8.89	0.00	0.00	0.00	0.01
Ca	0.02	18.31	0.00	0.00	0.00
Fe	1.58	1.01	49.28	0.00	66.58
Ba	0.46	0.11	0.00	58.75	0.01
Total	99.58	100.50	101.85	99.88	99.11

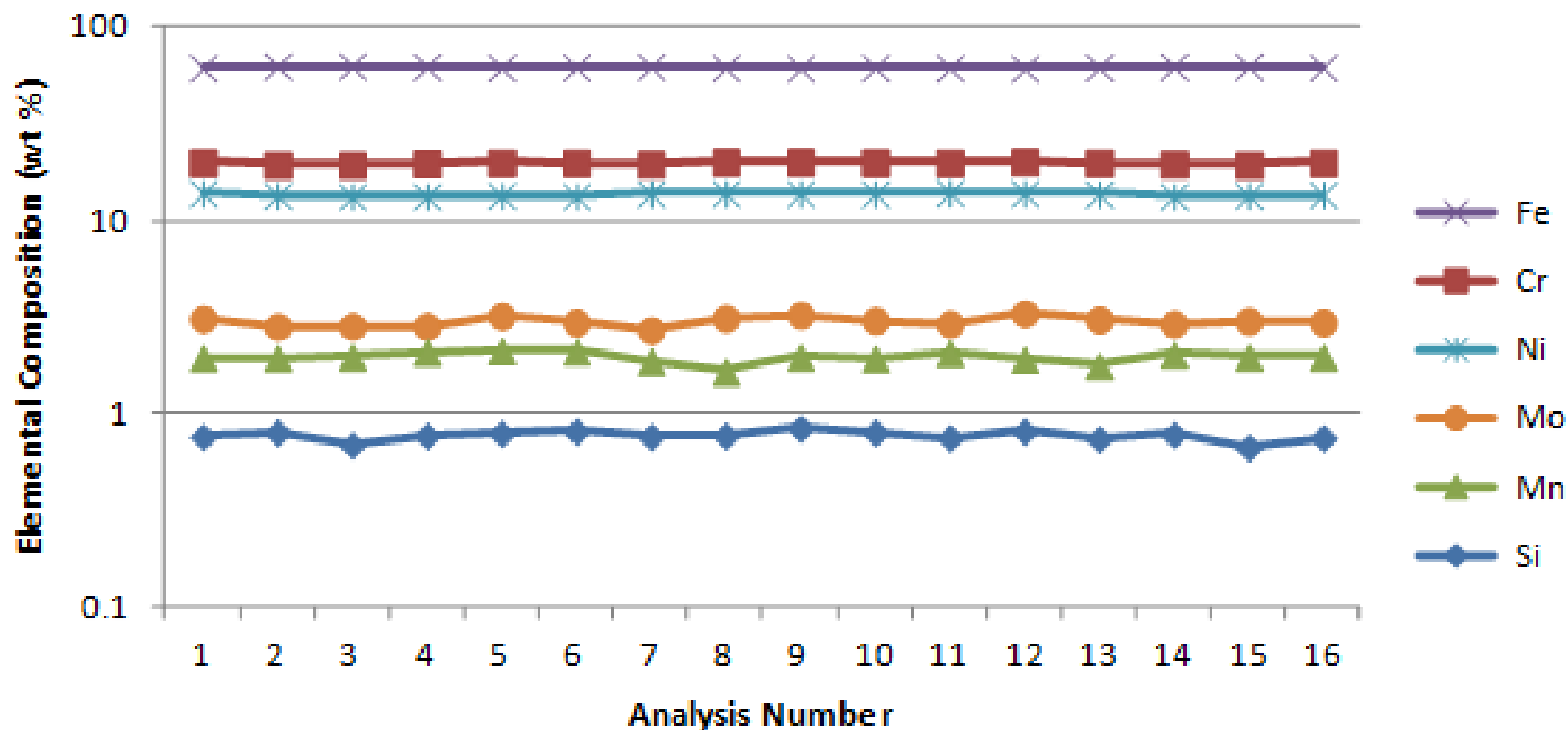
Steel Quantification Quality

160A 6-Element WDS Quantification

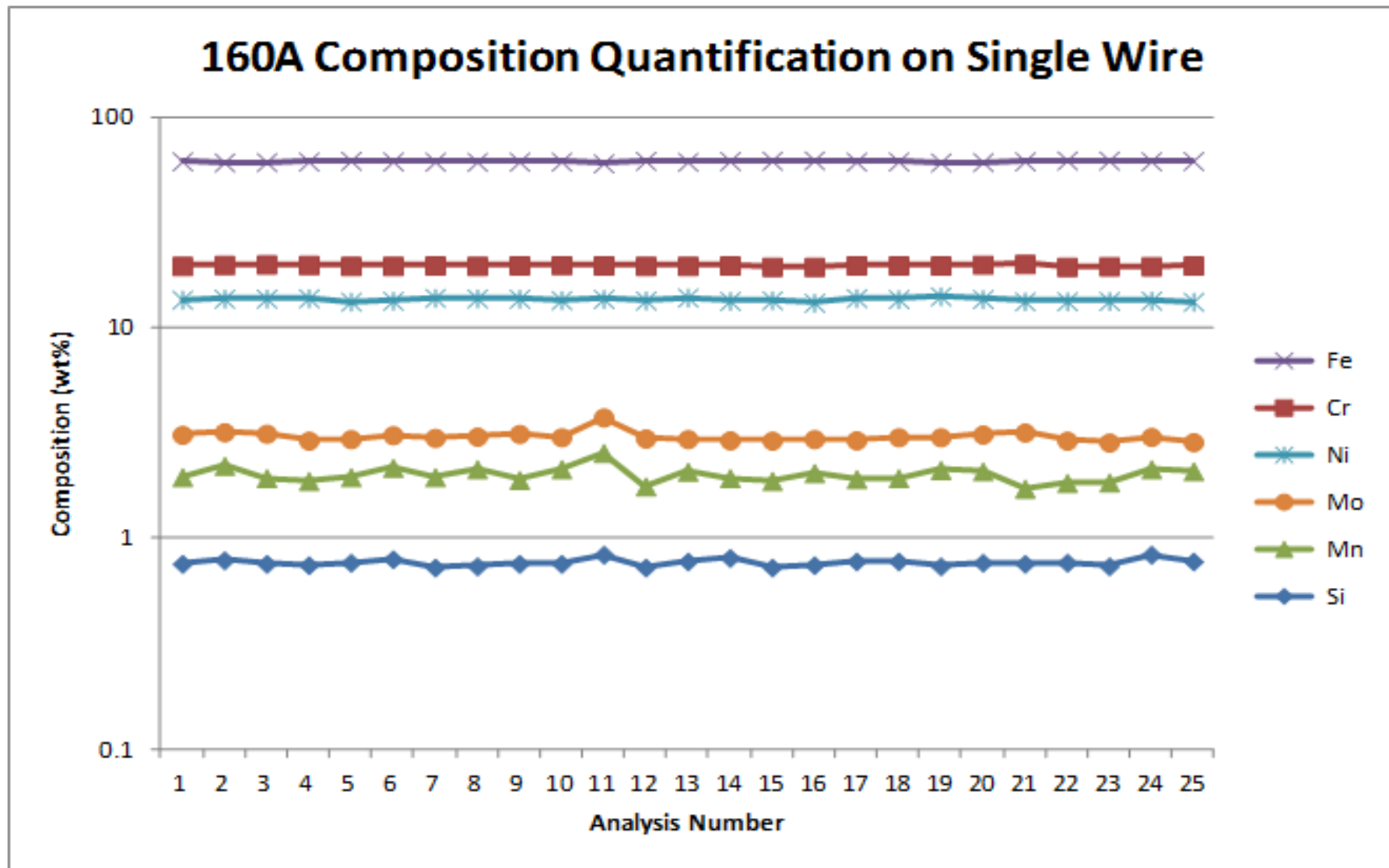


