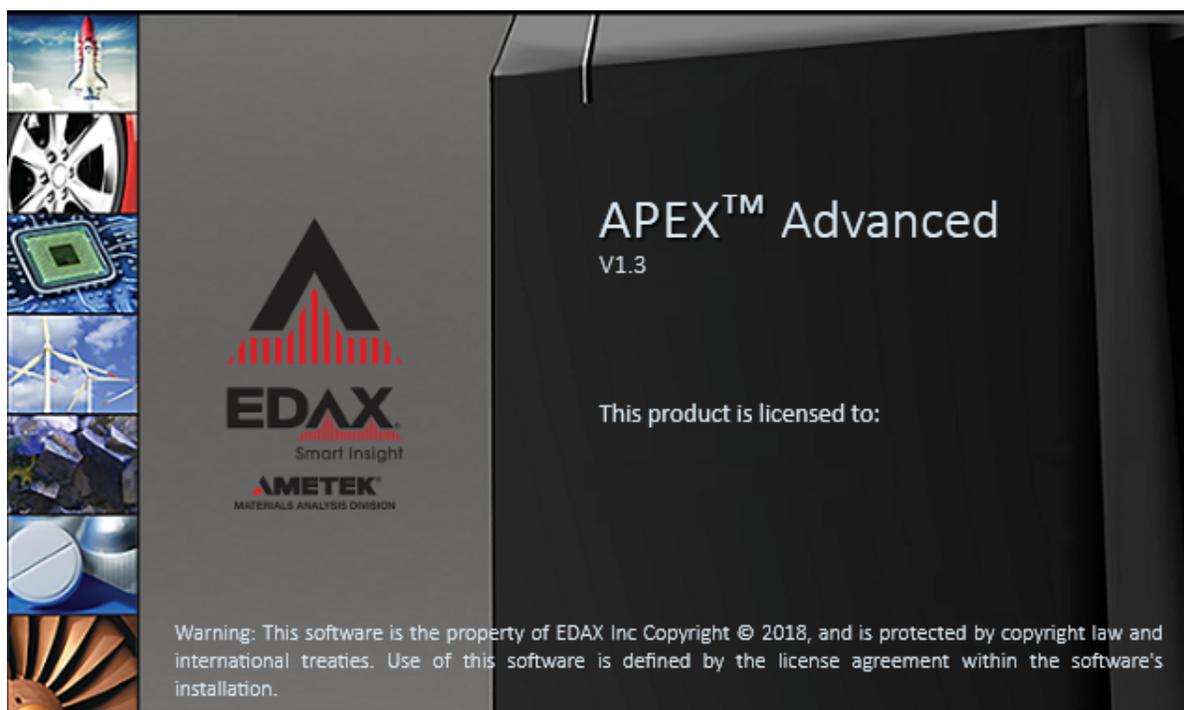


APEX™ User Manual



EDAX Inc.
Ametek Materials Analysis Division

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Chapter 1

Introduction to APEX™

1.1 Launching APEX™

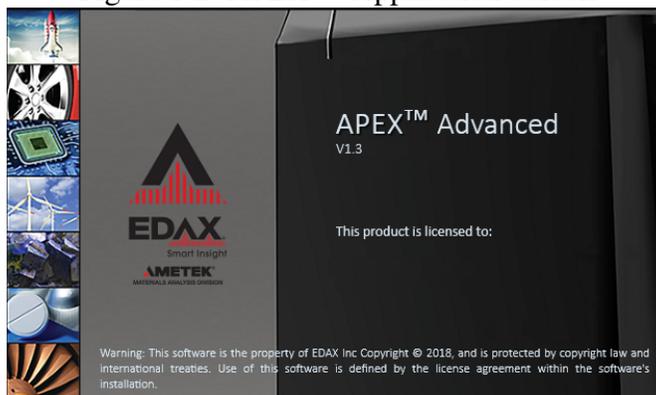
From the windows desktop double click on the APEX™ application icon to start the software (shown in figure 1.1).

