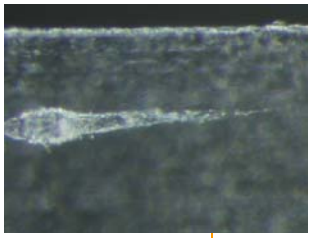
Stardust run March 2006
Advanced Light Source

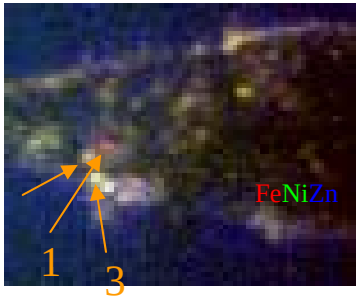
Matthew Marcus
Sirine Fakra
Andrew Westphal
Konstantin Ignatiev

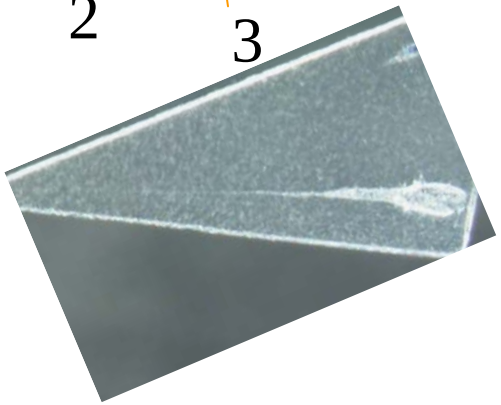
summary



track 42 (called 9 by westphal: three sulfide particles (sphalerite, pyrrhotite)
Diverse Ni/Fe ratios (c.f. track 7 fragment below)

track 43 (called 10 by westphal): multiple particles and a large t.p.
analyzed 6 particles (1-4, t.p. & spot X)
One olivine, 3 mixed pyrrhotite+oxide(?)
Terminal particle is Fe, Ni metal
Spot 3 has Fe, Ni in very different environments

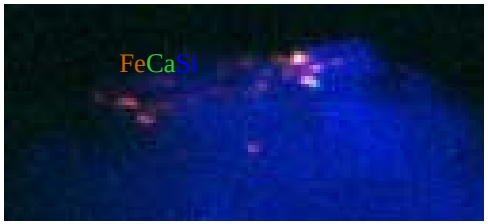


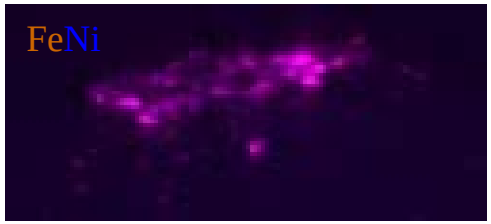


Track 38 (called 4 by westphal): two Fe, Ni metal terminal particles. Confirm SSRL discovery of a Ga-rich, Ni-poor unknown crystal in track (spot 1)

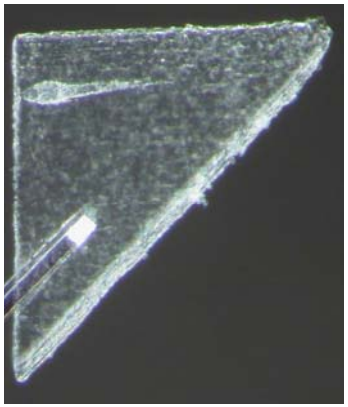
track 52 (called 12 by westphal): one Cr-rich terminal particle, analysis pending

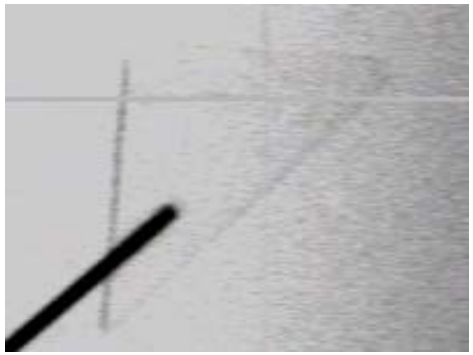
track 41 (called 7 by westphal) fragment: dozens of particles. They appear to be much more homogenous (e.g., Ni/Fe, Zn/Fe, FeXANES) than the particles in the smaller tracks. ***Implies a dependence of homogeneity on particle size***

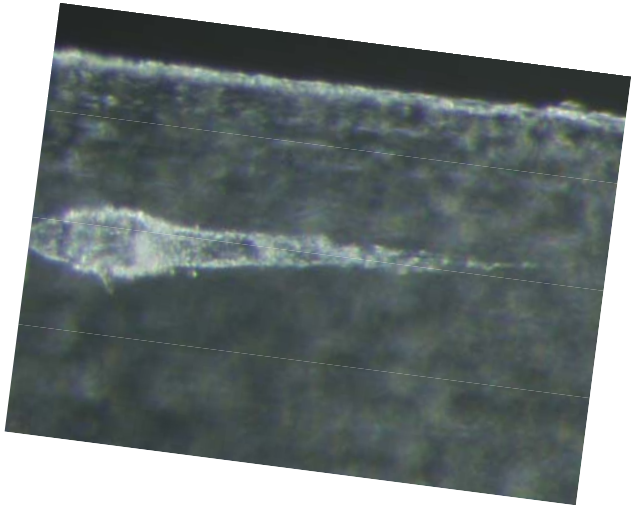


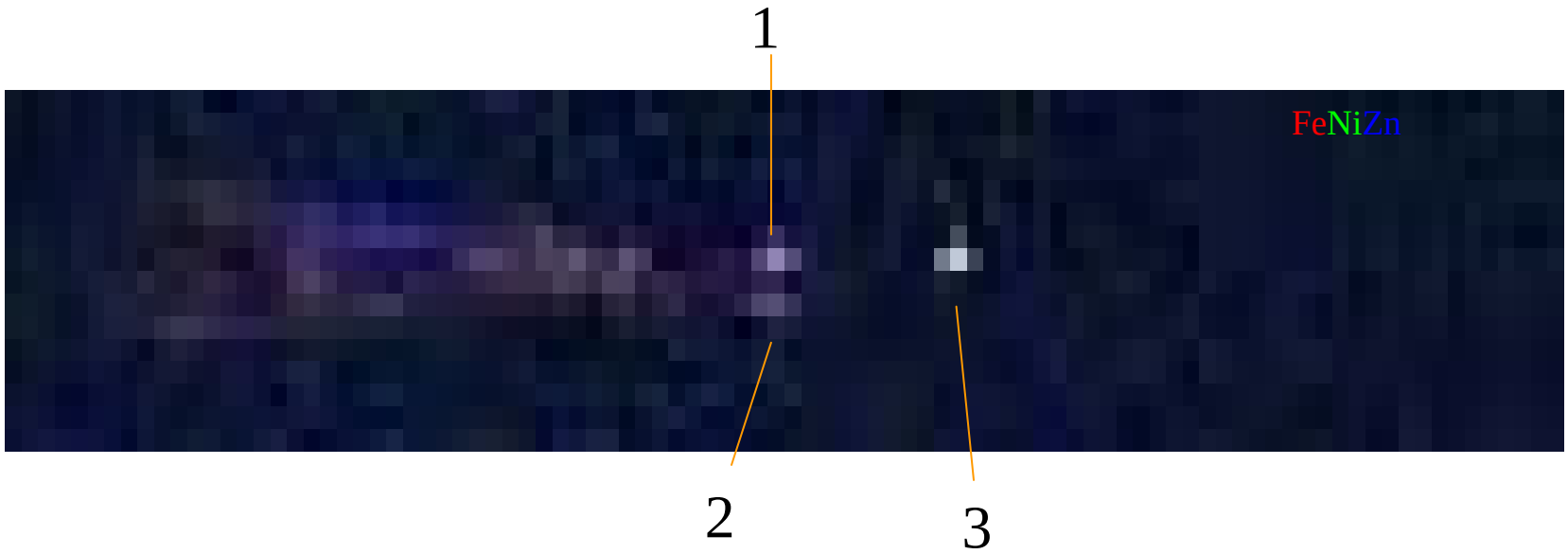


C2044 track 42





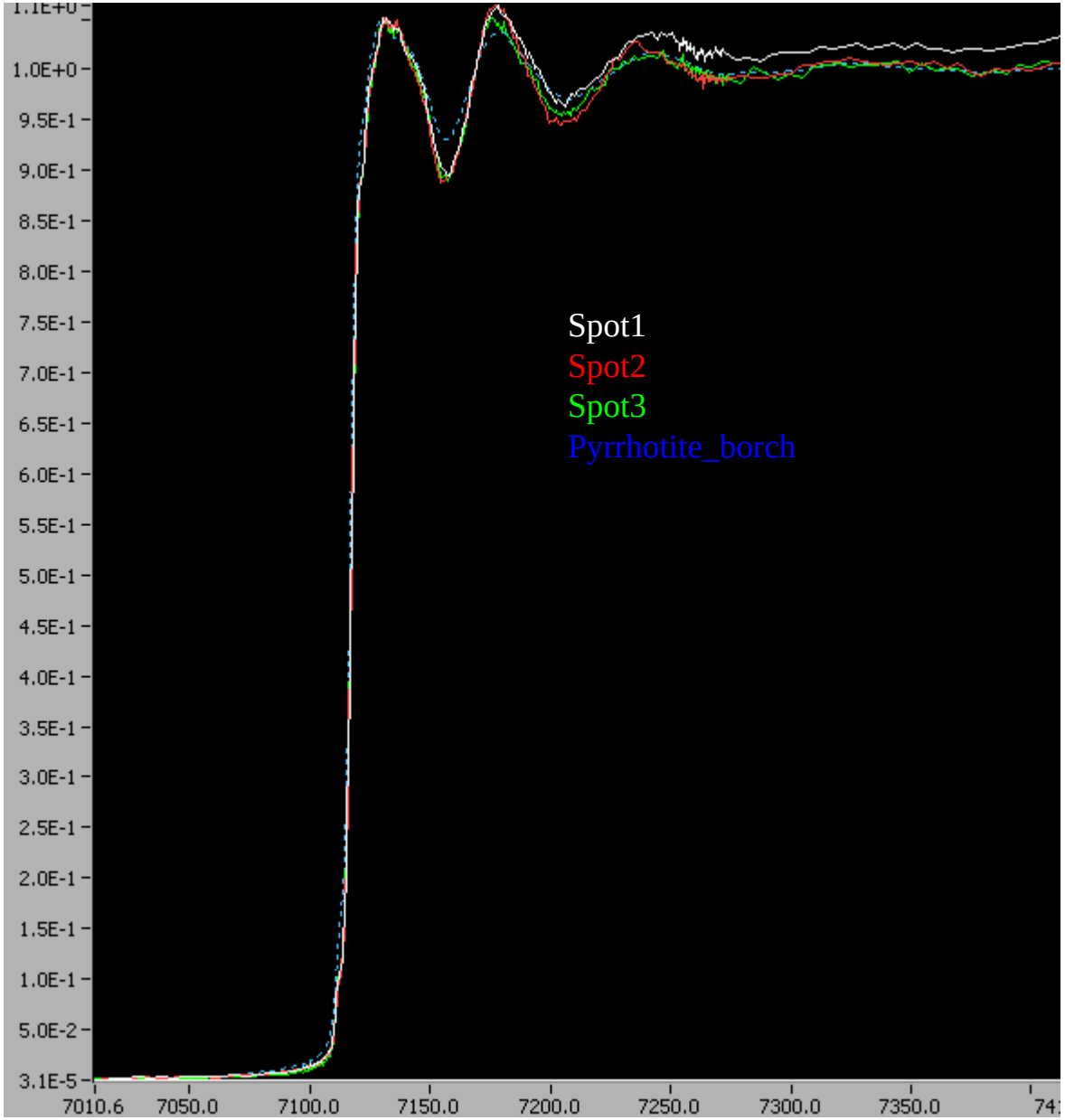




C2044 track 42 spots 1,2,3 Fe XANES

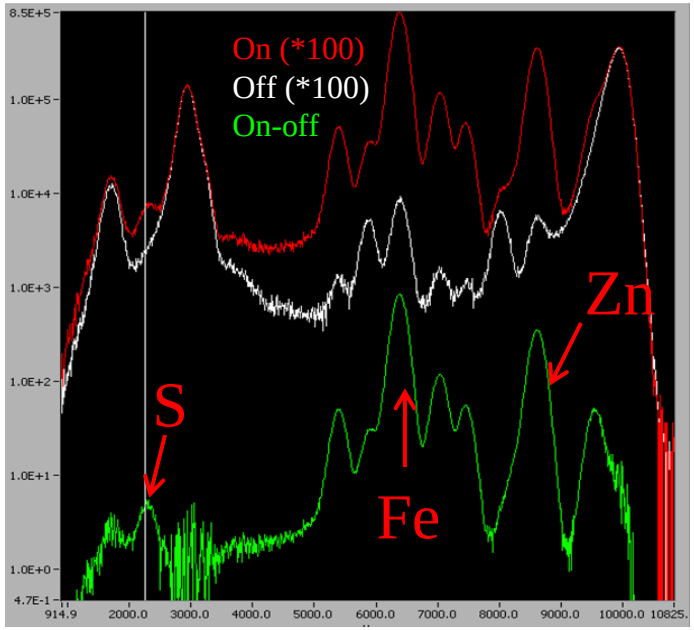
Textbook match to pyrrhotite for all three particles

