NUANCE
Northwestern University Atomic and Nanoscale Characterization Experimental Center

AZtec Post-Processing Manual

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Contents

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I. Introduction

This manual is intended as a guide for the post-processing of AZtec EDS data. There will be no discussion on optimization of parameters for live acquisition, responsive processing during analysis, or settings to be adjusted prior to data acquisition. The intent is to provide guidance on only those tasks that can be performed on previously collected data. **For assistance optimizing live data acquisition parameters, please consult the AZtec EDS manual at each microscope, locate an SEM manager, or contact SEM staff via the emails listed below.**

AZtec projects can only be read from a local drive and cannot be opened directly from a shared drive. To open an AZtec project on the Post-Processing PCs or your own computer, copy the entire project folder (both the .oipx project file AND the data folder must be copied) and paste to a local (C: or removeable) drive or to the PC Desktop.

To access the latest version of AZtec on your personal computer, please complete the virtual AZtec EDS training. Instructions for setting up the software on your own PC will be provided once training has been completed. Please note, only 50 users can access the network license at a time. If you're not actively using the software, please close it to make space for others. You must be connected to the Northwestern VPN to access the network license.

To view the full suite of Oxford Instruments AZtec manuals, visit the **Help > User Manuals** tab in the AZtec software.

Should you run into any issues or have questions, or would like to request an update, correction, or addition to the manual, feel free to reach out via email to an SEM staff member:

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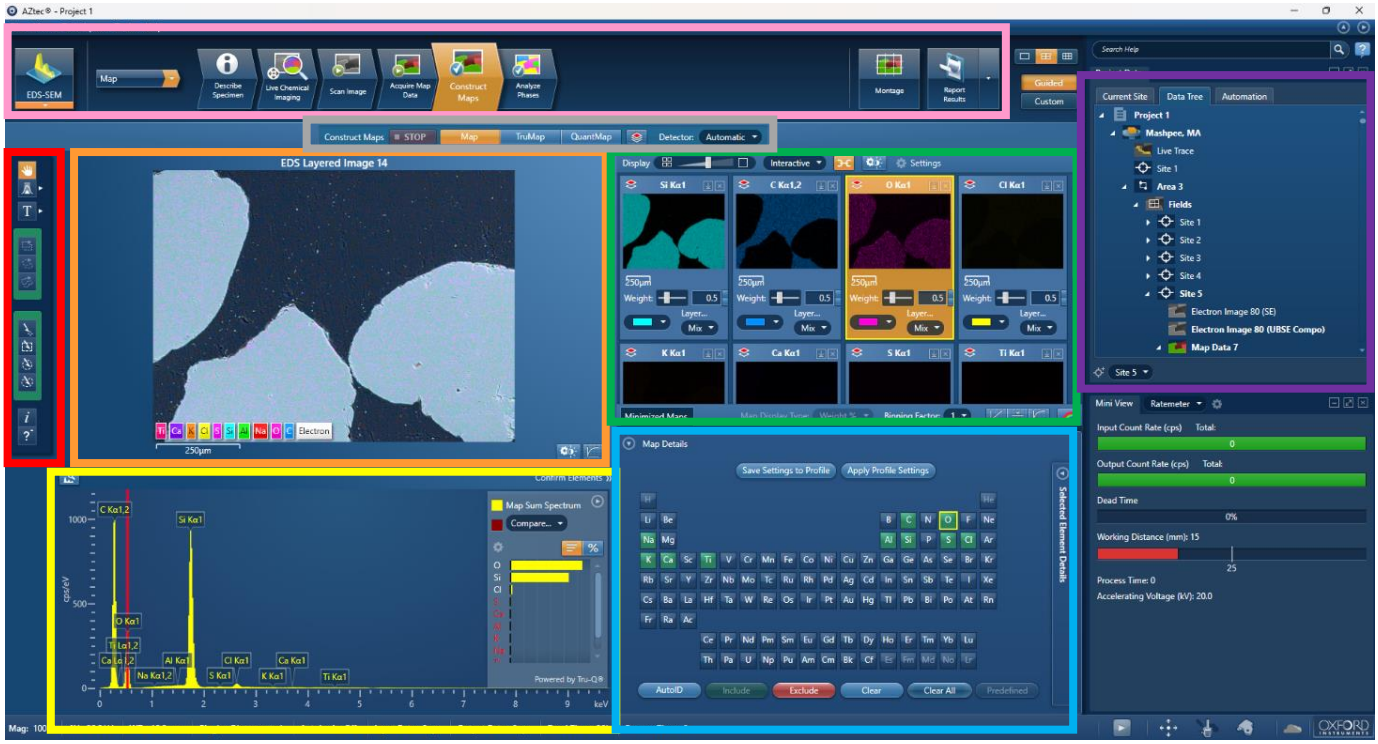
II. Overview

1. The AZtec software is divided into several fields and toolbars:



- Navigator Selector
- Acquisition Toolbar
- Palette Toolbar*
- Image Field
- Spectrum Field
- Maps/Linescans Field
- Elements Field
- Data Tree

2. *There are multiple versions of the Palette Toolbar when processing data:
    a. Basic Palette Toolbar
        i. Pan: Navigate around the spectrum/image/map with the mouse
        ii. Normalize
            1. Point: Double-click in the Spectrum Field to normalize to an energy level
            2. Region: Click and drag to normalize to a range of energy levels
        iii. Annotate: Overlay text, shapes, scale bars, or angle measurements
        iv. Show data values: displays total counts at an energy level
        v. Show candidate elements: double click in Spectrum Field to generate candidate elements at an energy level

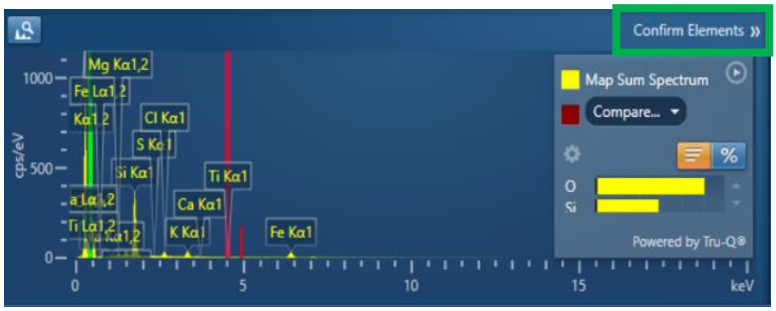
b. Reconstruction Palette Toolbars
    i. Mapping Reconstruction Tools
        1. Reconstruct a spectrum from a point
        2. Reconstruct a spectrum from a rectangular region
        3. Reconstruct a spectrum from an elliptical region
        4. Reconstruct a spectrum from a freehand region

    ii. Linescan Reconstruction Tools
        1. Reconstruct Line Point Spectrum
        2. Extract a linescan by defining the start and end point
        3. Extract a horizontal linescan by defining a rectangular region
        4. Extract a vertical linescan by defining a rectangular region
        5. Extract a linescan by defining a rectangular region
        6. Extract multiple linescans by defining a rectangular region

c. Montaging Palette Toolbar
    i. Pan: Navigate around the montaged image with mouse
    ii. Move and Select: Highlight and reposition an individual frame
    iii. Select Montage Region: Highlight a region of the montaged image
    iv. Cannot relocate fields in reloaded projects: should be grayed out

III. Peak ID

1. Confirm Element Peak ID in the Spectrum
    a. In **Point & ID** mode, select the **Confirm Elements** tab in the Navigator Selector
    b. In **Map** or **Linescan** mode, click *Confirm Elements »* in the top right corner of the Spectrum Field – this will bring you to the Confirm Elements tab in Point & ID mode

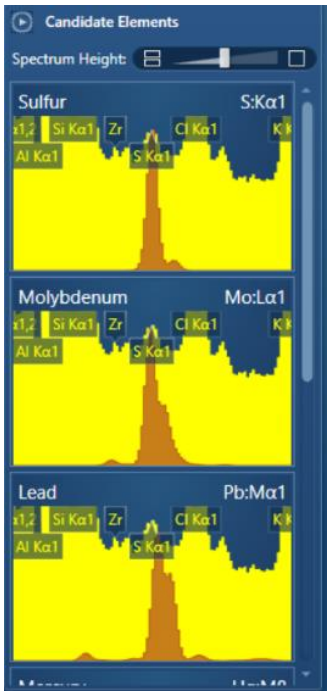


    c. Using the Pan button, locate the spectral region of interest
    d. In the Confirm Elements settings cog, there are several checkboxes used to toggle on or off various spectral analysis tools:
        i. Markers: Markers: Selected element in Elements Field displays lines at expected peak positions in Spectrum Field
        ii. Peak Shapes: Selected element in Elements Field displays a peak profile at the expected peak position in Spectrum Field

iii. Fitted Spectrum: Overlays expected spectrum outline based on background signal to validate accuracy of AutoID – ensures there are not too few/too many peaks identified (add/remove peaks manually in **Elements Field** to update)

iv. Theoretical Spectrum: A fitted spectrum that also takes internal Quant settings into consideration

v. No Pulse Pile Up Correction: Overlays spectrum outline that hasn't been corrected for pulse pile up (sum peaks will be visible)



e. Using the *Show candidate elements* button on the palette toolbar, double click the peak of interest to identify potential elemental matches.