Figure 1.1: The APEX™ Icon



The application splash screen will start and display the EDAX License information as shown in figure 1.1. The progress of the software loading is shown by the blue dots traversing across the window below the license information.

Figure 1.2: APEX™ Application Screen



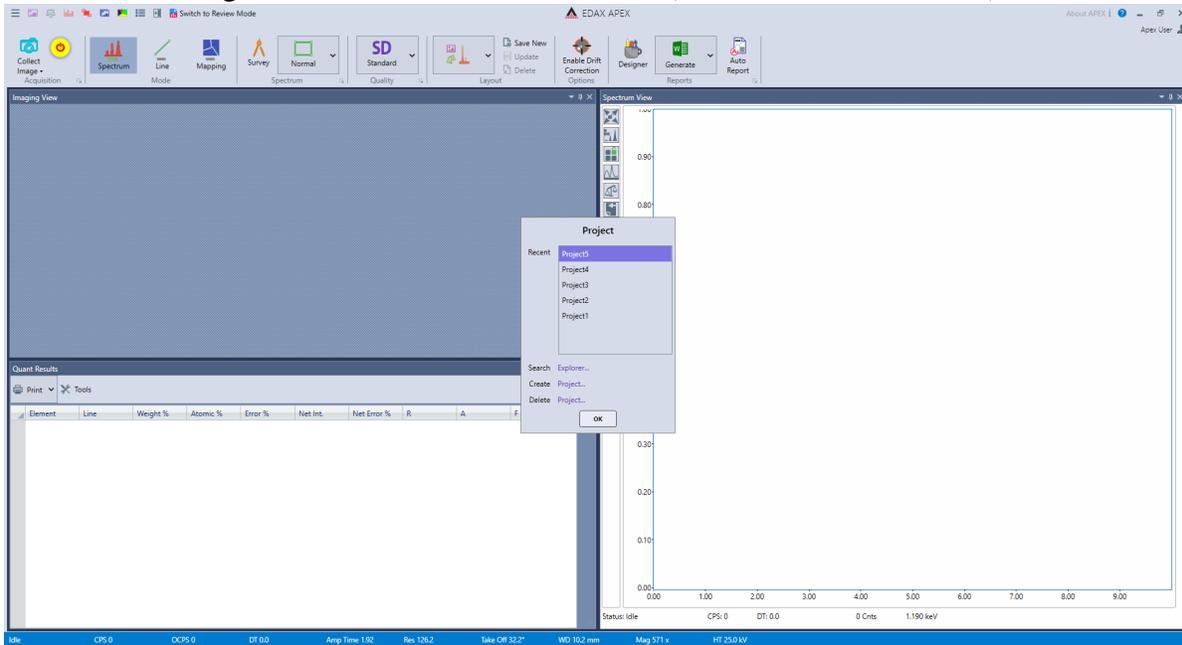
When the application is ready the startup window shown in figure 1.3 will be displayed where an existing project can be selected to review or examine data, or a new project can be created.

To create a new project, click **Create** → **Project** Then, the project can be named or left as the default: **”New Project,”** then click **OK**.

For detector types other than EDAX Element, the cooling must be turned on by clicking the **Cooling On** icon on the **Collection Toolbar** (see section 1.3 on page 4).