But other FeS species also good match **MAM please confirm**

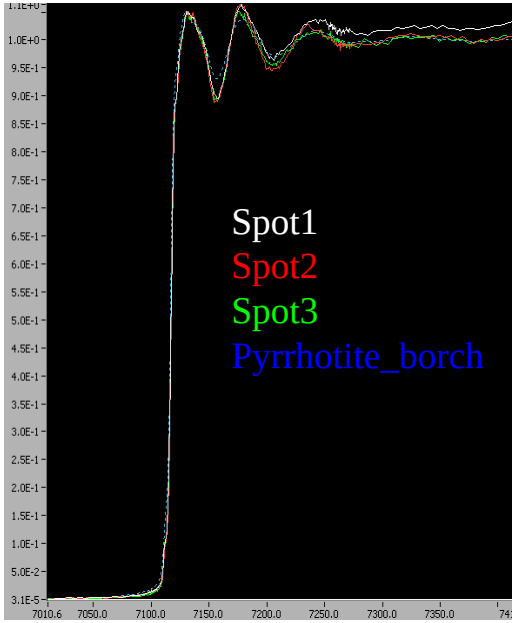


C2044 track 42, Spot1: pyrrhotite+sphalerite

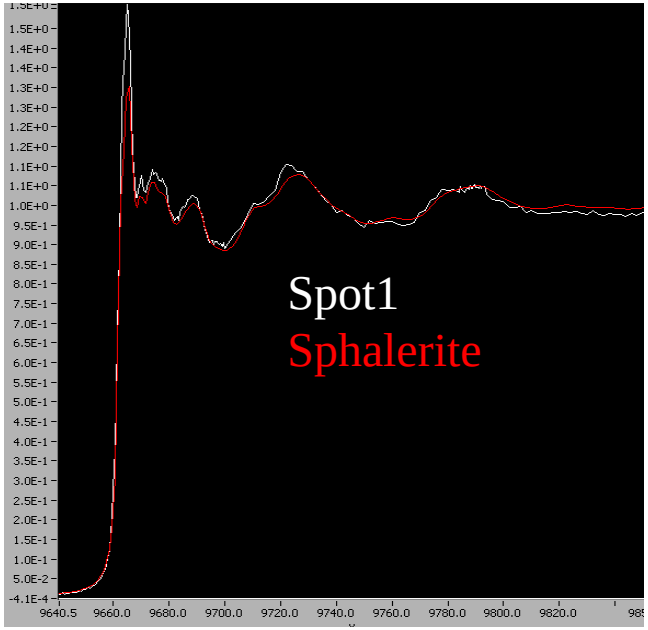
10keV MCA



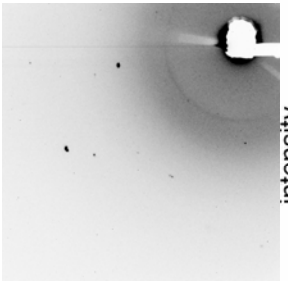
Fe XANES

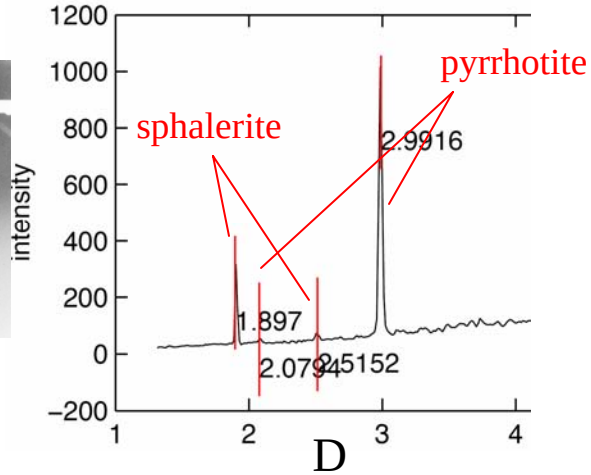


Zn XANES

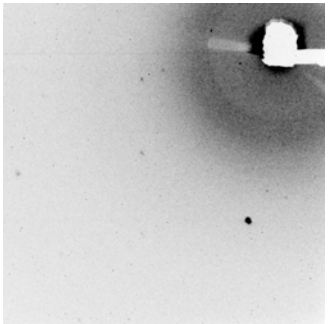


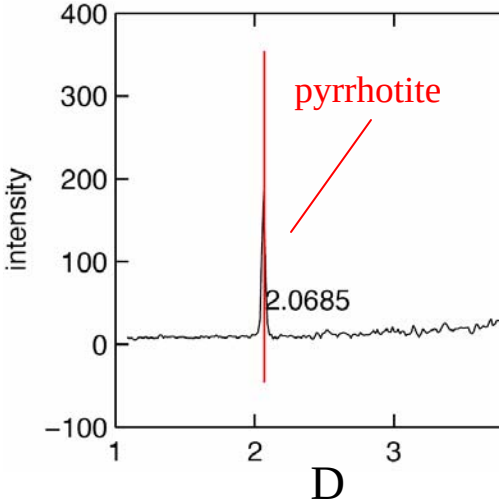
14keV XRD





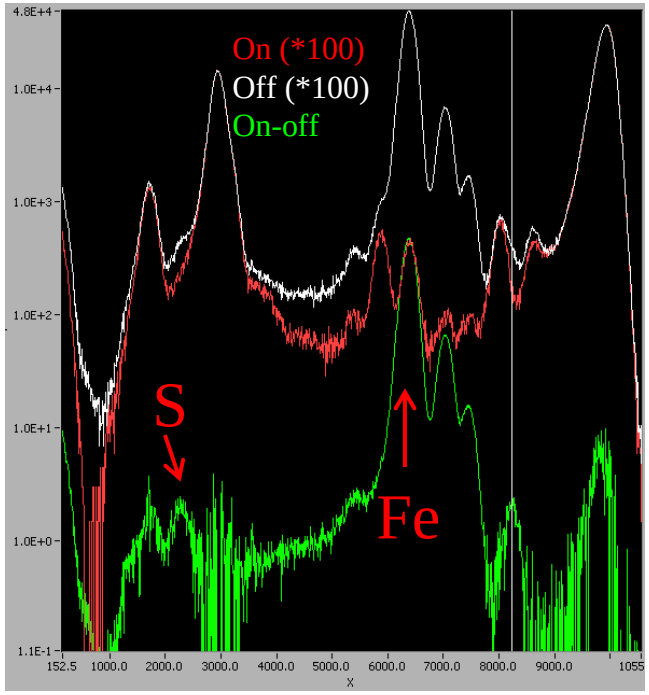
17keV XRD



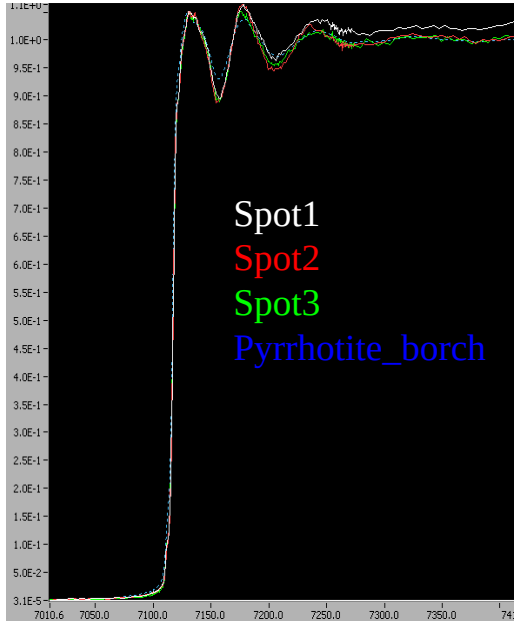


C2044 track 42, Spot 2: pyrrhotite

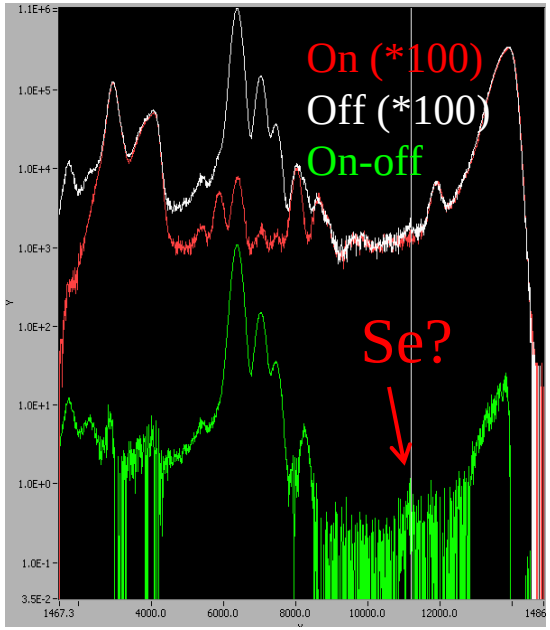
10keV MCA



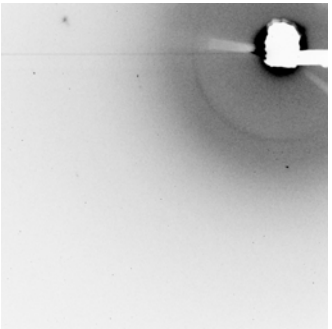
Fe XANES

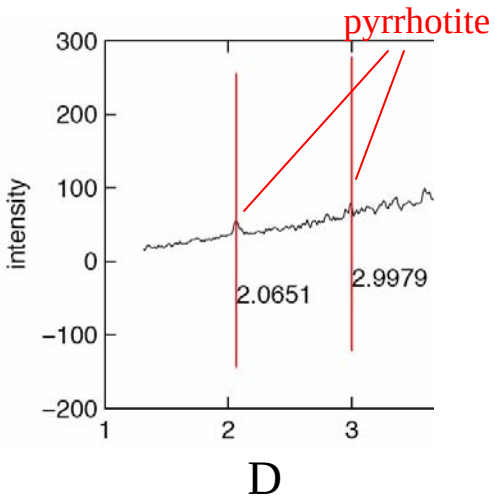


14keV MCA

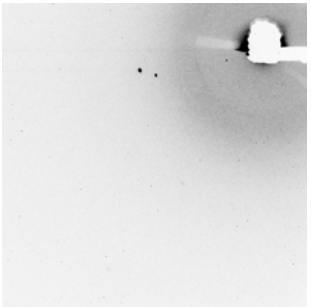