i. Open the **Candidate Elements** pane on the right side to view the candidate element profiles

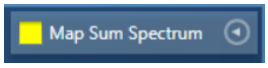
ii. Double click the Candidate Elements box to Include or Exclude the peak label from the spectrum

iii. Include or Exclude candidate elements by selecting the element in the **Elements Field** and clicking *Include* or *Exclude*

f. Compare the Fitted Spectrum to the data with the identified peaks Included and Excluded

2. Compare Multiple Spectra

a. Multiple Spectra can be compared from within the *MiniQuant* in any **Spectrum Field** or from the **Compare Spectra** module in **Point & ID** mode

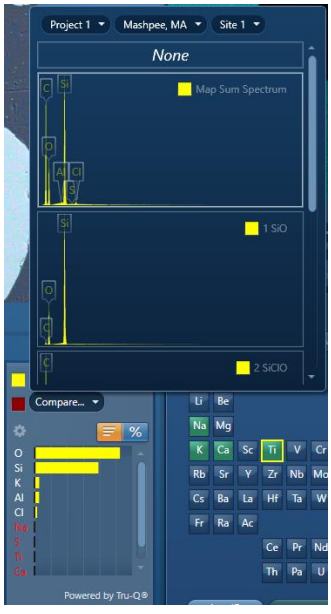


i. To open the MiniQuant, expand the *Map Sum Spectrum* box in the top right corner of the **Spectrum Field**

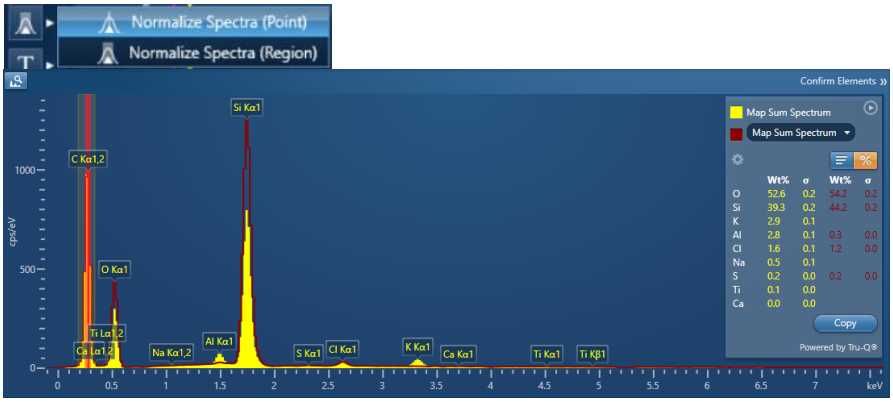
ii. In the *Selected comparison spectrum dropdown* (red box), choose any spectrum collected in the current Project, from any Sample, and from any Site to compare to the currently displayed spectrum

iii. A red outline of the <u>selected spectrum will be *overlayed on the current spectrum*</u>

1. The <u>yellow spectrum</u> will be the spectrum selected in the **Data Tree**
2. The <u>red spectrum</u> outline will be of the spectrum chosen in the **MiniQuant**



iv. It will be a good idea here to *Normalize* the spectra – typically against a bulk material such as C or Si or a particular peak of interest



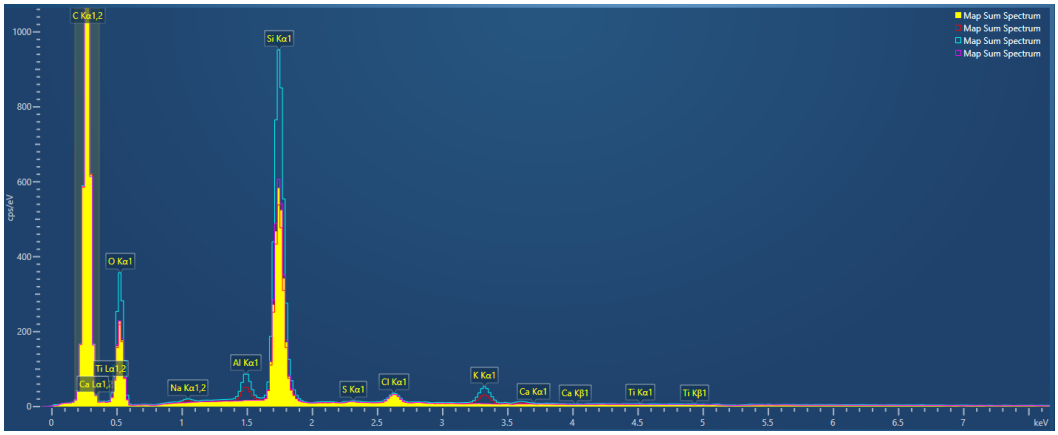
b. 3 or more spectra can be compared in the **Compare Spectra** module in **Point & ID** mode

i. Select individual spectra from the Data Tree or select multiple spectra by holding CTRL

ii. Once spectra are highlighted, click the *Add Selected Acquisitions* button under the Data Tree 

and they will populate the Spectrum Field

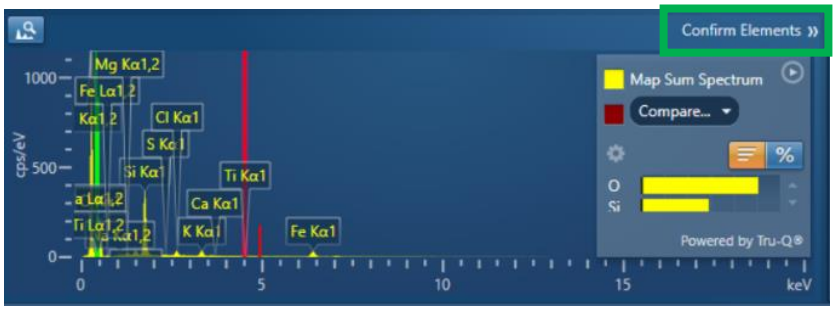
iii. It will be a good idea here to *Normalize* the spectra – typically against a bulk material such as C or Si or a particular peak of interest



3. Add a Label to an Unlabeled Peak

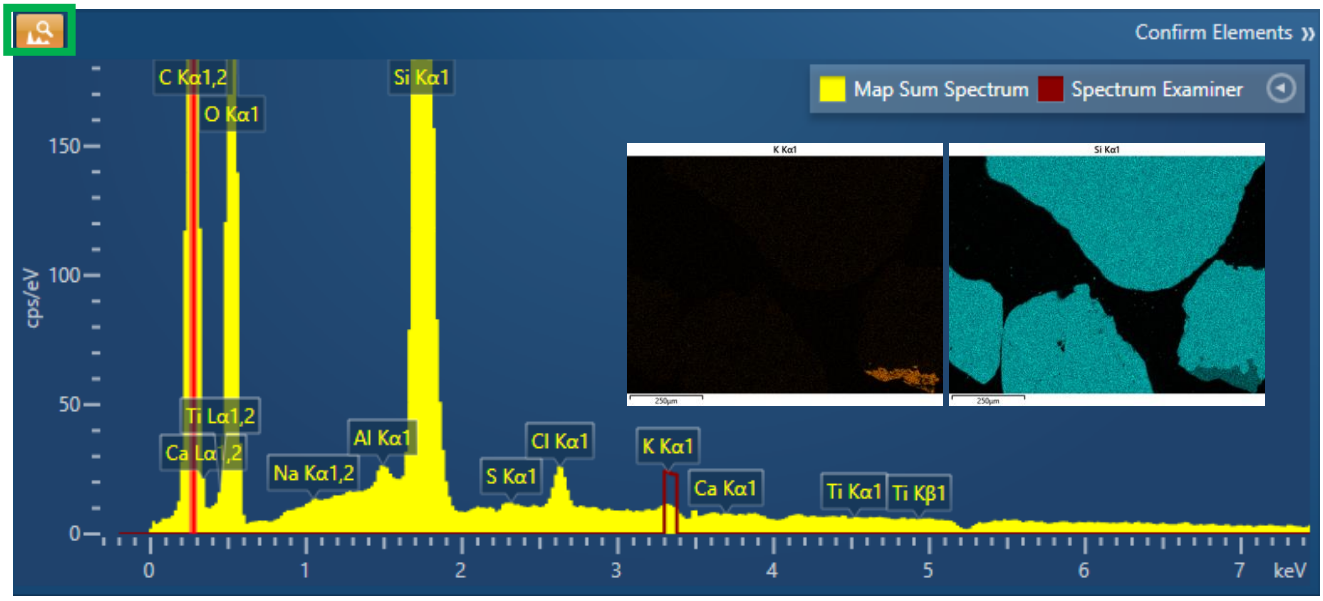
a. In **Point & ID** mode, select the **Confirm Elements** tab in the Navigator Selector

b. In Map or Linescan mode, click *Confirm Elements »* in the top right corner of the **Spectrum Field** – this will bring you to the Confirm Elements tab in Point & ID mode