1.2. LAYOUT OVERVIEW

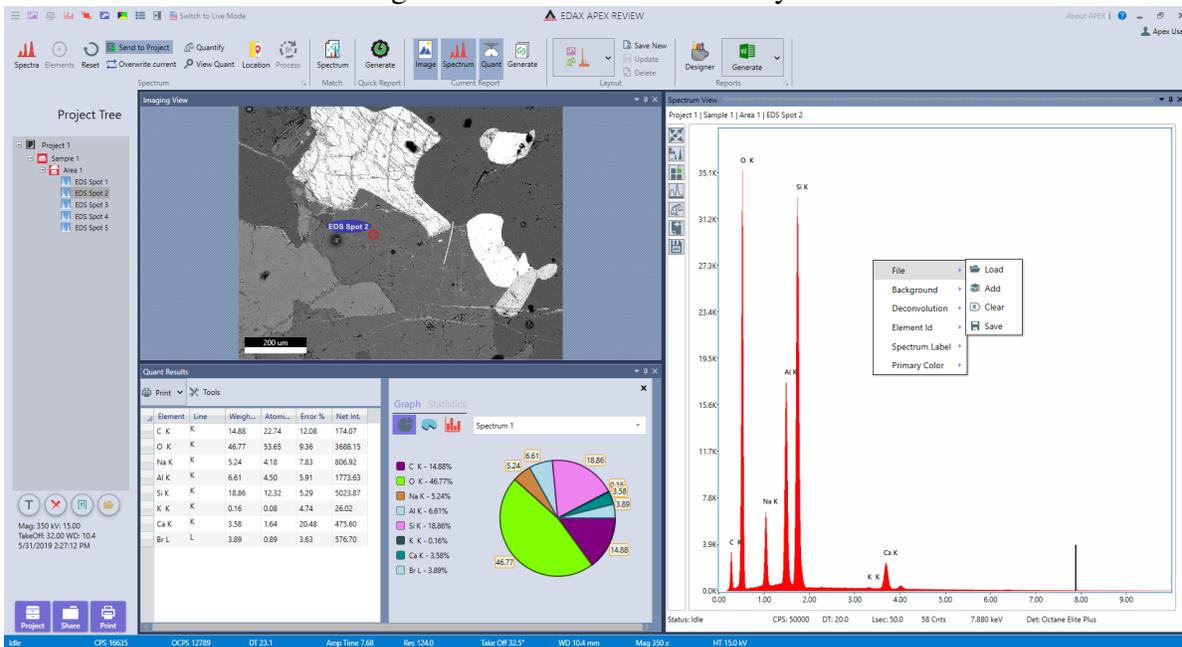
Figure 1.3: APEX™ Launch Screen (Live Collection Window)



1.2 Layout Overview

The title of the window displays which mode APEX™ is in. It has two states: a live collection window and a review window. **EDAX APEX™** is the data collection window, while **EDAX APEX™ Review** is where you can review all types of data and produce reports.

Figure 1.4: APEX™ Review Layout



- One of the many powerful features of the APEX™ is the two windows in which you can collect and review data *simultaneously*.

- Users can choose from the preset layouts or create custom layouts using the **Layout Toolbar**.

Preset Layout Options

APEX 1.5 gives users the option of choosing from multiple layouts for each mode i.e. Spectrum, Line Scan or Mapping.

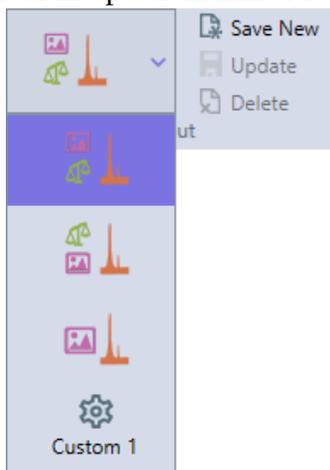
Preset Layouts Spectrum/Line Scan Mode:

- **Layout 1:** Image top left, quant bottom left, spectrum right half.
- **Layout 2:** Quant top left, image bottom left, spectrum right half.
- **Layout 3:** Image left half, spectrum right half.

Preset Layouts Mapping Mode:

- **Layout 1:** Image top left, spectrum top right, multi-map bottom.
- **Layout 2:** Spectrum top left, image bottom left, multi-map right half.
- **Layout 3:** Multi-map top, image bottom left, spectrum bottom right.
- **Layout 4:** Spectrum top, image bottom left, multi-map bottom right.
- **Layout 5:** Spectrum top left, multi-map top right, image bottom left, phase map bottom right.
- **Layout 6:** Spectrum top left, image bottom left, phase map right half.