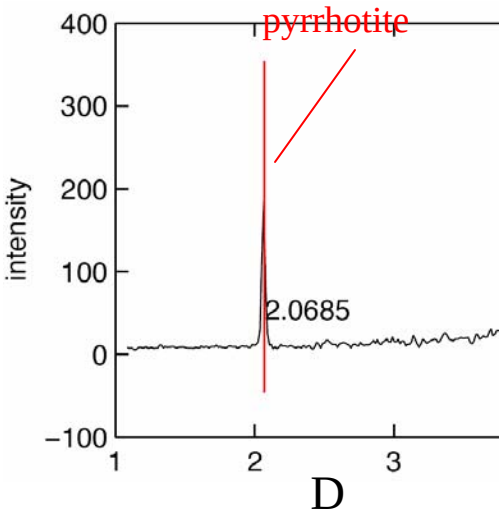
14keV XRD





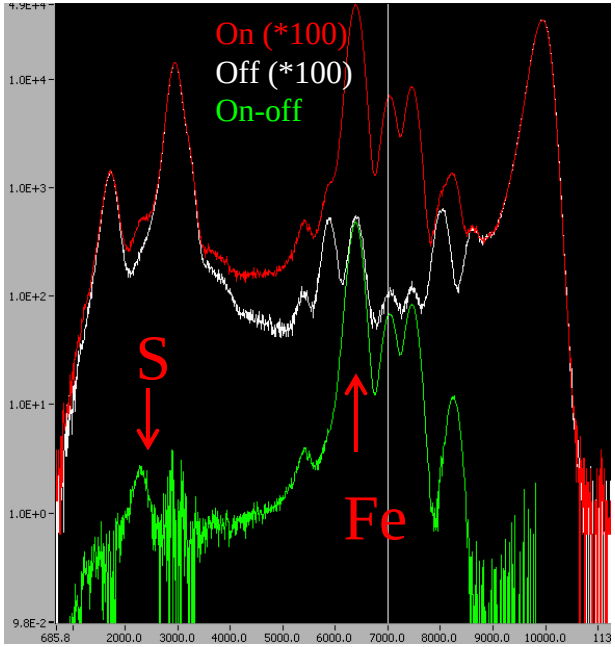
17keV XRD



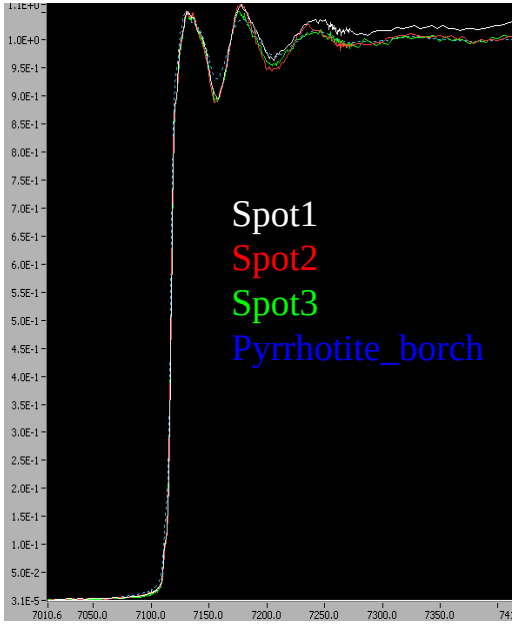


C2044 track 42, Spot 3: pyrrhotite

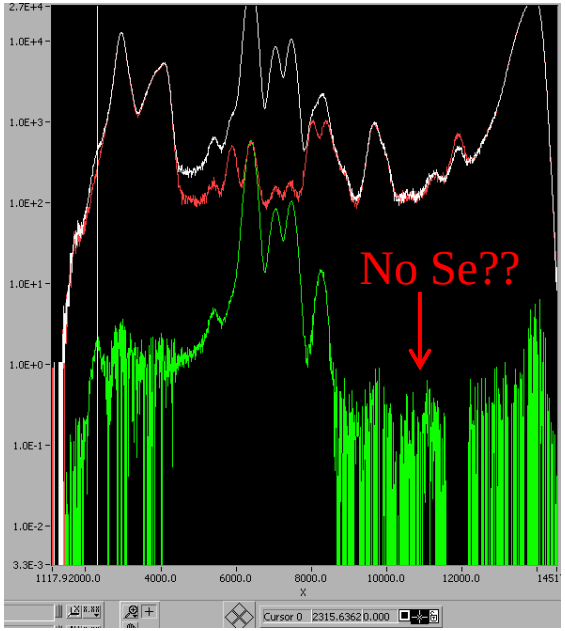
10keV MCA



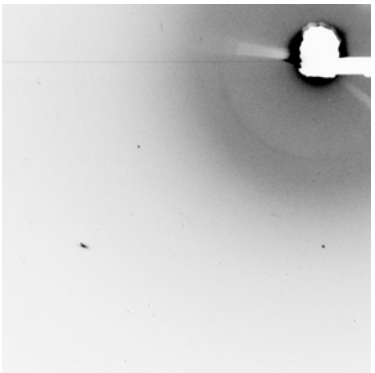
Fe XANES

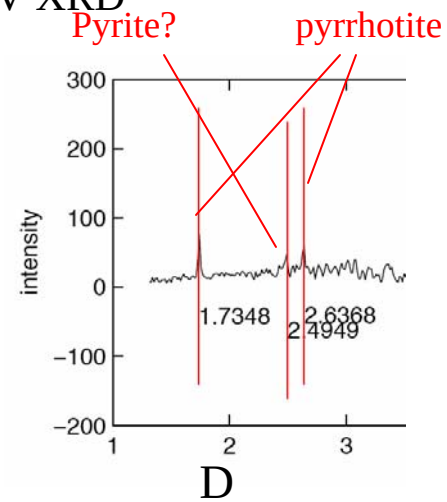


14keV MCA

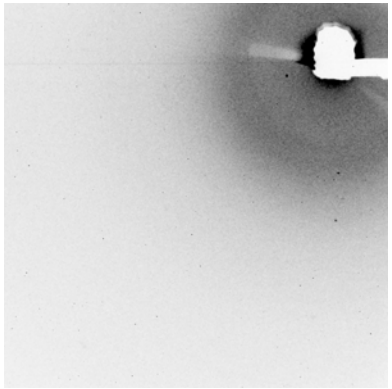


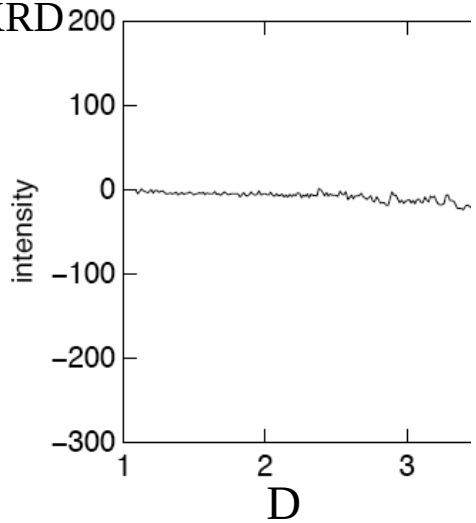
14keV XRD



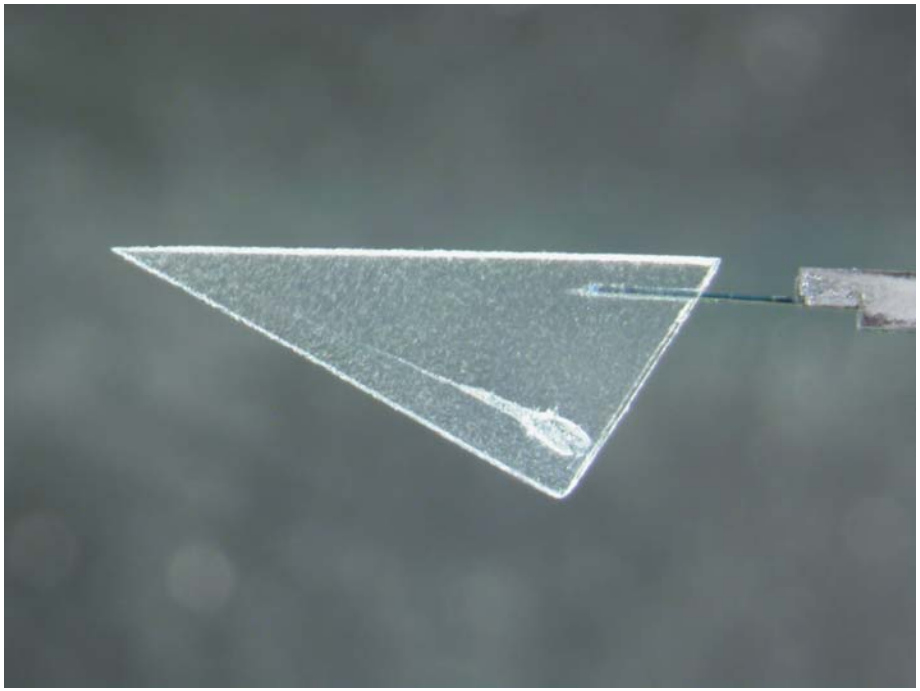


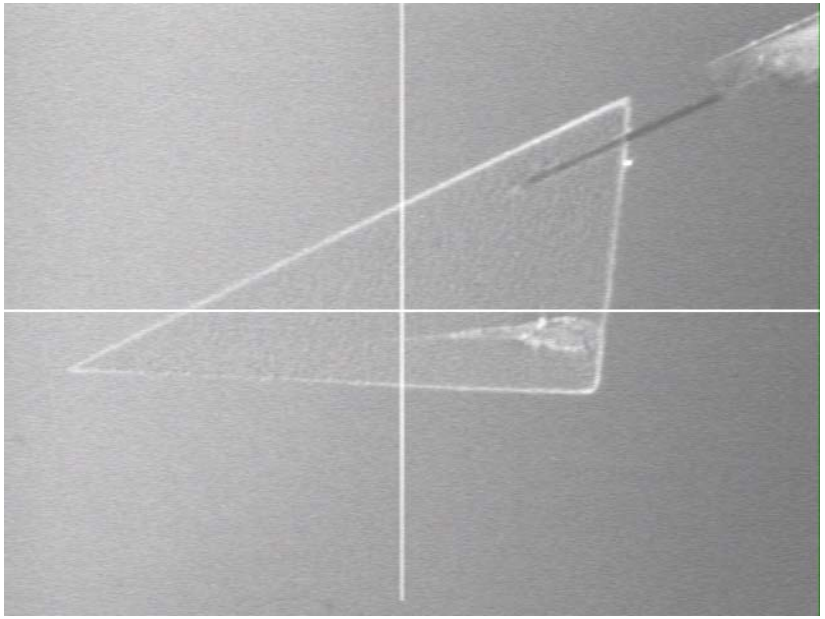
17keV XRD



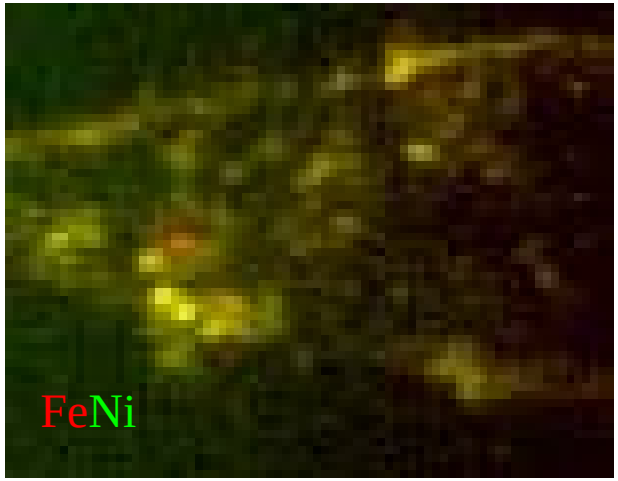


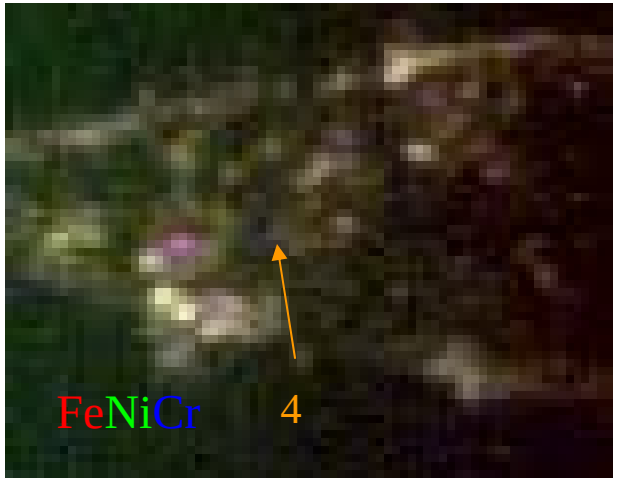
Track 43

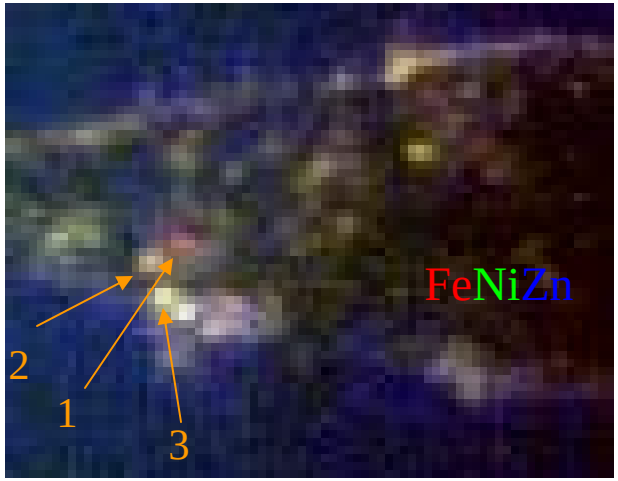




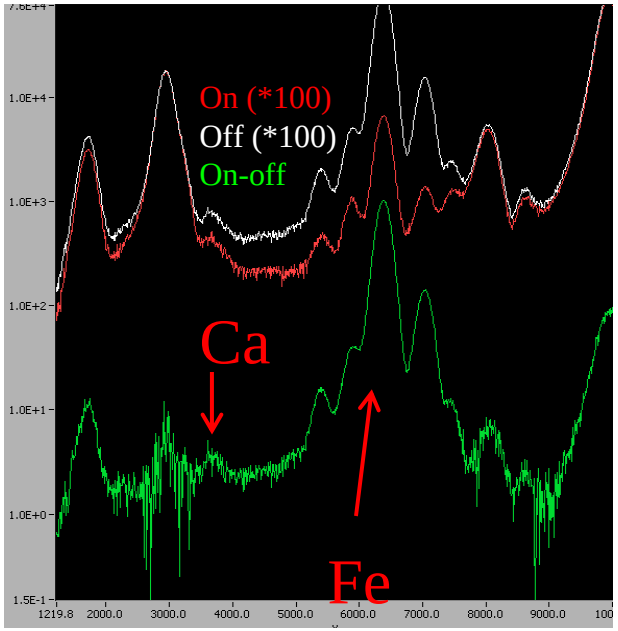