Steel Quantification Material Consistency

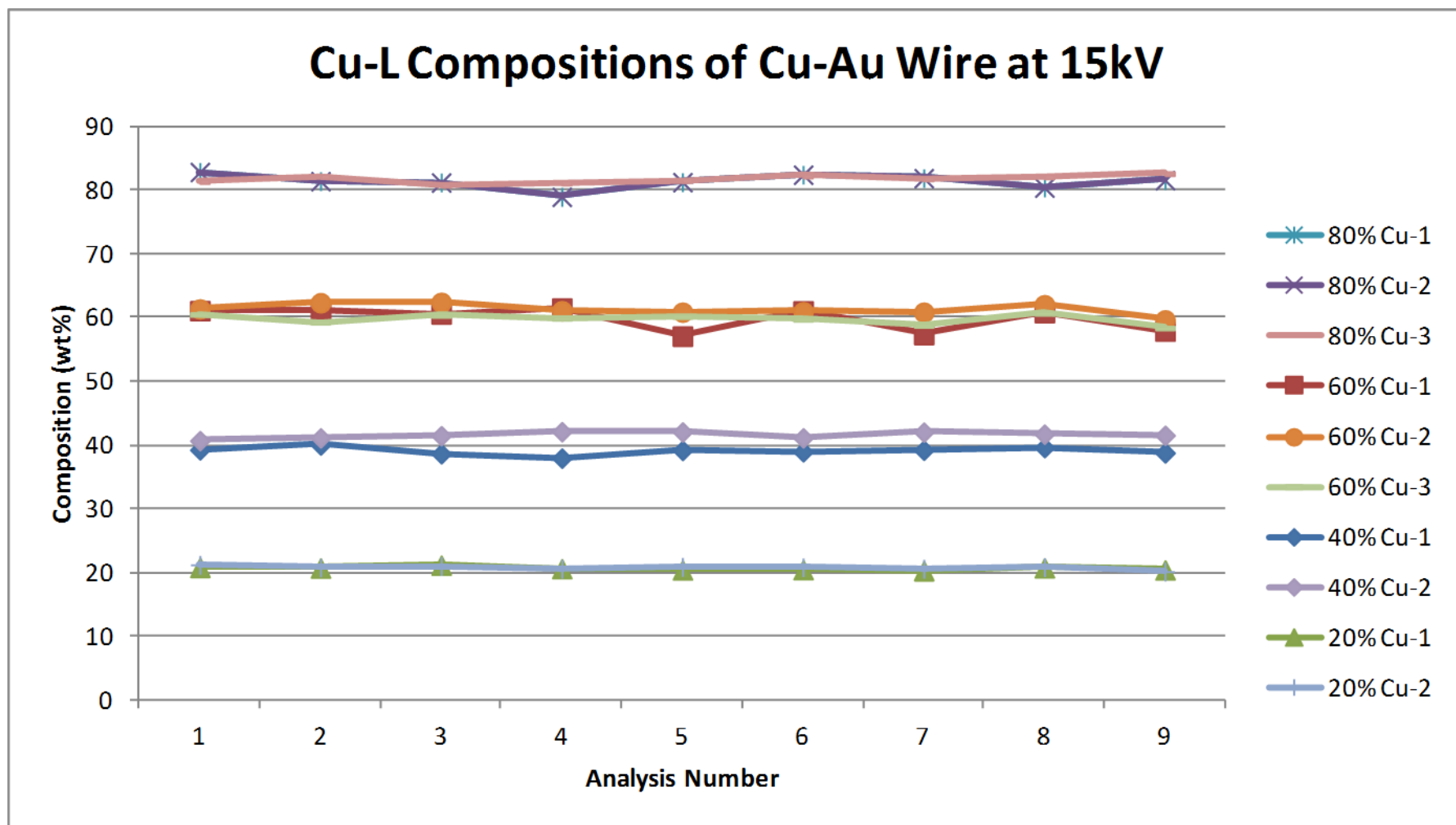
160A WDS Elemental Quantification on Different Wires