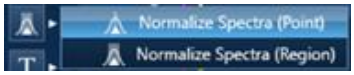


c. Using the Pan button, locate the spectral region of interest
d. The element at the peak position of interest must be *Included* in the **Elements Field**
    i. Open the *Peak Labels* pane on the right side to view the available line series for that element
    ii. Toggle labels for specific energy lines of that element

4. Find (if there are any) Trace Elements Hidden by the Background Noise
    a. Choose **Map** mode from the Navigator Selector dropdown menu
    b. In the **Spectrum Field**, click the *Spectrum Examiner* button  in the top left corner
        i. Spectrum Examiner scans the maps pixel-by-pixel to look for minor elements present in high concentrations but only in small, localized areas
        ii. The map sum spectrum considers the full mapping region, so signal from small, intense areas in the map may be lost in the background noise

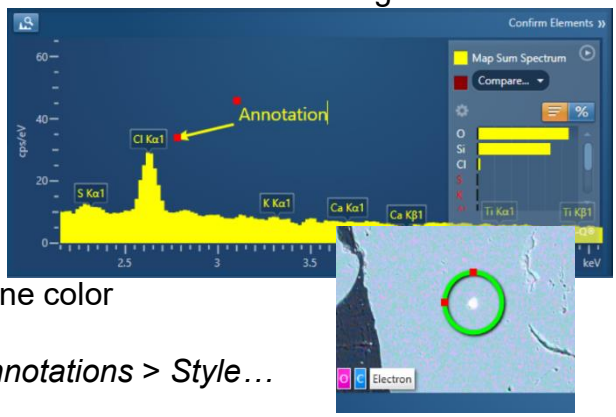


IV. Spectrum Processing



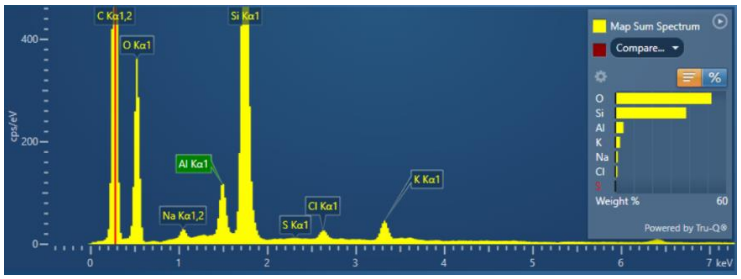
1. Normalize a Spectrum
    a. From the **Basic Palette Toolbar**, select a (*Point*) or a (*Region*) normalization
        i. Point: Double-click in the **Spectrum Field** to normalize to an energy level
        ii. Region: Click and drag to normalize to a range of energy levels (*This will auto update the normalization as the region is expanded or contracted*)
    b. Toggle the normalization on or off to see how the spectrum is affected
        i. Right click in the **Spectrum Field** and select/deselect *Normalize*

2. Annotate a Spectrum
    a. Select the *Annotate* button in the **Palette Toolbar**
        i. Text: Overlay text on the Spectrum/Image Fields
        ii. Rectangle/Ellipse: Draw shapes on the Spectrum/Image Fields
        iii. Caliper: Overlay a calibrated measurement tool on the Image Field
        iv. Angle: Overlay a calibrated angle measurement tool on the Image Field
    b. If making a text annotation, an arrow can be extended from the text position to point to a feature of interest
        i. Click and drag the red dot at the top left of the annotation
        ii. Hold and drag to extend the arrow



    c. Annotations can be modified for font size and arrow/line thickness or font and arrow/line color
        i. Click the annotation to select it
        ii. Right click the annotation – select *Annotations* > *Style…*
        iii. Make desired modifications
    d. To remove annotations, hide or delete individual selections or all annotations
        i. Right click the annotation – select *Annotations*
        ii. *Select All* to highlight all annotations
        iii. Uncheck *Show* to hide all highlighted annotations
        iv. Select *Delete* to delete all highlighted annotations

3. Modify the Peak Labels
    a. Select Pan on the **Palette Toolbar**
    b. Click on a peak in the **Spectrum Field** to highlight it green
        i. Click and drag to move the highlighted label

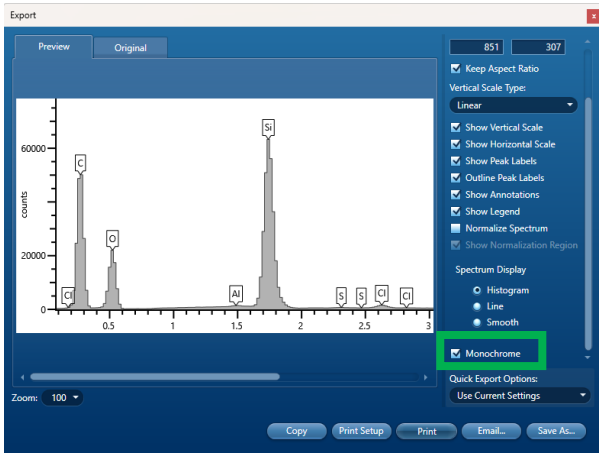


4. Modify the X and/or Y-Axes
    a. Hovering over the **Spectrum Field**, use the scroll wheel on the mouse to expand or contract the X-Axis
    b. Clicking and dragging inside the Spectrum Field will let you manually move the spectrum to the lines of interest:
        i. Horizontally will move the X-Axis of the spectrum
        ii. Vertically will stretch or compress the peaks along the Y-Axis
    c. Set a defined X-Axis range by right clicking the **Spectrum Field** > *X-Axis* > *Adjust*
        i. Enter the desired <u>minimum and maximum energy lines to be displayed</u> in the window
        ii. *Apply*

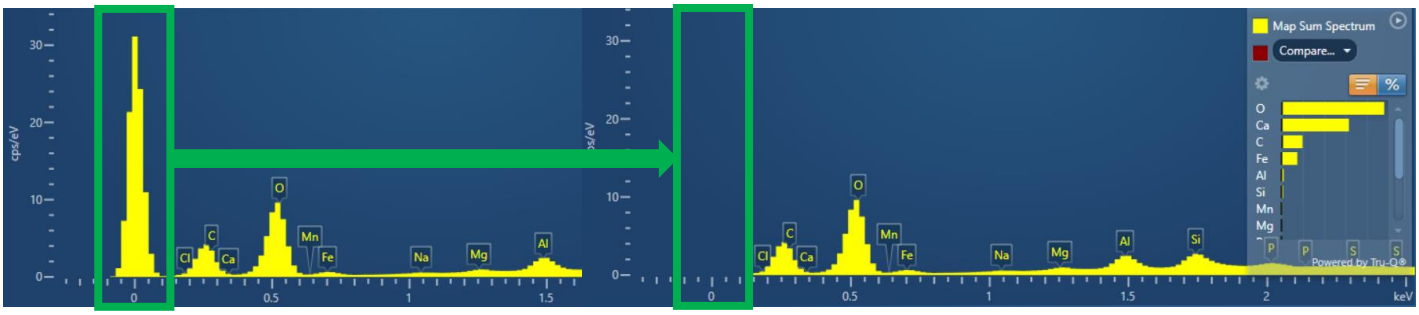
iii. This scale can then be locked by selecting *Locked* above Adjust

d. Y-Axis can be toggled between total number of counts or counts per second per eV
   i. Right click **Spectrum Field** > *Y-Axis* > *Units*
   ii. The Y-Axis can also be *Locked* in the same manner as the X-Axis

5. Remove the Blue Color Background from the Spectrum
   a. Right click the **Spectrum Field** > *Export* > *Settings…*
   b. Scroll to the bottom of the settings menu on the right side of the window
   c. Select the *Monochrome* box – You will see the display showing a grayscale spectrum
   d. Click *Save As…* to save the monochrome spectrum



6. Remove the Noise Peak (below ~0.1 keV) from the Spectrum
   a. Note: The Noise peak is an electrical noise-based peak from the system that typically appears in the spectrum below ~0.1keV
   b. To hide the Noise Peak, right click the **Spectrum Field** > *Noise Peak* > *Hide*
      i. This removes all counts <~0.1keV from the spectrum