Track 43 mouth



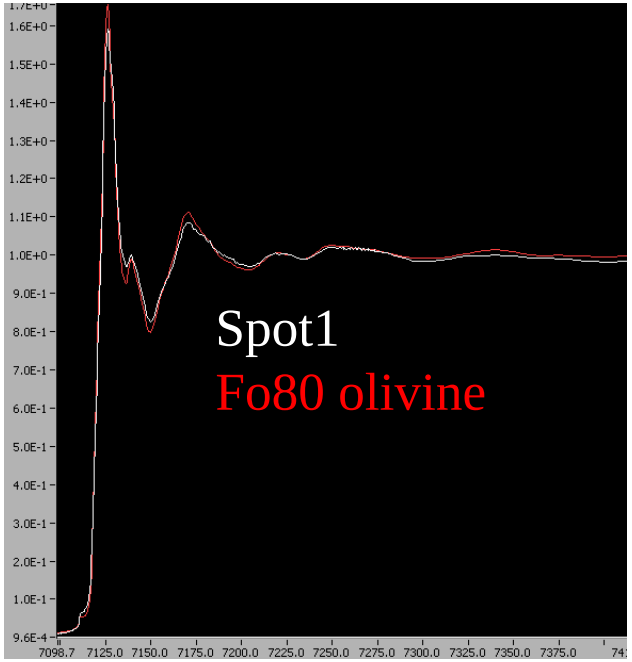




C2044 track 43, Spot 1: olivine + Ca-bearing phase (in aerogel?)

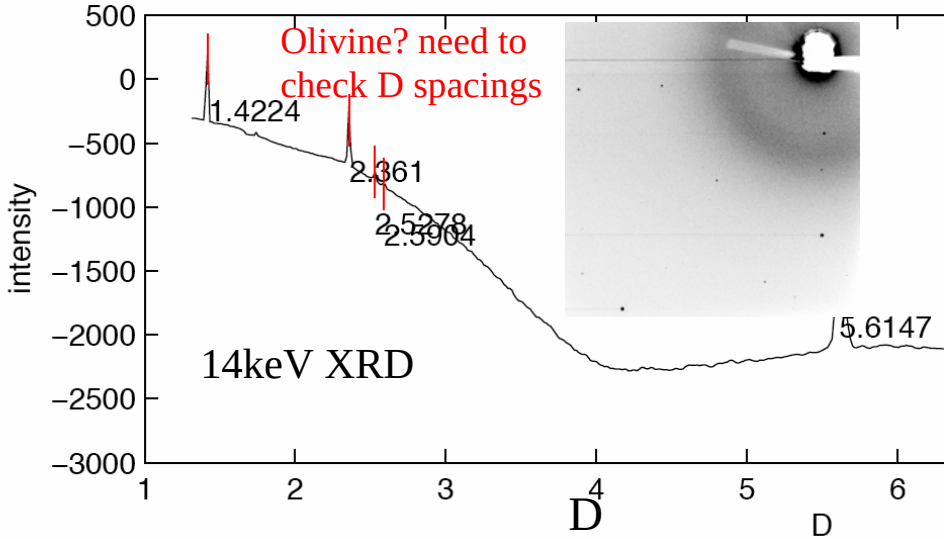


Fe XANES

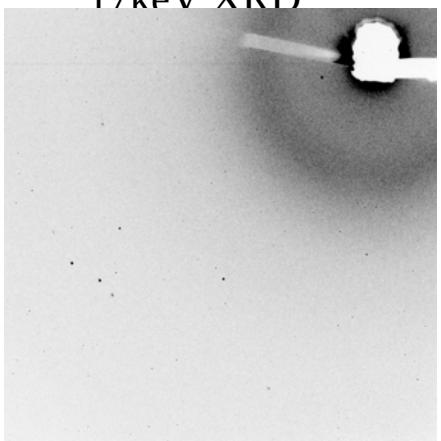


XANES not diagnostic of Fo/Fa

MAM please confirm



17keV XRD

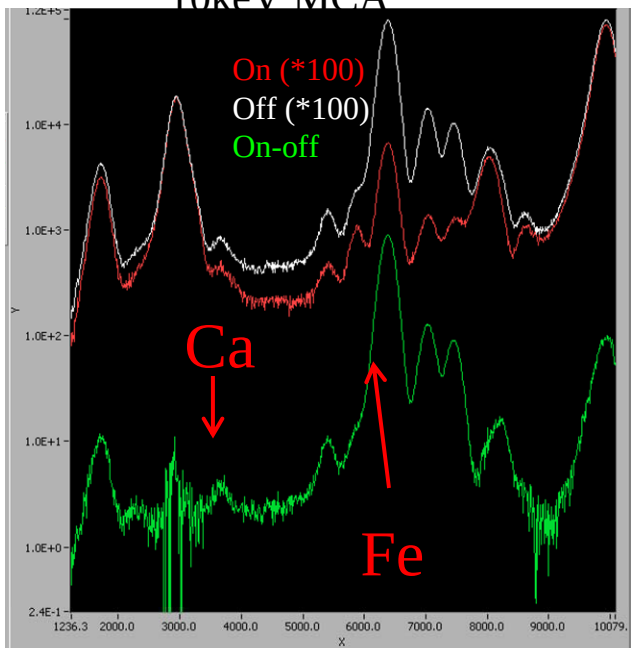


need to make 17kev D spacings

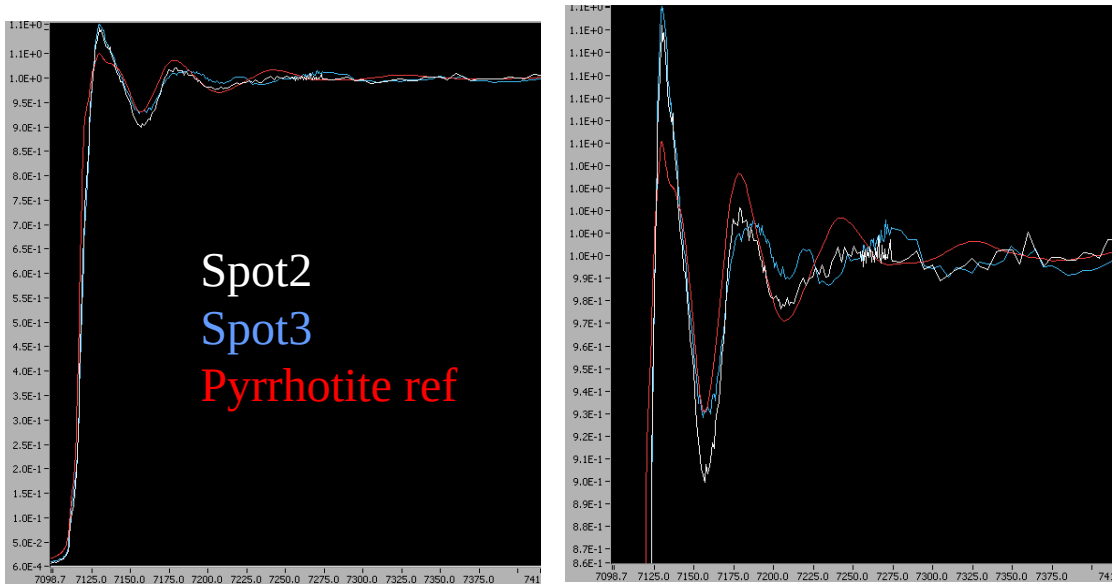
D

C2044 track 43, Spot 3: **Suspect spots2,3 are mixtures of pyrrhotite + oxide(?)**

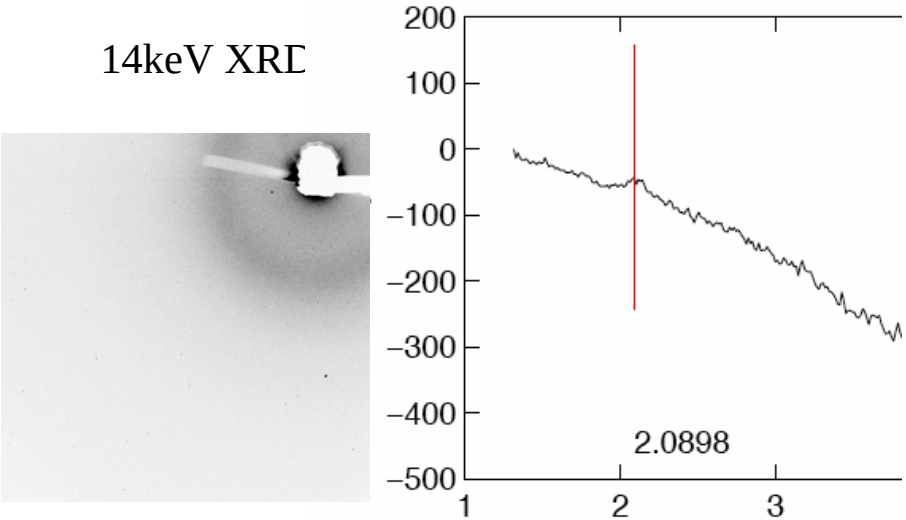
10keV MCA

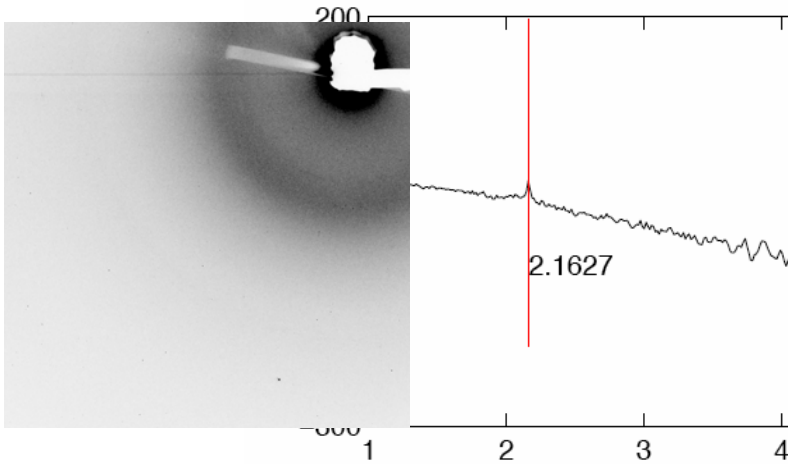


Fe XANES



14keV XRD

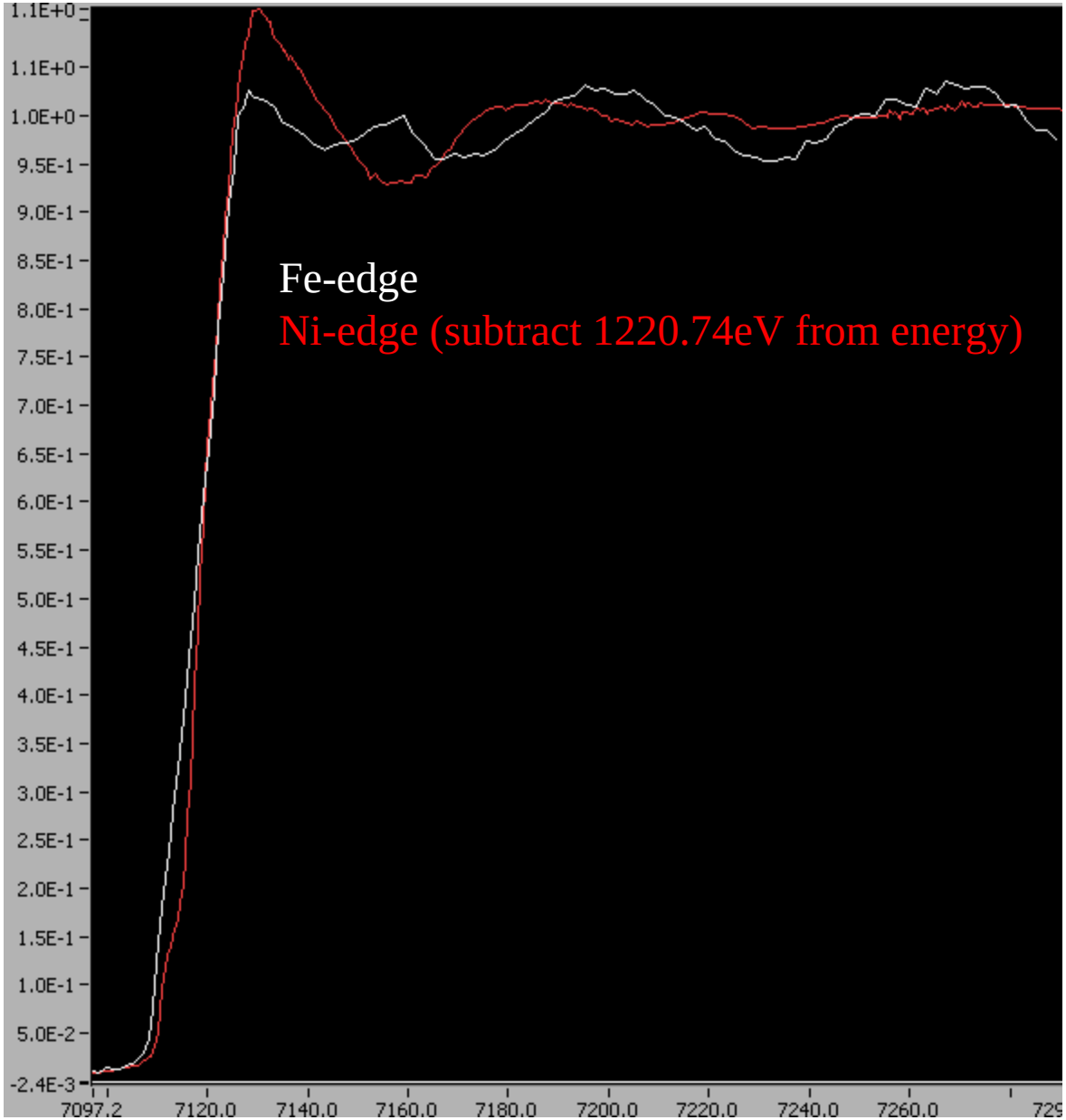




D

track43 spot3 has Fe, Ni - Does Ni substitute for Fe?