Figure 1.5: Expanded Layout Toolbar in Spectrum/Line Mode (left) and Mapping mode (right)



Multiple Custom Layouts

APEX 1.5 allows a user to create and save up to 5 layouts per mode. This means a user has the option of saving up to 15 layouts on the live side and 15 layouts on the review side.

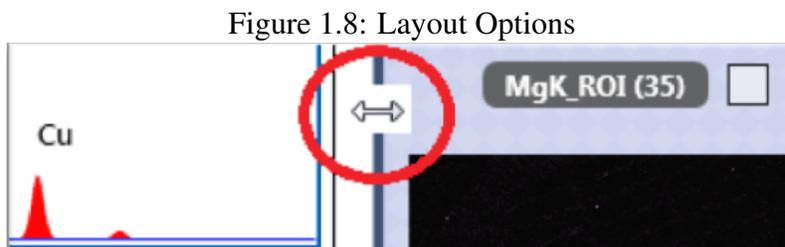
- **Creating a Custom Layout:** To create a new custom layout just arrange the layout the way that is desired and click the **Save New** button. You can save a maximum of 5 custom layouts per mode.
- **Updating a Custom Layout:** A custom layout can be updated to save any new arrangement that is desired just by clicking the **Update** button.
- **Deleting a Custom Layout:** To delete a custom layout all that is needed is to select the custom layout and click the **Delete** button. The current layout will revert to the first layout in the layout combo box.

Figure 1.6 shows a new custom layout selected in APEX Reviews Spectrum mode. Once the layout is saved it will be selected and a new Custom Layout Icon appears in layout the combo box. The Update and Delete buttons become active when a custom layout is selected. You can see a thumbnail tooltip of a custom layout by hovering over it with the mouse (See Figure ??).

Figure 1.6: Custom Layout

Figure 1.7: Custom Layout with a Thumbnail Preview

To fine tune the layout of windows, move the mouse pointer over the splitter sections (see red circle in figure 1.8) between windows to change the size of each of the windows. The individual windows can also be detached from the general user interface by clicking and dragging in the header bar of the window. The detached windows can re-arranged independently of other windows, moved to secondary monitors, or be re-docked by moving to an edge in the user interface or hovering over one of the dock icons that show up when moving the window.



1.3 Icons

Title Bar Toolbar

The title bar toolbar shown in figure 1.9 allows the user to show or hide different view panels in order to easily view spectra, quant, and mapping results. As APEX™ can display live quant results while data is collecting, these icons are especially useful.

Figure 1.9: The Title Bar Toolbar



Collection Toolbar

Below the title bar toolbar is the collection toolbar (figure 1.10) which enables users to set up data collection easily: moving from left to right across the top of the page. The icon next to the **Image Collection** icon will be **Detector Cooling** if detector is not ready, and be replaced by the **Data Collection Start/Stop** icon once detector is ready.

Description of the title bar icons:

Show/Hide the APEX™ Project Tree Panel



Show/Hide the Image Panel



Show/Hide the Quantification Panel



Show/Hide the MultiMap X-ray Panel



Show/Hide the Spectrum View Panel



Show/Hide the Multifield Scan Table



Show/Hide the Advanced View Panel



Switch from Collection to Review Mode

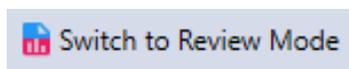
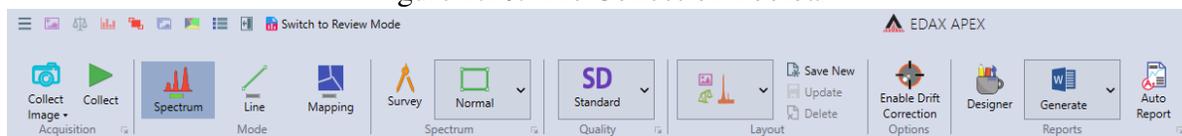
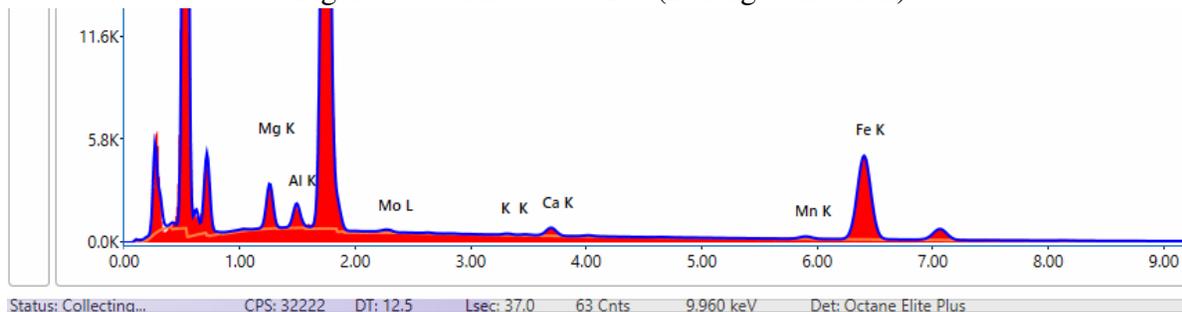


Figure 1.10: The Collection Toolbar

**Status Bar**

The Status Bar is located at the bottom of the Spectrum View window. It displays what task the detector is completing and how far along the task is via a progress bar. It also displays important information about the collection settings and conditions.

Figure 1.11: The Status Bar (During Collection)



- There are three possible status displayed: **Collecting**, **Idle**, and **Identifying Elements**. There is also a progress bar behind the text that shows the progression of spectrum collection. There are four different colors used for the status bar, indicating the status of the software. The bar is **blue** when the software is idle, **orange** when data is collecting, **purple** when an image is collecting, and **red** if there is a network communication problem.

Description of the collection icons:

The Image Collection Icon



The Detector Cooling Icon



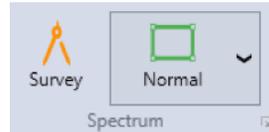
The Data Collection Start/ Stop Icon



The Collection Mode Icons



The Spectrum Mode Icons



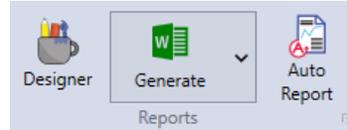
The Collection Quality Icon



The Drift Correction Icon



The Report Generation Icons



The Auto Report Icon



Collection Conditions:

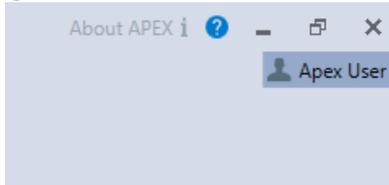
The display of the status bar can be customized in **User Preferences** (see section 1.4).

- **CPS** : The EDS Detector total counts per second.
- **DT** : The Dead Time percentage (updated once per second).
- **Lsec**: The live time (in seconds) for the current spectrum.
- **Cnts**: The intensity (in counts) at the energy cursor position.
- **keV**: The energy (in keV) at the energy cursor position.
- **Det**: The model type of the EDS Detector.

1.4 User Profile Preferences

The user profile preferences allows users to customize the display and storage options to best meet their needs. To access the user profile menu, click the **User Profile Icon** in the top right on the screen. This will pull up the **User Preferences** tab, pictured below. The display and storage options are described below. The **User Account** tab enables a user *First Name* and *Last Name* to be entered for the account (see Figure 1.14). This name will be used for reports. The **User Name** is automatically set to ApexData. For more information on data backup and handling settings, see section 6.1 on page 77.