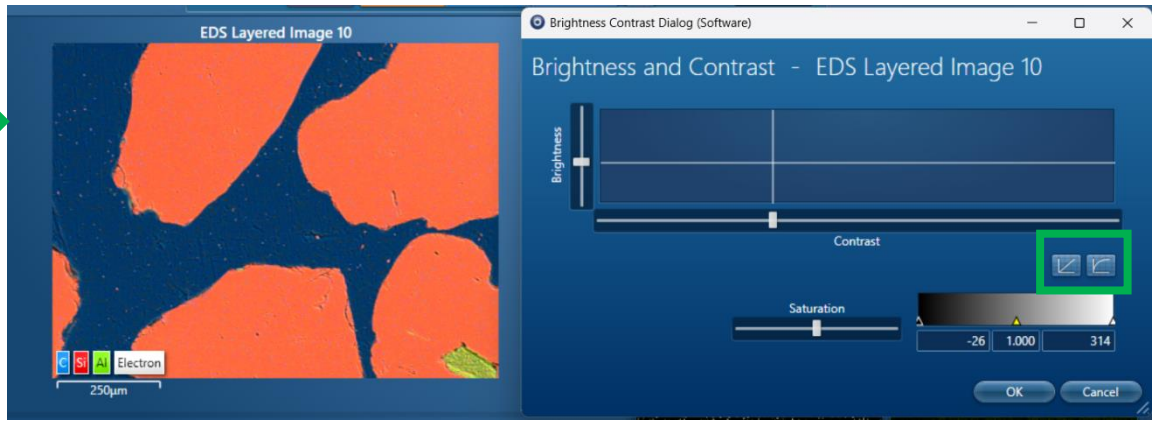
   c. *Including* or *Excluding* from Scaling (in the same Noise Peak submenu) impacts the Y-Axis when Resetting the Scales
   d. These settings can be useful when the noise peak is large compared to the measured X-ray signal

V. Mapping

1. Visually Enhance the Maps (Brightness/Colors/Noise Reduction)
   a. Maps can be visually enhanced individually, or the overall layered image can be enhanced
   b. Layered Images can be adjusted for brightness/contrast and enhanced by weighting individual maps
   c. In the **Image Field**, select the *Color, Contrast, Brightness, and Gamma Control* button

1c 1f

d. Manually adjust the Brightness, Contrast, and Saturation values using the slider bars to see live updates to the Layered Image

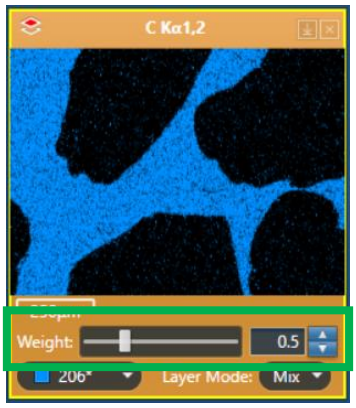


1e

e. Alternatively, select the *Auto Brightness*, or *Auto Gamma* buttons on the right side of the Dialog box to auto adjust

f. Auto Gamma can also be run without opening the Dialog box by selecting the *Auto Gamma* button next to the Brightness and Contrast Dialog button

g. To weight an individual map more or less heavily in the layered image, adjust the *Weight* slider of the individual map in the **Maps Fields**
   i. Adjusting these sliders will also display live updates to the layered image



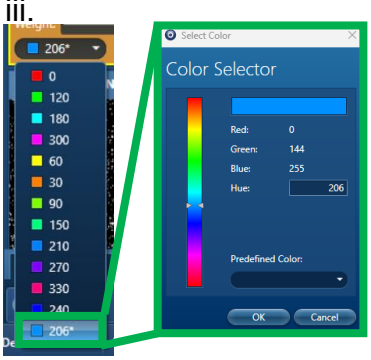
h. Adjust Brightness and Contrast for individual maps by selecting the *Display the brightness and contrast dialog* button in the **Maps Field** (same icon as the B/C settings for the layered image)
   i. Repeat steps 1d. and 1e. for the element maps of interest

i. Apply Brightness/Contrast settings to all maps by using the *Brightness Adjustment* buttons near the bottom of the **Maps Field**

   i. Auto Brightness: each map contains (at least) one brightest pixel and (at least) one darkest pixel with a full 8-bit brightness scale distributed throughout
   ii. Normalize Brightness: brightness scale distribution assigned based off the overall brightest and darkest pixels across all maps (darker pixels in one map means lower counts compared to highest count pixel in most intense map)
   iii. Auto Gamma: Same as Auto Brightness, but emphasizes the mid tones more

j. Map colors can be changed manually or automatically
   i. Automatically: Select the *AutoLayer* icon in the **Acquisition Toolbar**

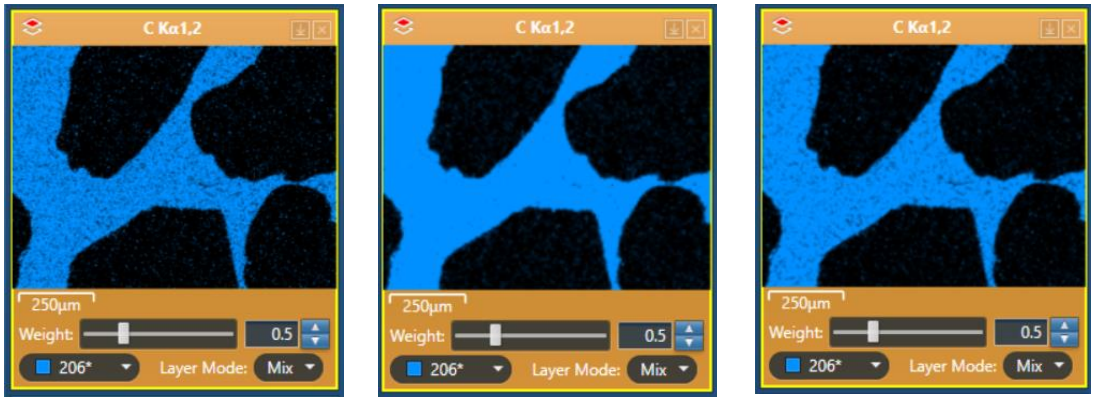
iii.



ii. AutoLayer automatically colors and layers maps based on relative spatial and intensity relationships among the detected element maps
    1. Maps with insignificant signal will be whited out
iii. Manually: In each element map, select a map color from the *Hues* dropdown
    1. Custom map colors can be set in the **Color Selector** – choose the final color option

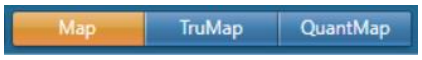
k. Reduce Noise by binning or smoothing the data
    i. Binning: Change the *Binning Factor* dropdown value at the bottom of the **Maps Field**

        1. Binning is a data point clustering technique used to reduce the influence of <u>noise pixels</u> in the map
    ii. Smoothing: In the **Maps Field** Settings menu, select *Smooth Element Maps*
    iii. Choose Type of Smoothing and Kernel size
        1. Smoothing works off either a *rolling average* or *Gaussian smoothing* to reduce noise

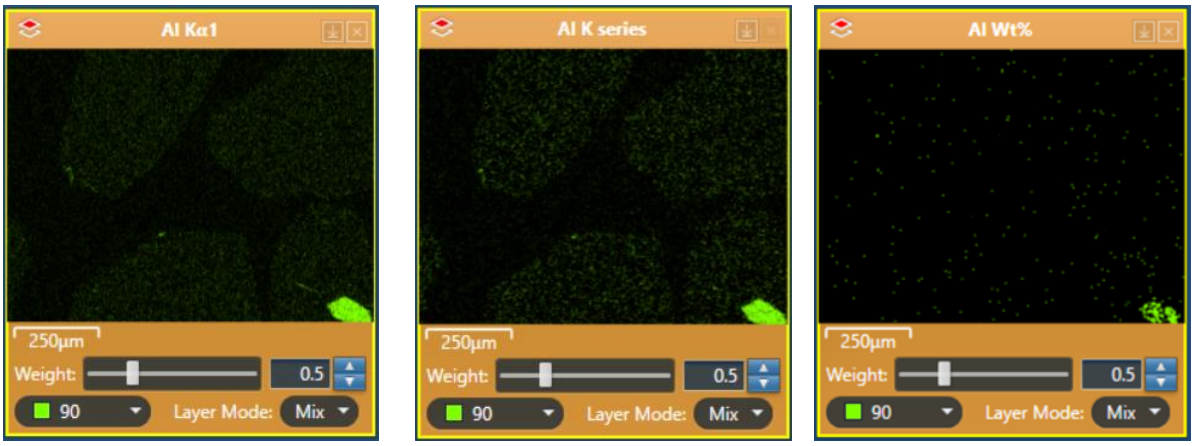


Same C map with no binning/smoothing, a Binning Factor of 4, and a 5x5 Gaussian Smoothing.