Take XANES at both edges, plot together



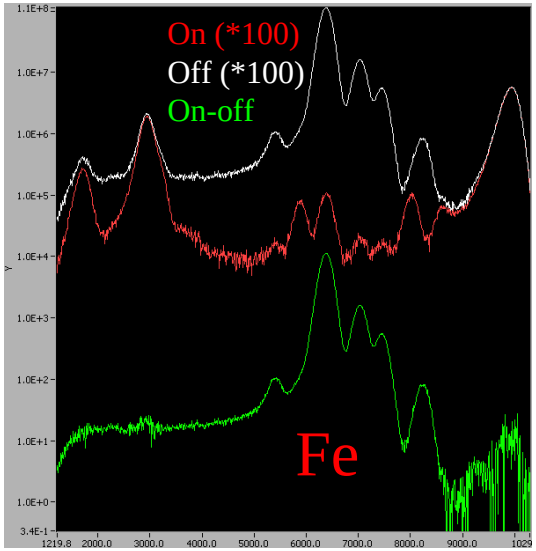
Track 43

That odd offset figure is the difference in edge energies for elemental Ni, Fe, according to Kraft, et. al.

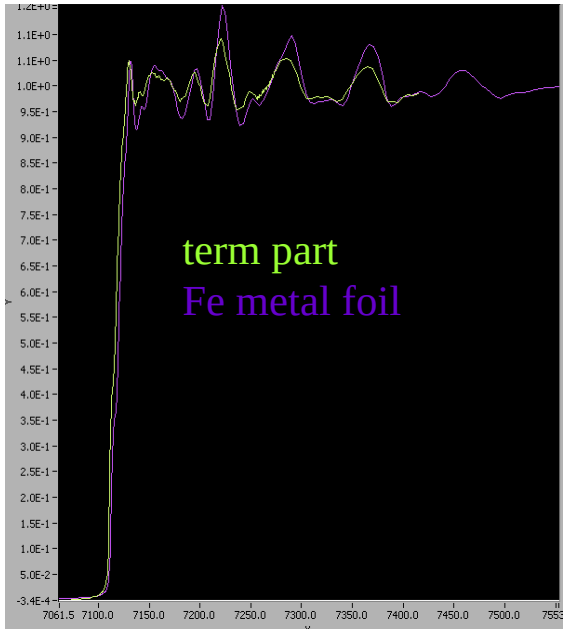
The Fe, Ni environments are very different, showing that the elements are either in different phases or different sites in the same phase.

C2044 track 43, term part: Fe,Ni metal

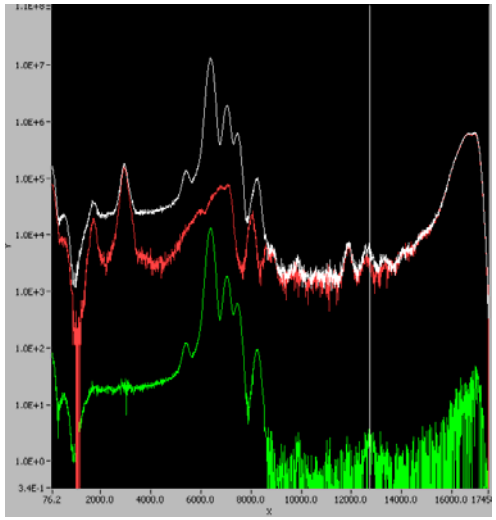
10keV MCA



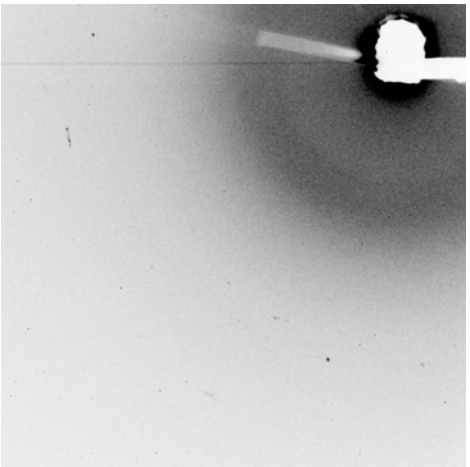
Fe XANES



17keV MCA



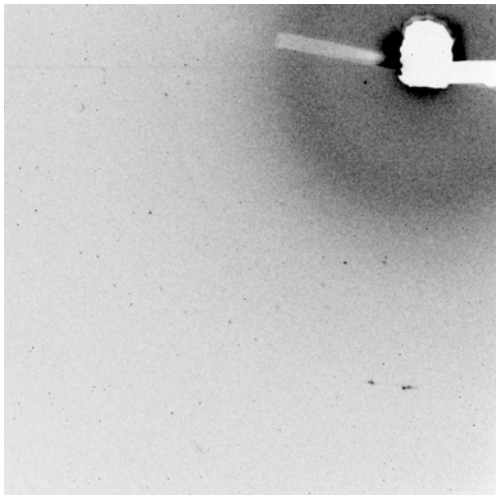
14keV XRD



D-spacing not yet analyzed

D

17keV XRD



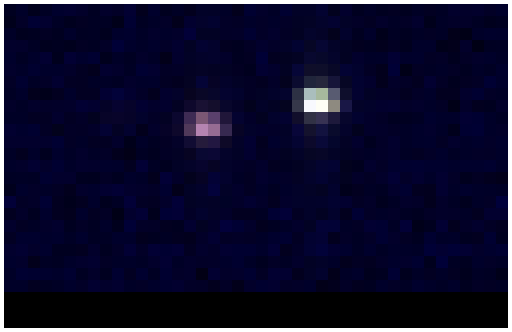
D-spacing not yet analyzed

D

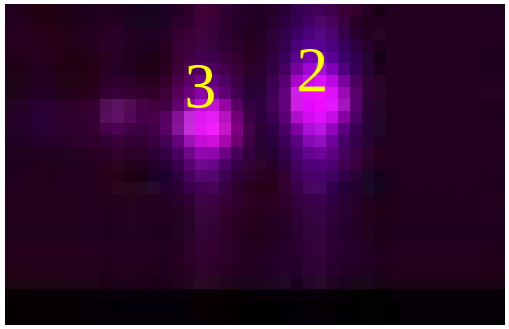
Track 38: The one with Ga

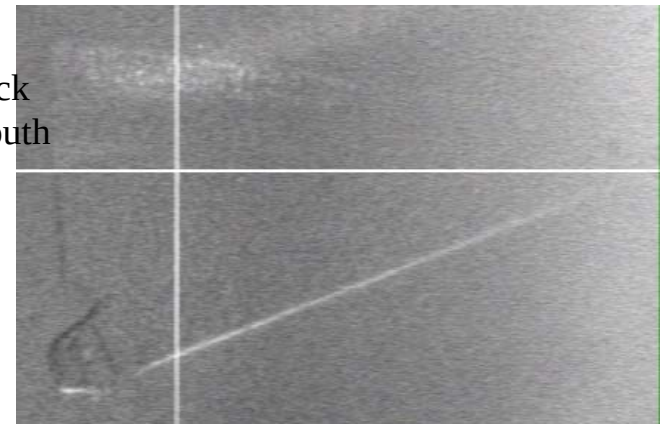
Mounted between polypropylene sheets

NiFeZn

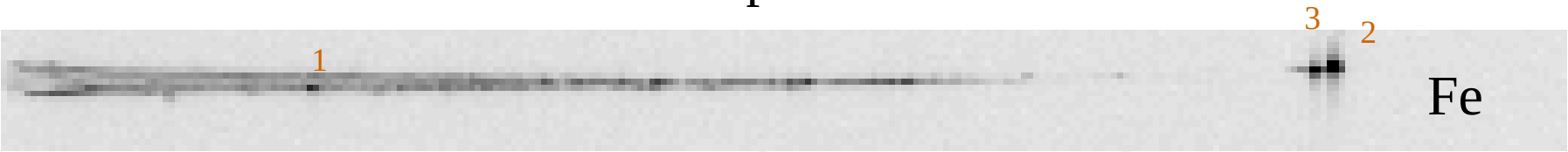


NiFe

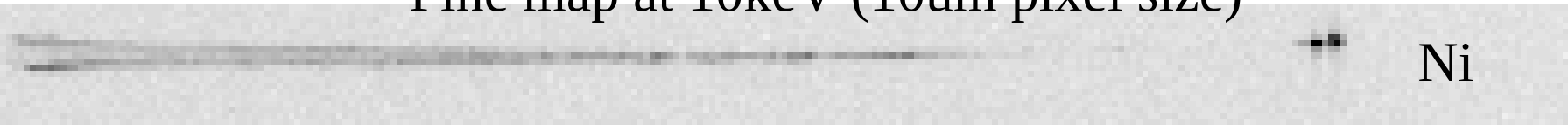




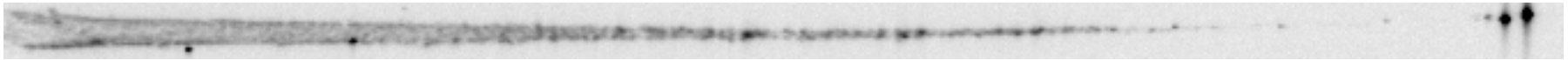
track 38 coarse map



Fine map at 10keV (10um pixel size)