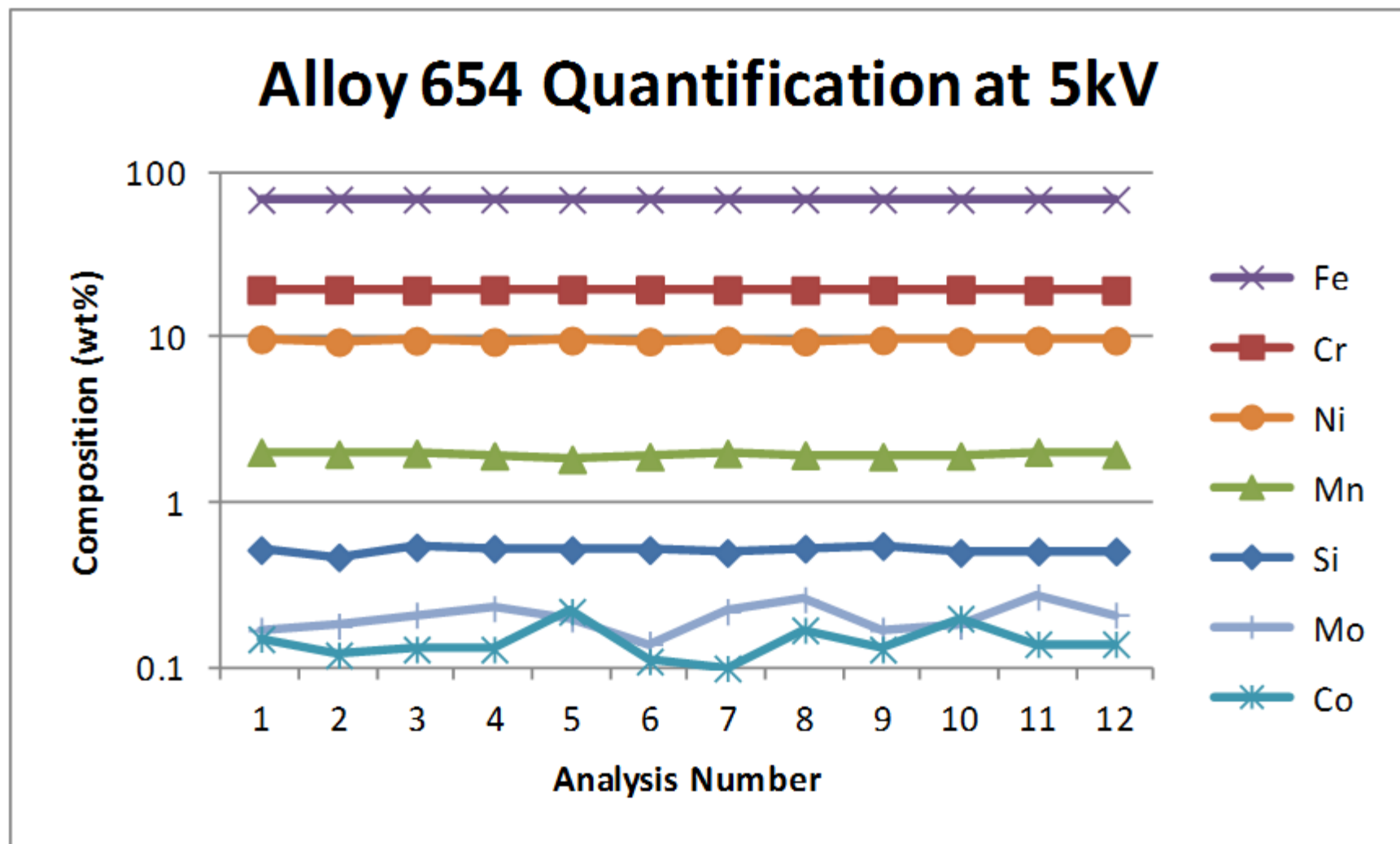
Steel Quantification Sample Consistency



Low X-ray Energy Quantification



Low Beam Voltage Quantification



Summary

- WDS is complementary to EDS.
- Better spectral resolution helps peak identification and quantification.
- Lower background helps in trace element identification and quantification.
- Better low-energy intensity aids low beam voltage quantification.

- See NS7, MagnaRay WDS, UltraDry EDS, and QuasOr EBSD in Booth 520 at M&M 2013