l. Noise can also be reduced by generating a *TruMap* or *QuantMap* after data collection
m. Select *TruMap* or *QuantMap* in the **Acquisition Toolbar** to reprocess the maps



    i. TruMap: Runs a peak deconvolution process in the Map Sum Spectrum data to <u>reduce peak overlaps</u> and <u>minimize spectral background noise</u>
        1. *Reduces background noise in element maps as well*
    ii. QuantMap: Performs a <u>theoretical quantification</u> (using internal standards) on <u>each map pixel</u> to provide more accurate elemental distributions

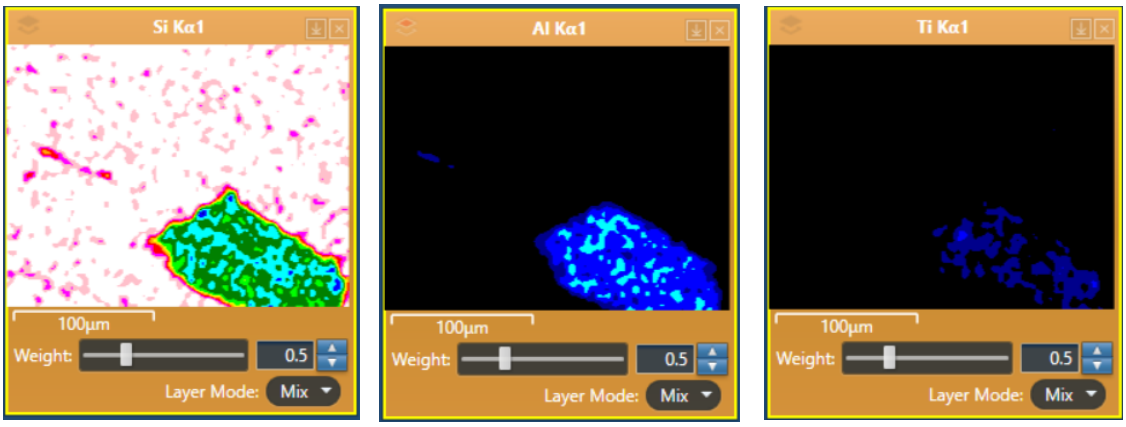


Same Al map processed as collected data (Map), TruMap, and QuantMap – QuantMap showing Aluminum signal likely localized to a small particle in lower righthand corner of frame

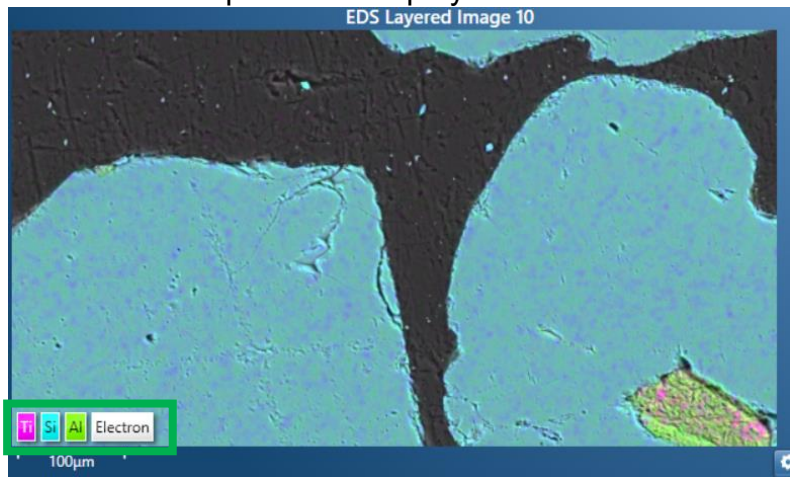
n. Click the QuantMap settings cog  to:

   i. Normalize QuantMap results
   ii. Select Deconvolution Elements
   iii. Perform Pulse Pile Up Corrections (removes Sum Peaks)
   iv. Enable Sigma level Thresholding

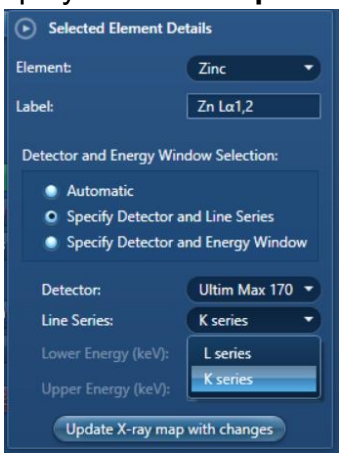
2. Identify Trace Elements in the Maps
   a. Running a *TruMap* or *QuantMap* (see above 1m-1n) with *AutoID* selected in the **Elements Field** can elucidate minor elements previously undetected through the background noise
      i. Ensure Results have been *Normalized* and *Thresholding* Enabled (**Point & ID** > Calculate Composition > *Advanced* tab > Enable Thresholding checkbox)
   b. Discrete Color Maps can also discover whether there are trace amounts of an element visible in the maps
      i. Select the *Discrete Color Images* button at the bottom of the **Maps Field** 
      ii. Each pixel is assigned a value 1-12 based on measured intensity – each value displays as a different color (Always ***Normalize*** Brightness!)
         1. Black = lowest intensity; White = highest intensity

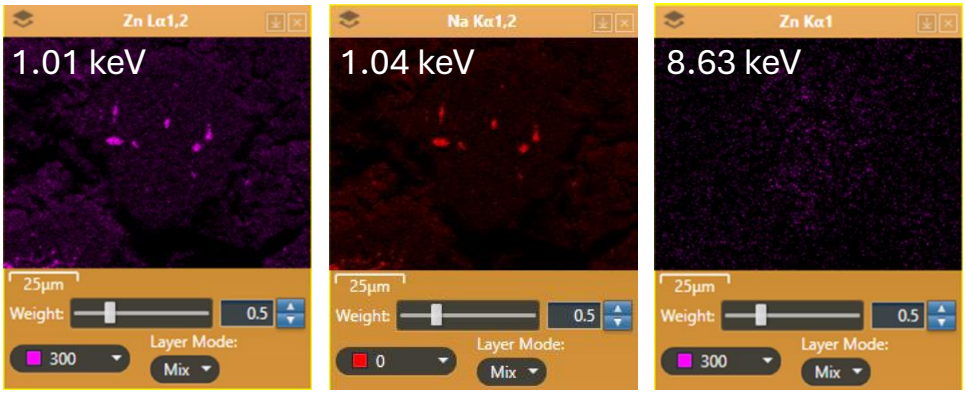


3. Include/Exclude a Map from the Layered Image
    a. Automatically: Select the *AutoLayer* icon in the **Acquisition Toolbar** 
        i. AutoLayer automatically colors and layers maps based on relative spatial and intensity relationships among the currently identified element maps
            1. Maps with insignificant signal will not be included in Layered Image
    b. Manually: Toggle the Include/Exclude map from *Layered Image* icon in the top left of each map tile
        i. Red = included  ; Gray = excluded 
    c. All included maps will be displayed in the lower left of the **Image Field**



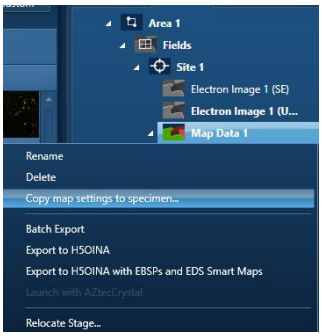
4. Display the Map of a Different Line Series (K/L/M) than the Current One
    a. This will be most useful when dealing with overlapping lower energy lines
    b. In the **Elements Field**, expand the *Selected Elements Details* tab (right)
    c. Choose the element of interest from the dropdown
    d. Select *Specify Detector* and *Line Series*/*Energy Window*
    e. From the Line Series dropdown, choose the line series to be displayed in the **Maps Field**, or restrict displayed data by entering a lower/upper energy bound
    f. Click *Update X-ray map with changes* button to apply





g. Repeat for all element maps to be updated

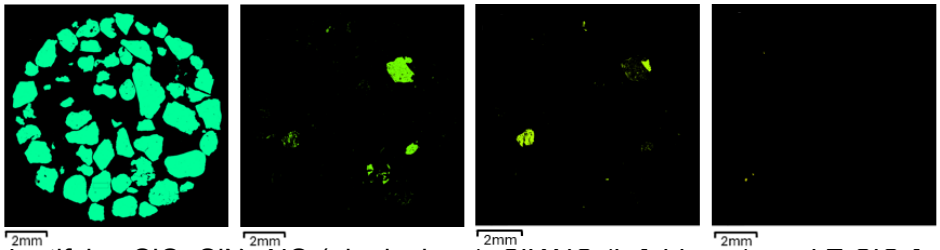
5. Copy and Paste the Map Settings (Hue/Weighting/Binning/etc.) from one Site to the Maps of all the Other Sites in the Specimen



   a. In the **Data Tree**, right-click on the Map Data # node containing the settings you want to copy
   b. Select *Copy map settings to specimen…*
      i. Start (Processing takes longer for TruMap/QuantMap)
   c. All Map Data # nodes in the Specimen will now display the same map settings as the selected node