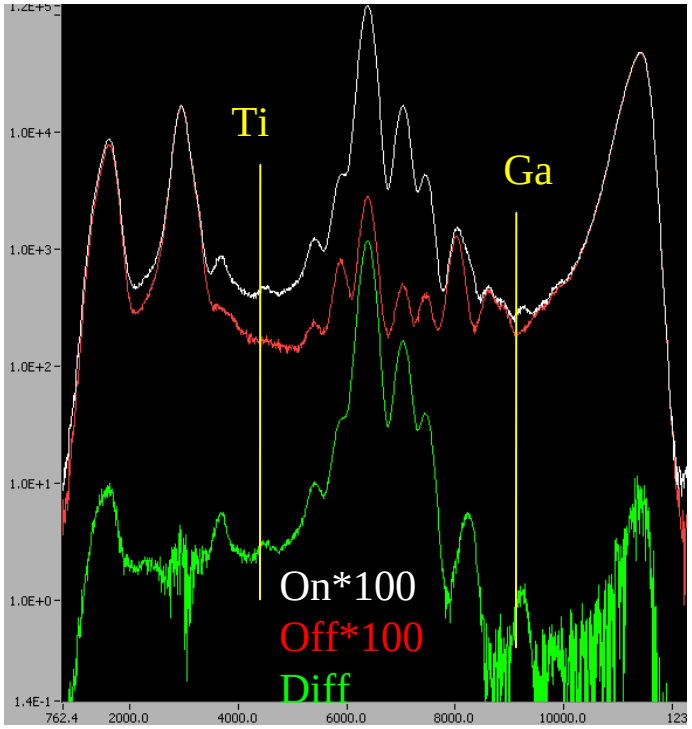
Fe



FeNi

C2044 track 38, spot 1: Ga-rich, Ni-poor unknown crystalline material

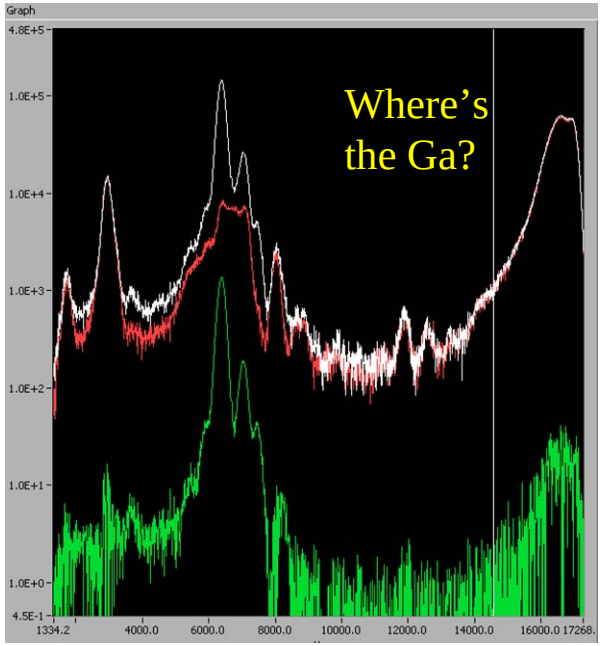
11.5keV MCA



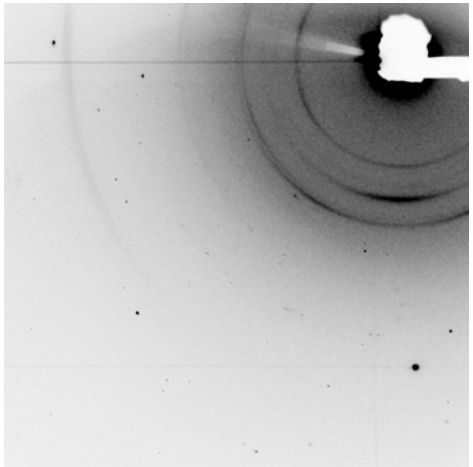
Fe XANES

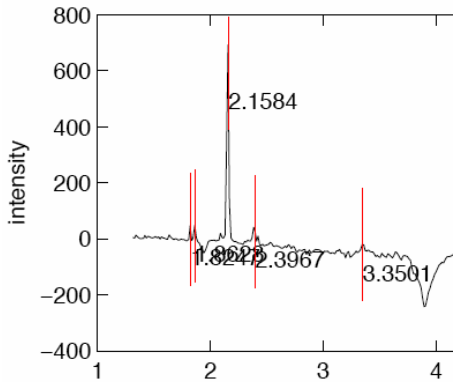
XANES missing

17keV MCA

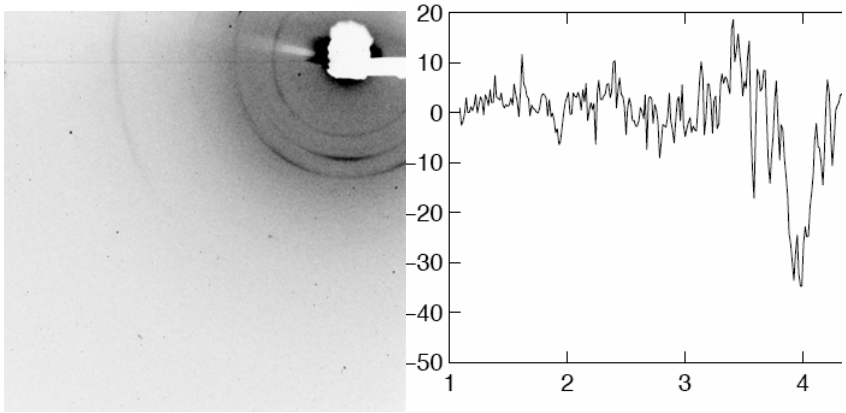


14keV XRD



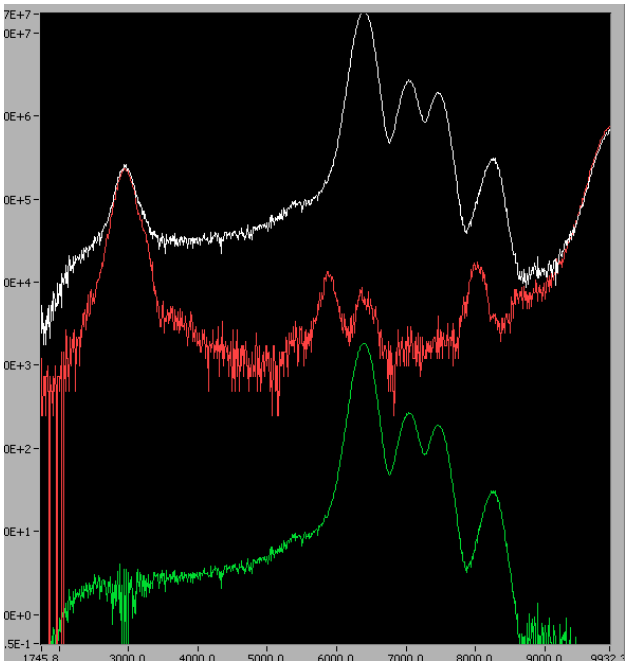


17keV XRD



C2044 track 38, spot 2: Fe,Ni metal

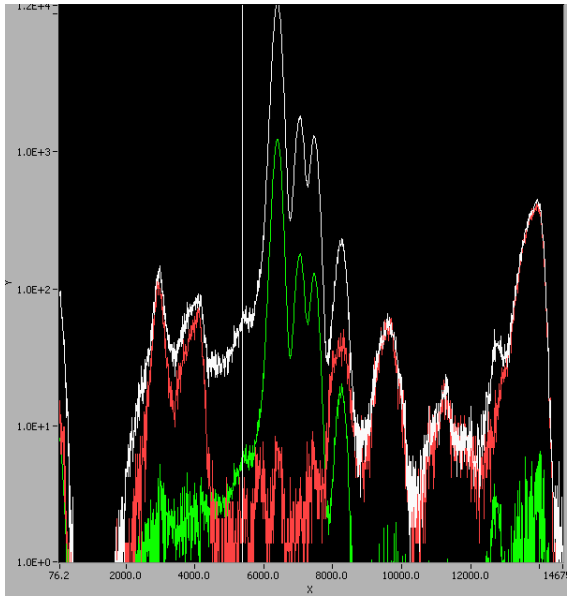
11.5keV MCA



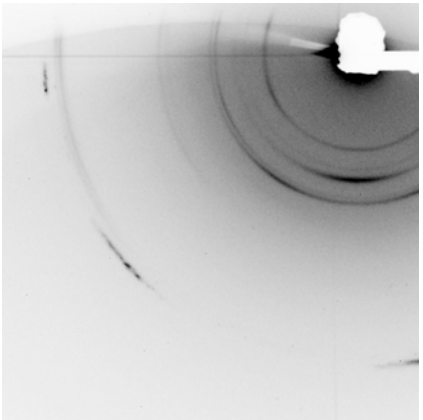
Fe XANES

XANES missing

14keV MCA



14keV XRD

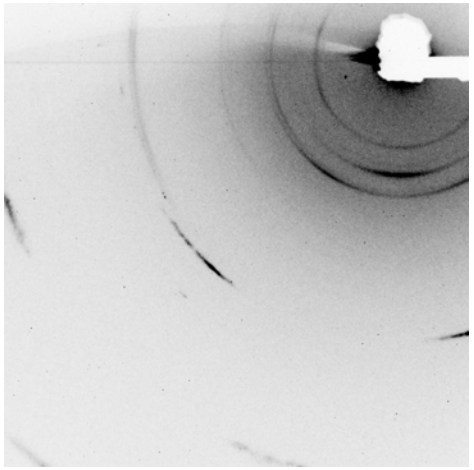


Diffuse bands are polypropylene foil

D-spacings need to be done with new alumina calibration

D

17keV XRD

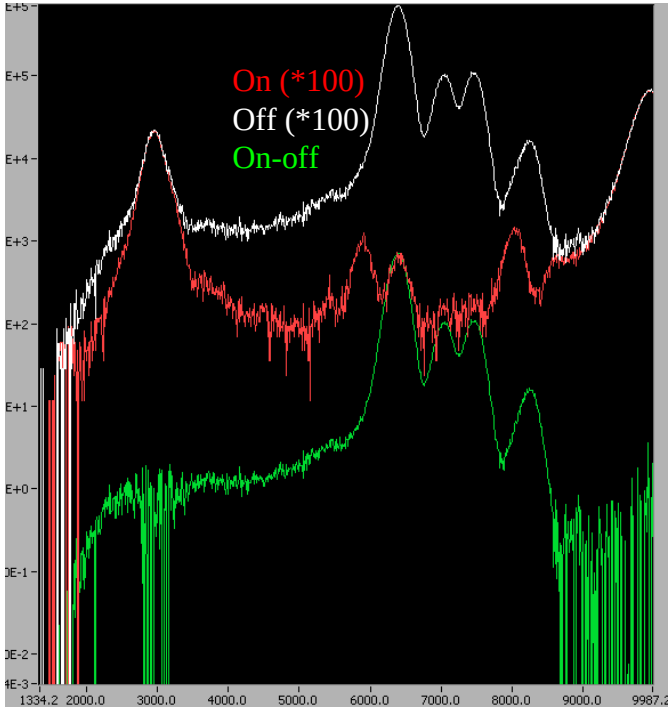


D-spacings after background subtraction

D

C2044 track 38, spot 3: Fe,Ni metal

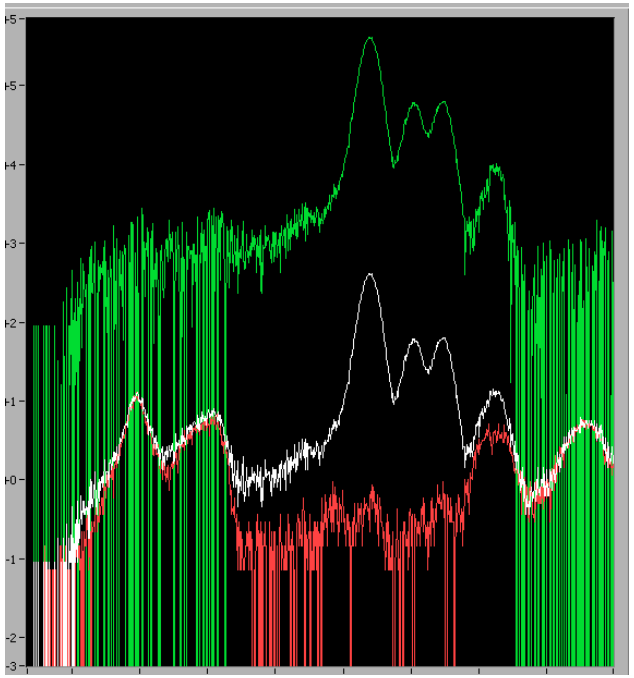
11.5keV MCA



Fe XANES

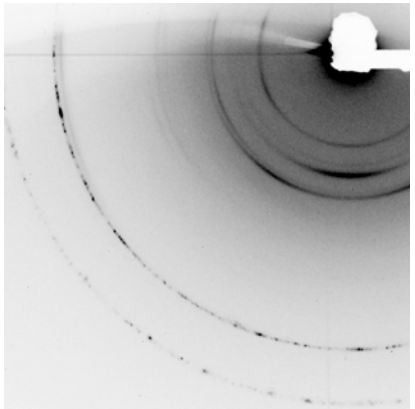
XANES missing

14keV MCA



14keV XRD

Diffuse bands are polypropylene foil

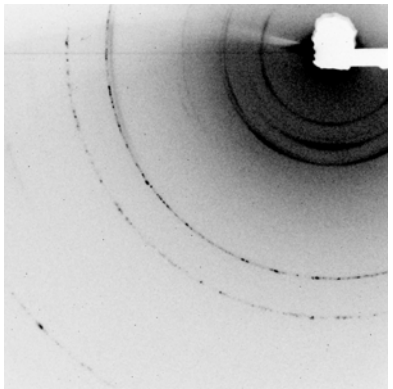


D-spacings need to be done with new alumina calibration

D

17keV XRD

D-spacings after background subtraction



D

Track 38: terminal particles at 10keV

Mounted between polypropylene sheets

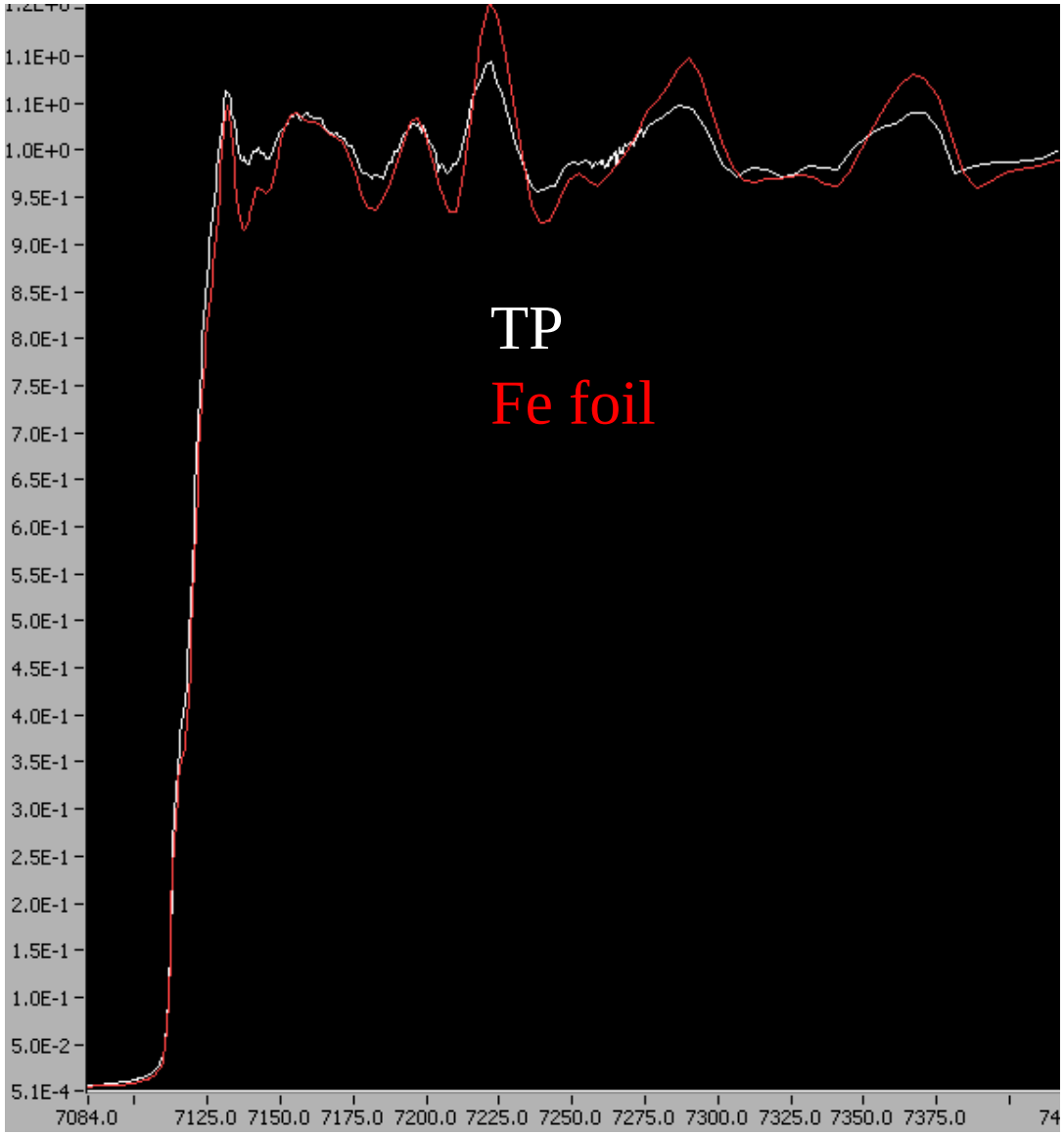
Fe xanes on terminal particles (spots 2 and 3)

Ni xanes on terminal particles: spot 2 very strong (Fe>>Ni, so was done with five layers Al foil to attenuate Fe signal)

Is this track 52 or track 38??

XANES on terminal particle

Fe-edge XANES looks like Fe metal

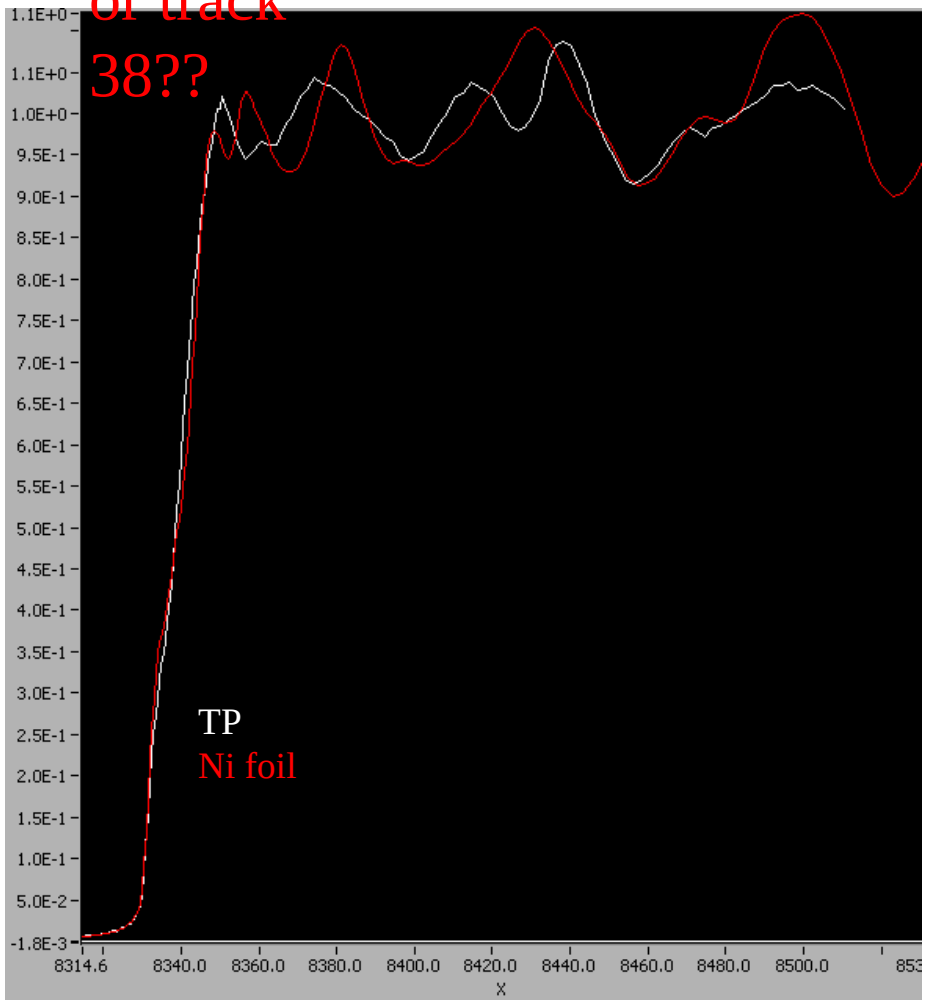


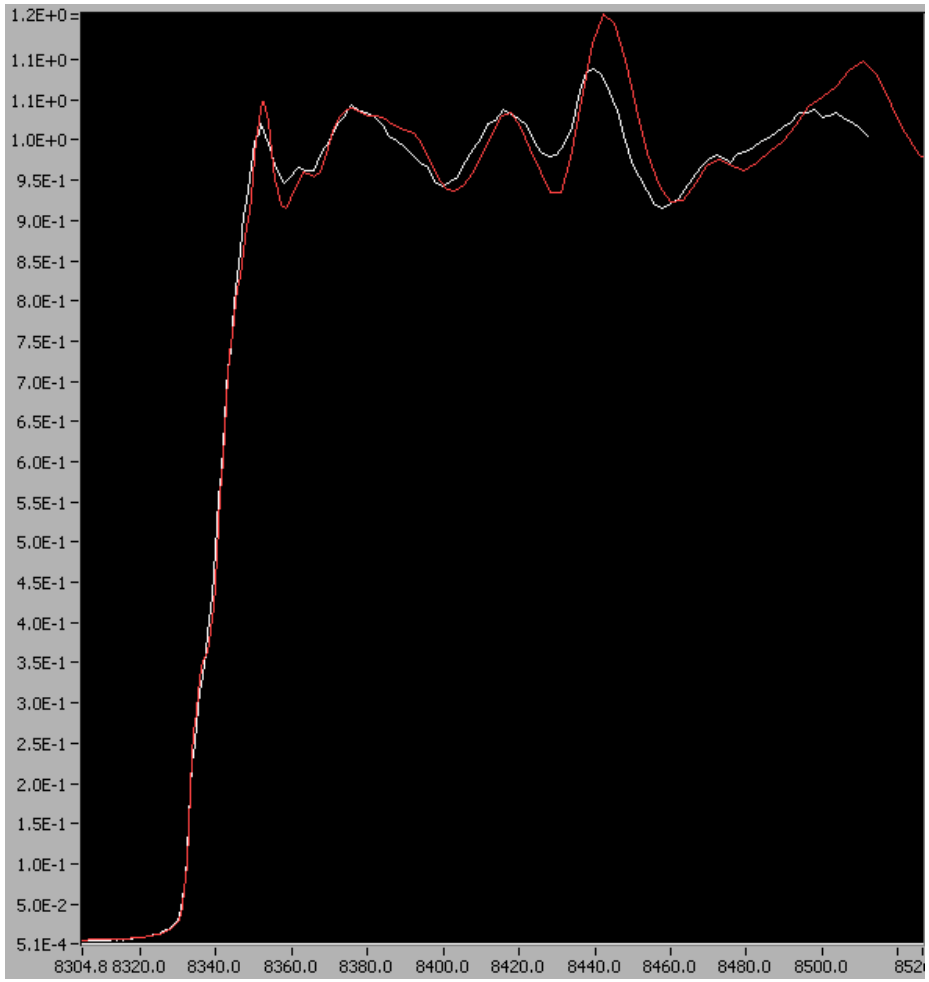
Amplitude difference probably due to overabsorption

XANES on terminal particle

Ni-edge XANES looks like Fe (not Ni) metal

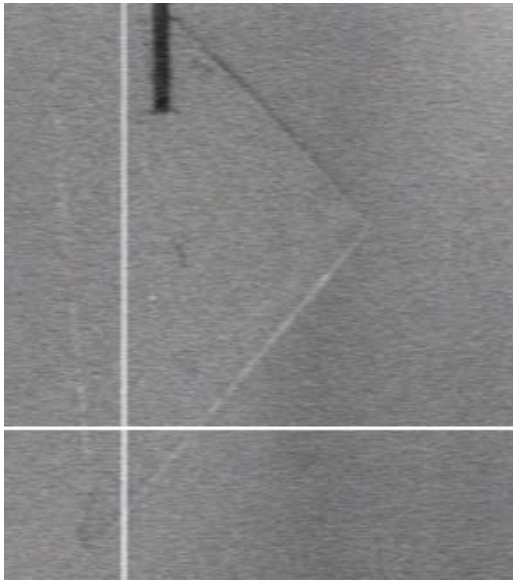
Is this track 52 or track 38??



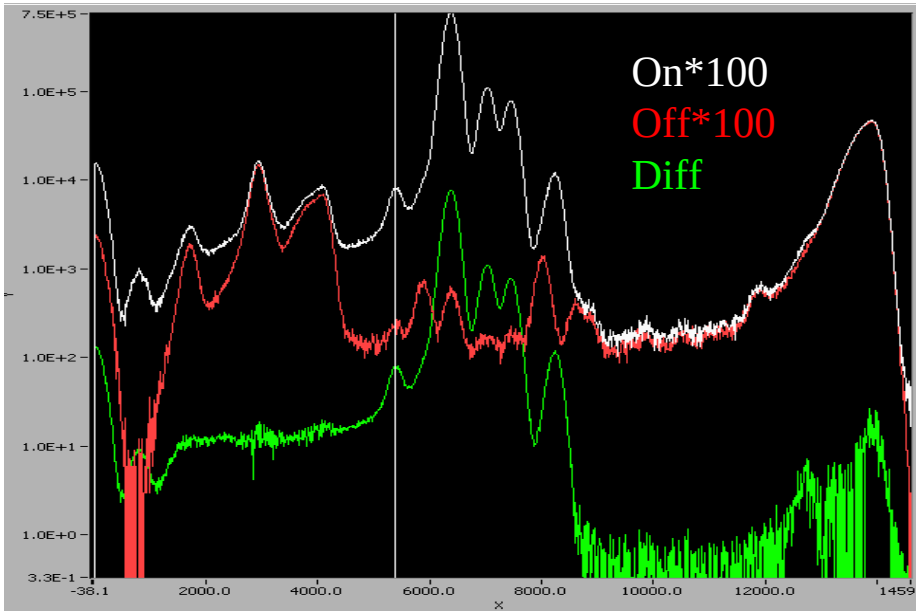


This is consistent with the Ni being present as a solid solution in the Fe. There is a distance shift, presumably due to the different size of Ni vs. Fe. The amplitude deficit cannot be overabsorption because Ni is dilute.