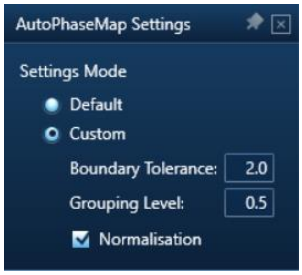
VI. Phase Mapping

1. Identify the Phases in the Sample
   a. Phase Mapping identifies unique phases at discrete areas within an EDS map based on the individual elemental spatial overlaps
   b. In **Map mode**, select the *Analyze Phases* tab in the Navigator Selector
   c. Select the Montaged area, individual EDS mapping site, or subsampled region of interest from the **Data Tree**



Phase Map identifying SiO, SiNaAlO (plagioclase), SiKAlO (k-feldspar), and ZrSiO from a sand sample

   d. The *AutoPhaseMap* settings cog allows for a Default or Custom AutoPhaseMap
      i. Default: Initiates an AutoPhaseMap with *Boundary Tolerance* of 3 and *Grouping Level* of 2 with Normalization unchecked
      ii. Custom: Users can change Boundary Tolerance and Grouping Level values and choose to Normalize the AutoPhaseMap



1. Boundary Tolerance: Controls the specificity of the grain boundary identification
   a. Lower value: larger grain boundaries – *less specific*
   b. Higher value: smaller grain boundaries – finds best fit for grain boundary pixels
2. Grouping Level: Controls the level of clustering of similar-type pixels
   a. Lower value: less clustering – *more phases*
   b. Higher value: more clustering – *fewer phases*
3. Normalization: Performs auto-brightness/contrast among different grains of similar composition but different brightness levels

a. Very useful for montaged images (see Section VII) as not every field in a montage has the same brightness/contrast levels

e. Select the *Find Phases* button to initiate the AutoPhaseMap
   i. Note: The amount of time required for AZtec to process the AutoPhaseMap *scales with map dimensions and resolution*

2. Combine two Closely Related Phase Maps
   a. Increase the *Grouping Level* in Settings and select Find Phases again to reprocess the AutoPhaseMap
   b. To avoid reprocessing, locate the map *to be merged* (not the map another map will be merged into), right click, select *Merge into…*, and select the phase from the drop down to combine this map with

VII. Montaging

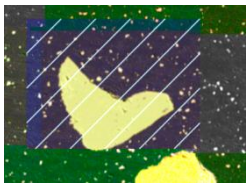
1. Copy and Paste the Settings from one Field to all the Other Fields

   THIS CAN ONLY BE DONE PRIOR TO MONTAGING THE LARGE AREA

   a. In the **Montage** tab, select the *Move and Select* tool in the **Palette Toolbar**

   b. Right click to highlight the Field of interest in the **Image Field**

   c. Select *Copy Field Settings to All Fields*

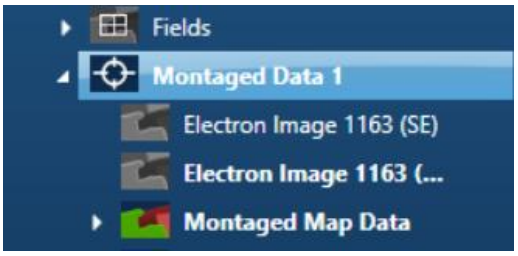
2. Align the Fields of the Large Area Map –automatic or manual

   a. Auto Align: Select the *Auto Align* button and AZtec will automatically orient maps appropriately
      i. The accuracy of Auto Align is typically based on the Overlap % used when setting up the large area map – 10% overlap is typical
   b. Manual Align: This can be done in a *Guided* (semi-manual) or fully manual manner
      i. Guided Align: Right click in the **Image Field**, select *Guided Align*, and follow the Guided Align directions – always be sure to perform an Auto Align after
         1. **Useful for very large area maps with many frames**
      ii. Manual Align: Use the *Move and Select* tool in the **Palette Toolbar** to position individual frames
         1. **More useful for large area maps containing only a few frames or for readjusting the position of a few frames within a larger area map**

3. Montage the Cartography/Large Area Maps Fields into one Image
   a. In the Montage settings cog, select the *Resolution* and *Folding* (type and value) for the Image and EDS data (and EBSD data if applicable)

b. After Manual or Auto Align has been performed, select the *Montage* button to initiate the Montaging function
   i. The individual fields will be stitched together into one large image (labeled in the Data Tree as *Montaged Data #* containing the Montaged Map Data)
   ii. This function also initiates an automatic brightness/contrast adjustment across the entire montaged image to display a more uniform brightness/contrast level throughout



VIII. Linescan

1. Reconstruct a Spectrum/Spectra from a Linescan
   a. One spectrum – In the **Palette Toolbar**, select *Reconstruct Line Point Spectrum*
      i. Select the Point # of interest in the **Linescan Field**
   b. Multiple spectra – In the **Linescan Field**, select the *Reconstruct Spectra from every point on the selected Linescan* button
      i. Choose *Binning Factor* from dropdown and click Start
   c. In the **Data Tree**, select the linescan/element node of interest
      i. Right click and select *Reconstruct Spectra from Linescan*
      ii. Choose *Binning Factor* from dropdown and click Start

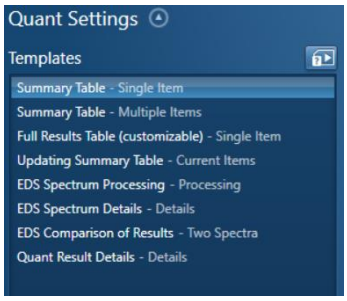
2. Extract Linescan Data from a Previously Captured Map
   a. There are several Linescan extraction tools in the **Palette Toolbar**; see Section II.2.b.ii for options
   b. Choose a linescan extraction option, click and drag in the **Image Field** to highlight a line/area/region to extract a linescan from – this initiates the extraction

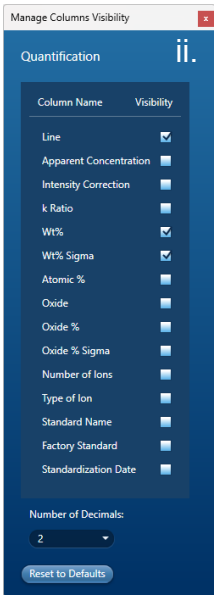
3. Make the Linescan Less Noisy
   a. The current data can be processed further
      i. In the **Linescan Field**, select a greater *Binning Factor* from the dropdown
      ii. In the Linescan Field settings cog, increase the *Smoothing factor*
   b. The current data can be reprocessed in the **Acquisition Toolbar**
      i. TruLine: Runs a peak deconvolution process in the *Line Sum Spectrum data* to reduce peak overlaps and minimize spectral background noise
      ii. QuantLine: Performs a *theoretical quantification* (using internal standards) on each linescan point to provide more accurate elemental counts

4. Edit the Format of the Data Lines in the Linescan
    a. In the Linescan Field settings cog, *Line Color* and *Line Thickness* can be formatted

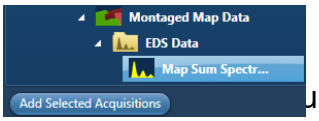
IX. Quantification

1. View Quantitative Results from the Experiment
    a. In **Point & ID** mode, go to the **Calculate Composition** tab
    b. Select the Site node(s) of interest in the **Data Tree**
    c. Under *Quant Settings>Templates*, find various Quant data display modes to view the data below in the **Quant Results View** field





        i. Summary Table (Single/Multiple Items): display data as Weight % or Atomic %



            1. For Multiple Items, highlight **Data Tree** nodes of interest and select *Add Selected Acquisitions* below
        ii. ull Results Table (customizable): Select *Edit Columns…* button in the Quant Results View to change the displayed data
        iii. Updating Summary Table: updates with newly collected data
        iv. EDS Spectrum Processing: Displays which X-ray lines were used in the quantification based on the selected *EDS quant standardization* (this can be found in the *Advanced* tab under options)
        v. EDS Comparison of Results: Provides a comparison of multiple spectra
2. Remove a Specific Element from the Quantitative Results
    a. In **Point & ID** mode, go to the **Calculate Composition** tab
    b. Under *Options*, select the *Deconvolution* tab
        i. From the dropdown, choose the element to remove and click *Add element*