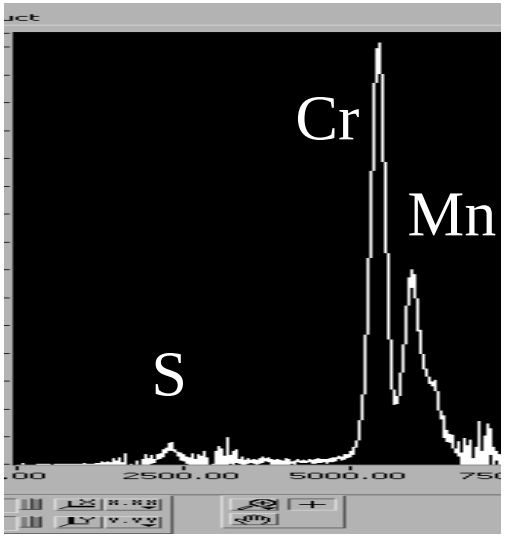
Track 52 VLM



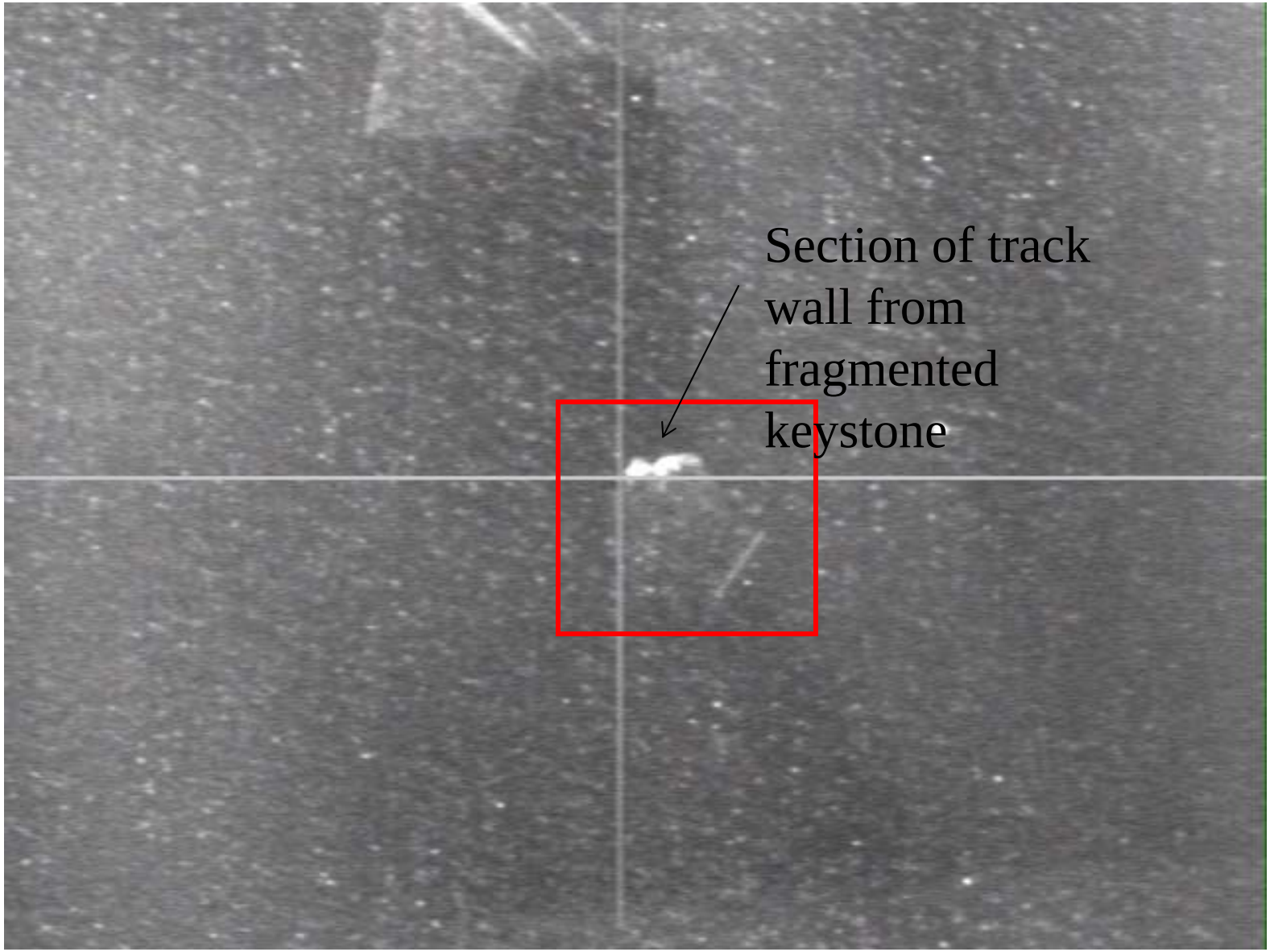
Track 52 TP MCA @ 14keV



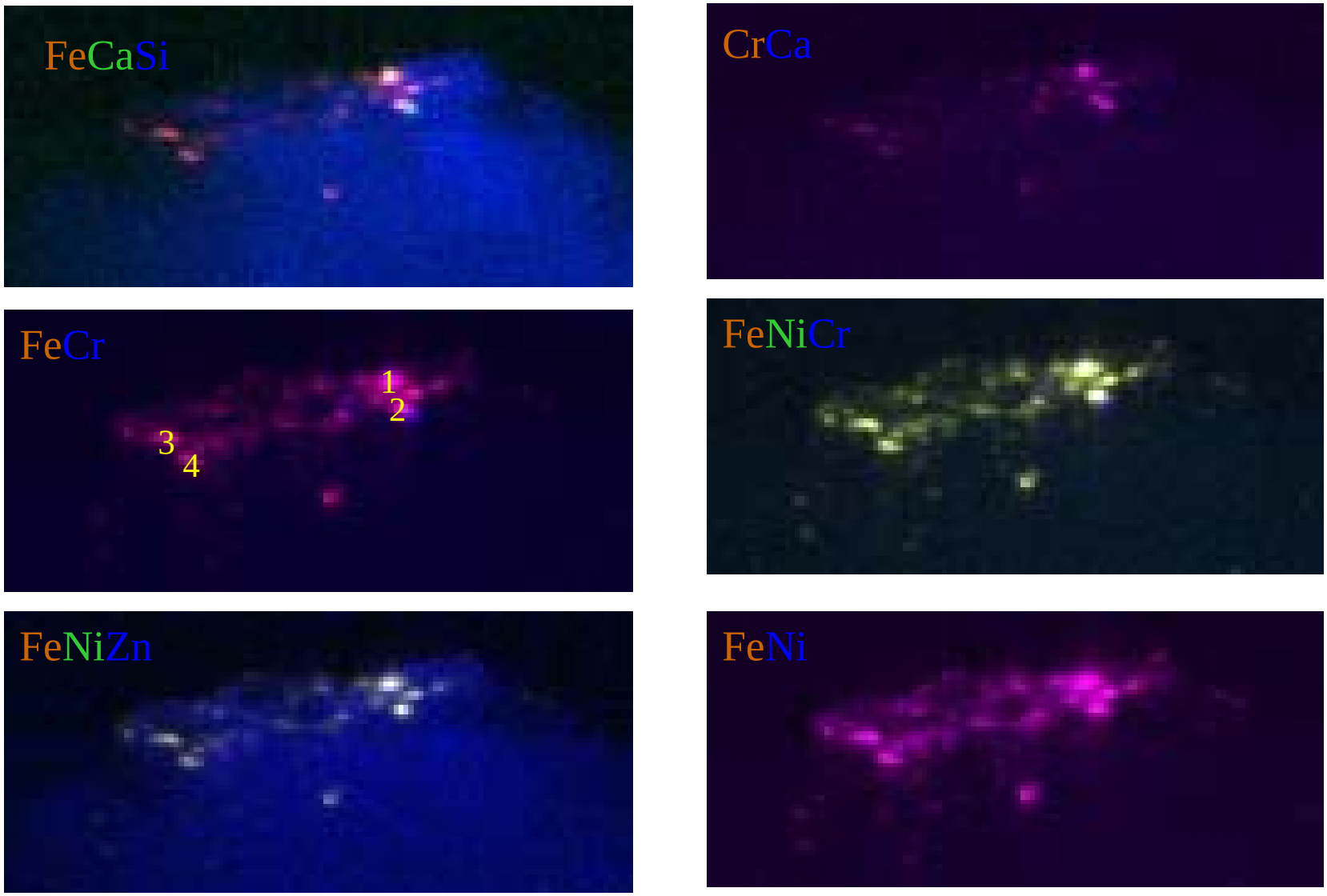
Track 52 TP MCA @ 7keV



C2044 Track 41 fragment

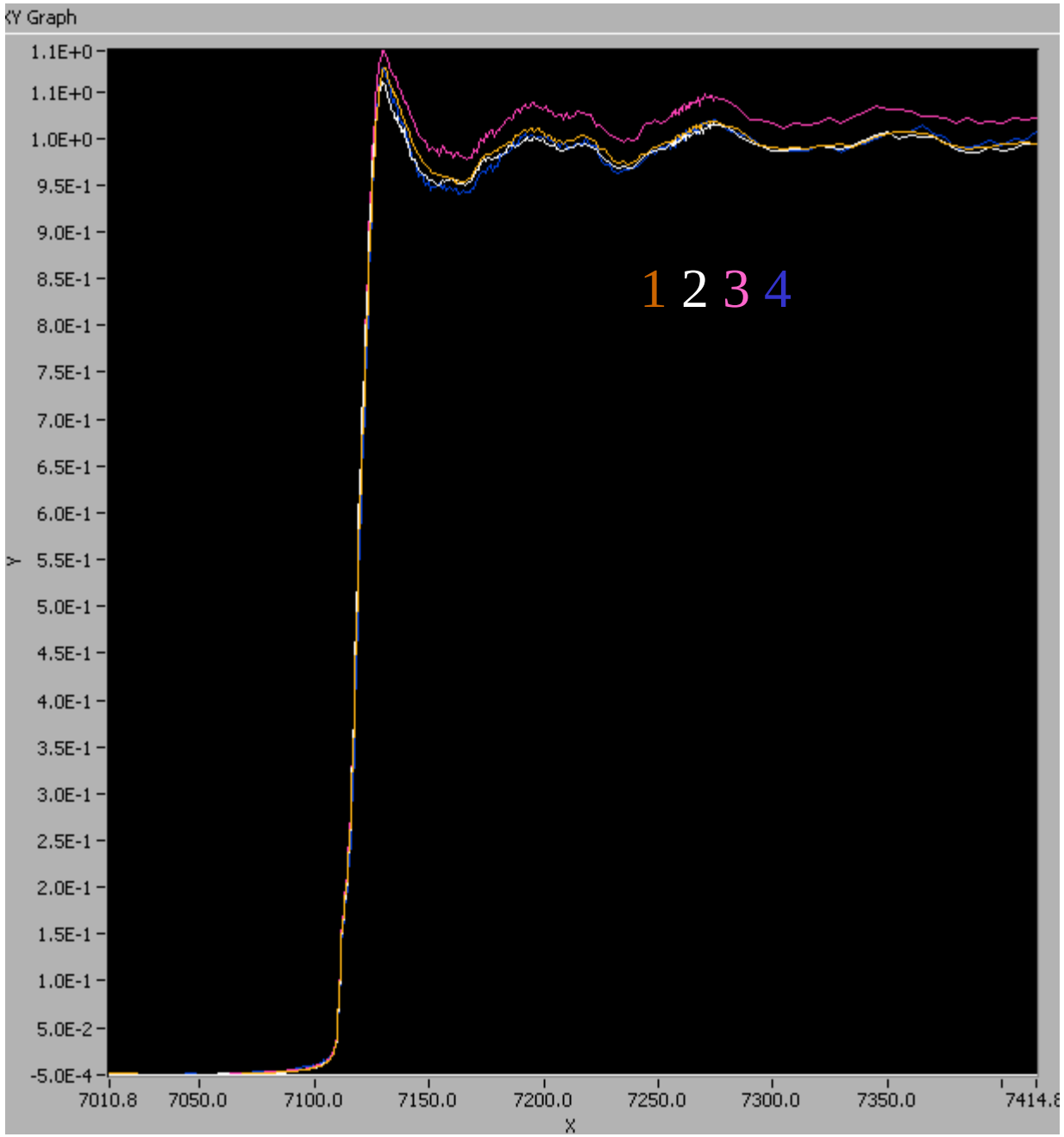


Track 41 fragment: XRF mapping at 10keV



Particles appear to be much less diverse as compared with other tracks
Integrated scan done, analysis pending

Track 41

Fe xanes on spots 1, 2, 3,4: all the same, Fe(0)?

not matching any standard we have