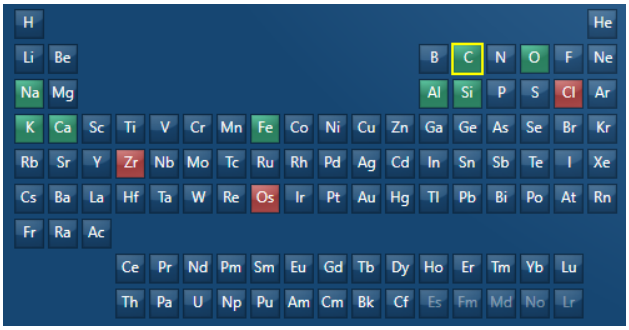
3. Make Sure there are no Residual Window Artifacts in the Spectra
    a. In **Point & ID** mode, go to the **Calculate Composition** tab
    b. Under *Options*, select the *Advanced* tab
        i. Check the *Correct for window artefacts* box

X. MiniQuant

1. Update the Elements Displayed in the MiniQuant
    a. In the **Data Tree**, select the spectrum or Site # node of interest
    b. Navigate to the **Confirm Elements** tab in **Point & ID** mode – there should be a large Spectrum Field with an Elements field below

i. Toggle individual elements by double-clicking the tile(s) to *Include* (green), *Exclude* (red), or *Clear* (blue) them from the MiniQuant and spectrum

c. Returning to any other mode displaying a Spectrum Field and MiniQuant should now show the desired elements



2. View the Results as a Relative Ratio (Bar Graph)
   a. From any Spectrum Field MiniQuant, toggle the results display button to *Display results in a chart*
3. View the Results as a Percentage (Table)
   a. From any Spectrum Field MiniQuant, toggle the results display button to *Display results as a table*

4. View the Results in Weight % or Atomic %
   a. From any Spectrum Field MiniQuant, select the settings cog
   b. In the *Result Type* dropdown, choose to display the results in Weight % or Atomic %

   Note: Ensure that *Normalize Results* is always checked in the Settings

   c. Click *Apply* to update the MiniQuant 

   Note: Weight % will display a sigma (σ) value column

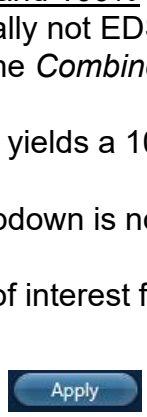
   Troubleshooting: If the Wt% or At% does not sum to 100% when normalized or displays an un-normalized total that is much less than 100%, ensure that no elements of interest have been deconvoluted

   i. In **Point & ID** mode, go to the **Calculate Composition** tab
   ii. under *Options* select the *Deconvolution* tab
   iii. Select the element of interest from the list and click *Remove element*
   iv. Return to the MiniQuant settings and toggle *Normalize Results* off and on if the values did not automatically reset

   Note: The MiniQuant can be easily found here by selecting the **Confirm Elements** tab to the left of the **Calculate Composition** tab

5. Account for Elements EDS had Difficulty Detecting (Li/U/etc.) in the Results
   a. From any Spectrum Field MiniQuant, select the settings cog

b. Toggle *All Elements* to *Element by Difference* – this option treats <u>any difference between the total Wt%/At% and 100%</u> as being due to a missing (usually not EDS detectable) element called the *Combined Element*
    i. This option **ALWAYS** yields a 100% total Wt%/At%
c. The *Combined Element* dropdown is now selectable
    i. Choose the element of interest from the dropdown
d. Click *Apply* to update the MiniQuant



Note: Weight % will display a sigma (σ) value column

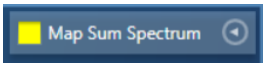
6. View the Results Stoichiometrically (C or O)
    a. From any Spectrum Field MiniQuant, select the settings cog
    b. Toggle *All Elements* to *Element by Stoichiometry* – this option treats the results as though the *Combined Element* <u>is bound stoichiometrically to *every other element analyzed*</u>
    c. The Combined Element dropdown is now selectable
        i. Carbon and Oxygen are the only available stoichiometric elements

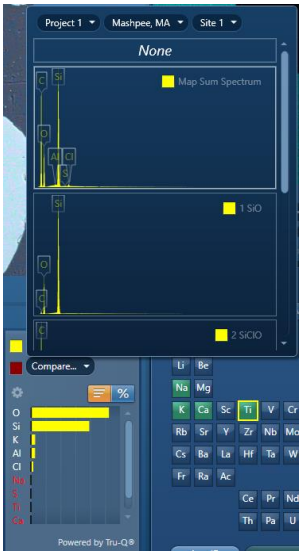
Note: Ensure that *Normalize Results* is always checked in the Settings

d. In the *Result Type* dropdown, there is now an Oxide % option (if Oxygen is selected as the Combined Element)
    i. Oxide % displays the results in the MiniQuant as a percentage of each element <u>relative to its Oxygen bonding</u>
e. Click *Apply* to update the MiniQuant

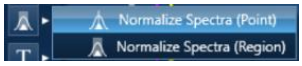
Note: Oxide % will display a sigma (σ) value column

7. Compare Multiple Spectra
    b. Multiple Spectra can be compared from within the *MiniQuant* in any **Spectrum Field** or from the **Compare Spectra** module in **Point & ID** mode
        i. To open the MiniQuant, expand the *Map Sum Spectrum* box in the top right corner of the **Spectrum Field**

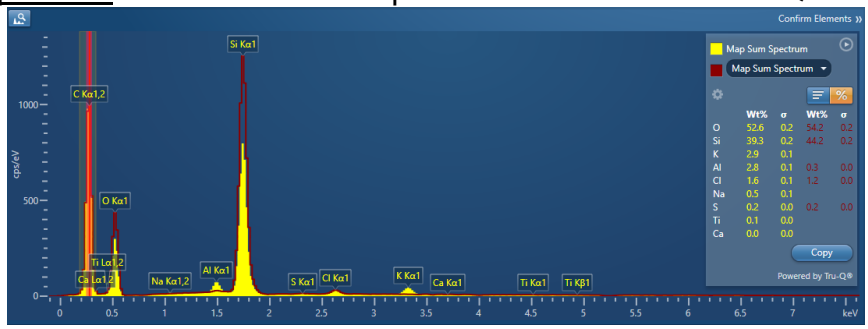




        ii. In the *Selected comparison spectrum dropdown* (red box), choose any spectrum collected in the current Project, from any Sample, and from any Site to compare to the currently displayed spectrum
        iii. A red outline of the selected spectrum will be *overlayed on the current spectrum*
            1. The yellow spectrum will be the spectrum selected in the **Data Tree**
            2. The red spectrum outline will be the spectrum chosen in the **MiniQuant**



        iv. It will be a good idea here to *Normalize* the spectra – typically against a bulk material such as C or Si



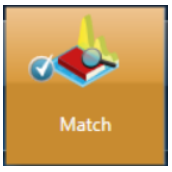
8. Compare the Spectral Results to a Known (Mineral) Standard
    a. Navigate to the **Confirm Elements** tab in **Point & ID**
    b. In the MiniQuant settings cog, check the *Match* box and select the Database to use
        i. The pre-set database is called *Minerals-Factory* – a database containing 101 of the most common minerals
    c. Click *Apply* to update the MiniQuant

    d. The MiniQuant will now show a database comparison dropdown (green square) beneath the spectrum comparison dropdown
        i. The database comparison gives the top 3 closest spectral matches from the database
        ii. The color-coded circles to the right of the matches indicate the strength of the match

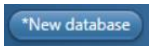
1. Green – Good match
2. Yellow – OK match
3. Red – Bad match

Note: Not every Database search results in 1 green, 1 yellow, and 1 red match – **<u>any combination is possible</u>**

9. Compare the Spectral Results to a Known (Custom) Standard



   a. Databases can be accessed through the *Match* tab in **Optimize** mode
      i. Database entries can be viewed in either Wt% or At%
   b. Create a new Custom Database by selecting **New database*



      i. Input a Name and a Description and click Save
   c. To add spectra to a new database, select the spectrum of interest and navigate to the **Confirm Elements** tab in **Point & ID** mode – ***<u>this cannot be done from the Spectrum Field in the Construct Maps tab in Map mode</u>***
      i. Right click in the **Spectrum Field** and select *Add to Match Library…*
      ii. In the pop-up, select the Database to save the spectrum to and provide a Name for the entry
      iii. Click Save
      iv. Repeat for any additional spectra to be added to the Custom Database
   d. To compare a newly acquired spectrum to a Custom Database, open the settings cog of the MiniQuant on the Confirm Elements tab
   e. Check the *Match* box and select the custom database to compare to
   f. Click *Apply* to update the MiniQuant

   g. The MiniQuant will now show a custom database comparison dropdown (green box) beneath the spectrum comparison dropdown
      i. The database comparison gives the <u>top 3 closest spectral matches</u> from the custom database
      ii. The color-coded circles to the right of the matches indicate the <u>strength of the match</u>
         1. Green – Good match
         2. Yellow – OK match
         3. Red – Bad match

Note: Not every Database search results in 1 green, 1 yellow, and 1 red match – **<u>any combination is possible</u>**

XI. Exporting

1. Save the Image Currently on the Screen
   a. Quick Export – Right click the image in the **Image Field**, select *Export Data Only*

b. Full Export – Right click the image in the **Image Field**, select Export>Settings, in the pop-up check the *Use Original Resolution* box, and Save As
    i. The Export>Settings can also be used to customize various aspects the exported image displays – it's best to adjust these settings prior to running a Batch Export
    ii. Note: The Quick Export Settings can be set here as well by selecting *Use Above Settings* in the *Quick Export Options* dropdown
c. Within the **Data Tree**, images can be saved/exported via a…
    i. Right click on the Map node > Export Map Data Values (.csv file)
    ii. Right click on the Image node > Export Data Only (image file)
    iii. Right click on the Image node > Save As
    iv. Right click on the Site # node > Batch Export > for Images, select the Image Type, Site #(s), and Export Folder > Click Start
        1. This will export all images found within the Site(s) selected
        2. Note: Check the *Use Image Export Settings* box to use the Export>Settings configuration from 1.b.

2. Save the Spectrum Currently on the Screen
    a. Right click in the **Spectrum Field** and select *Export*
        i. Selecting EMSA will output a .txt file of the spectrum
        ii. Select Save As to save an image file or open the Settings to customize various aspects the exported spectrum image displays
        iii. Higher resolution spectra can be automatically saved via the Point and ID > Confirm Elements tab – the dimension of the exported spectra rely on the dimensions of the displayed spectra within the software unless changes are made in the Export>Settings menu
    b. In the **Data Tree**, right click the Spectrum node and select Save As to save an image file

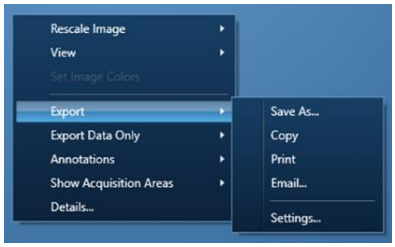
3. Save the Map(s) Currently on the Screen
    a. Quick Export – Right click a map in the **Maps Field** and Select *Export Data Only*
        i. Maps can be saved as .tiff files (image) or .csv/.tsv files (excel data points)
    b. Full Export – Right click a map in the **Maps Field** and Select Export>Settings, in the pop-up check the *Use Original Resolution* box, and Save As
        i. The Export>Settings can also be used to customize various aspects the exported map displays – it's best to adjust these settings prior to running a Batch Export
        ii. Note: The Quick Export Settings can be set here as well by selecting *Use Above Settings* in the *Quick Export Options* dropdown
    c. In the **Data Tree**, maps can be saved/exported via a…
        i. Right click on the Map node > Export Map Data Values (.csv file)
        ii. Right click on the Map node > Export Data Only (image file)
        iii. Right click on the Map node > Save As

iv. Right click on the Site # node > Batch Export > for EDS Maps, select the Image Type, Site #(s), and Export Folder > Click Start
    1. This will export all images found within the Site(s) selected
    2. Note: Check the *Use Image Export Settings* box to use the Export>Settings configuration from 3.b.

4. Save the Linescan(s) Currently on the Screen
    a. Right Click the **Linescan Field** and select *Export*
        i. *TSV or CSV* saves .csv/.tsv files (excel data points)
        ii. Save As saves an image file
        iii. Settings > Save As saves an image file that can be resized
    b. In the **Data Tree**, save Linescans via a…
        i. Right click on the individual element Linescan node(s) > Export Linescan Data Values (.csv file)
        ii. Right click on the Site # node > Batch Export > for Linescans, select the Format, Site #(s), and Export Folder > Start
            1. This will export all images found within the Site(s) selected

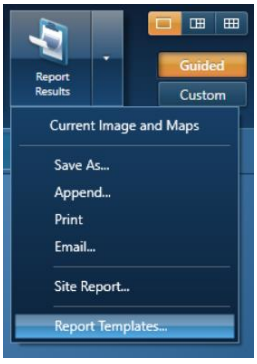
5. Save the Live Trace Image
    a. In the **Data Tree**, Right click the Live Trace line > Save As

Note: Additional modes to save Images/Spectra/Maps/ Linescans/etc. can be found in the Right click > Export dropdown menu



    a. Copy will copy the Image/Spectrum/Map/Linescan to the computer's clipboard
    b. Print will begin printing to a ***previously set up printer*** – change printer setup in Export>Settings
    c. Email… opens an email dialogue with the media attached as a .png file

XII. Reporting

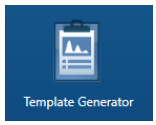


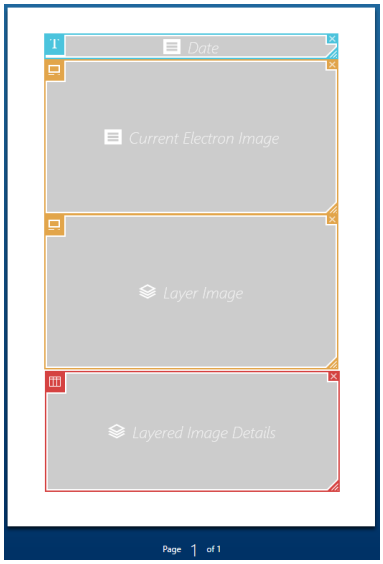
1. Generate an AZtec Report File
    a. In the **Data Tree**, select an element in the node of interest
    b. At the very right of the **Navigator Selector**, click the dropdown arrow on the **Report Results** button and select *Report Templates…*
        i. Filter the templates on the left to find the best template for your data – you will see a preview below
        ii. Select Save As…
        iii. The file will <u>automatically open</u> in a Word or Excel document (depending on the template used)
    c. To add additional data from the project to this report file:
        i. Leave the initial Word/Excel document <u>OPEN</u>

ii. Repeat steps a. through b.i.
iii. Select *Append…* (Note: <u>*Selecting* Save As… *again here will generate a new Word/Excel file*</u>)
iv. Repeat until all desired data is in the report file then save the Word/Excel document

d. All reports generated through AZtec will be saved to a *reports* folder in the AZtec Project folder unless specified otherwise

2. Generate a Custom AZtec Report File
   a. In the **Data Tree**, select an element in the node of interest
   b. At the very right of the **Navigator Selector**, click the dropdown arrow on the **Report Results** button and select *Report Templates…*





i. Under the Report Templates Filters, click the *Template Generator* icon
ii. Build a Custom Report Template
   1. Give the Template a unique *Title*
   2. Choose the Technique this template falls under – EDS or EBSD
   3. Choose a *Category* or *Categories* this report template falls into – these will be used as filters to easily locate the Template later
   4. Choose *Paper Size* and Report *Orientation*
   5. Select individual *Components* to add to the Template – a field will populate on the preview workspace to the right
      a. Click and drag a Component to move its positioning
      b. Right Click the Component to *Right/Center/Left Justify*, *Maximize Width or Height* on the page, or include that Component on <u>every page</u> of the Report
   6. Select the *Add New Page* or *Remove Current Page* buttons to add or remove pages from the report

   7. At the top left of the window click *Generate* to publish the report – the Custom Report Template will now appear in the list of Report Templates

3. Report the Image(s)/Map(s) in a Higher Image Quality
   a. At the top of the screen, select **Tools > Preferences…**
   b. Select the *Reports* tab
      i. Set the *Report Image Scaling (Pixels Per Inch):* dropdown to desired pixel density – <u>500 PPI is publication quality</u>

4. Report only a few of the Acquisition Areas Displayed in the Image Field, not All
    a. Right click in the **Image Field**
    b. Under *Show Acquisition Areas*, choose *Show Selected*
    c. In the **Data Tree**, hold CTRL or Shift and select the desired spectra
    d. Generating an AZtec report will only report on the selected spectra
5. Batch Report Multiple Sites at Once
    a. The Batch Reporting Template must be set prior to executing a Batch Report
        i. At the top of the screen, select **Tools > Preferences…**
        ii. Select the *Reports* tab
            1. Near the bottom of the menu under *Other Templates*, set the Batch Template drop down to the desired Reporting layout and format
    b. In the **Data Tree**, hold CTRL or Shift and select the desired Site #(s)
    c. Right Click one of the highlighted Sites and select *Batch Report…*
        i. Choose a folder to save the Reports to and click *Select Folder* – this will initiate the Batch Reporting function