Figure 1.12: The User Profile Icon



- **Application Logo**→**Change or Clear**: The Application Logo → Change icon allows the user to specify an image that will be used as the application logo. This logo will be displayed in the top right of the APEX™ window and will appear on all reports. To upload an image, click **Change** and select a file. To remove the current image, click **Clear**.
- **Language**: There are eight language choices for APEX™: English, Chinese, Czech, French, German, Japanese, Russian, and Turkish. Use the drop down menu to select a language. After setting a new language, restart the APEX™ software to see the new language in effect.
- **Automatic detector shutdown after inactivity**: Checking this box will shut down detector automatically after inactivity.
- **Status Bar Item Selection**: This icon allows the user to customize the parameters shown in the *Status Bar* on the bottom of the screen. Clicking the **Select** icon brings up a pop-up window in which parameters can be selected. To select a parameter, click the check-box next to it. To remove a parameter, deselect the check-box. For more about the status bar, see section 1.3 on page 5.
- **Custom Image Folder Location**: This setting allows the user to define the folder to which images and graphics will be saved to when using the *Send to Folder* option. To select a folder, click on the ... on the right of the current folder path and select a new folder.
- **Default Image Type**: This drop-down selection allows the user to select from four different graphic file types to save images as: BMP, PNG, TIFF, or JPEG.

Figure 1.13: The User Profile Selection Window

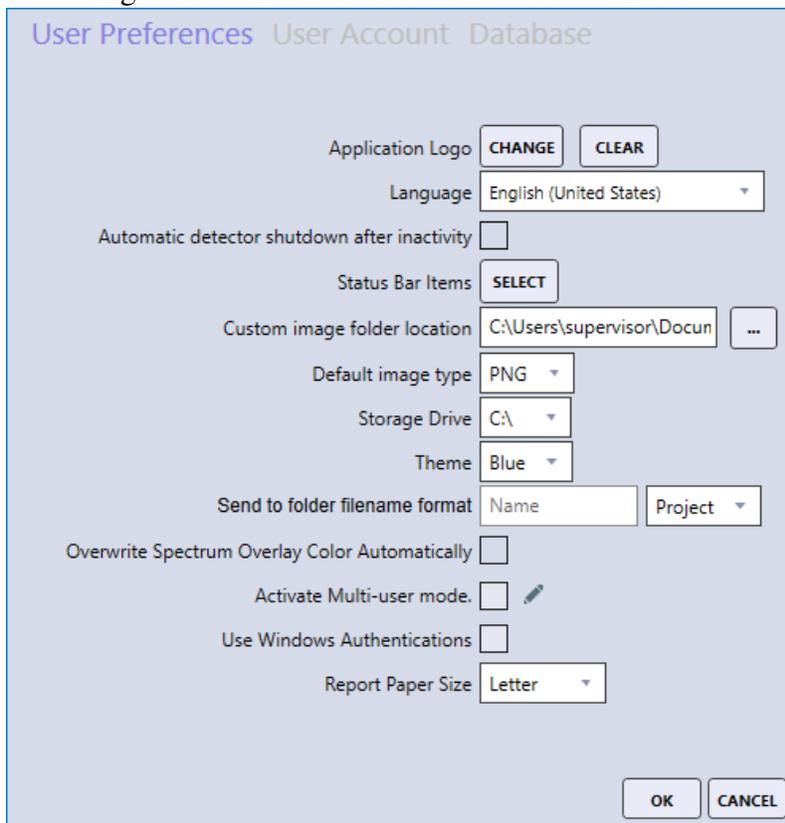


Figure 1.14: Change User Account Window

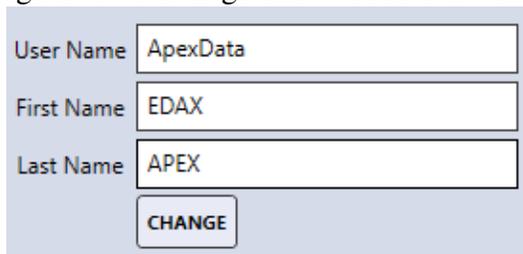


Figure 1.15: Language Drop Down Menu



Figure 1.16: Status Bar Items

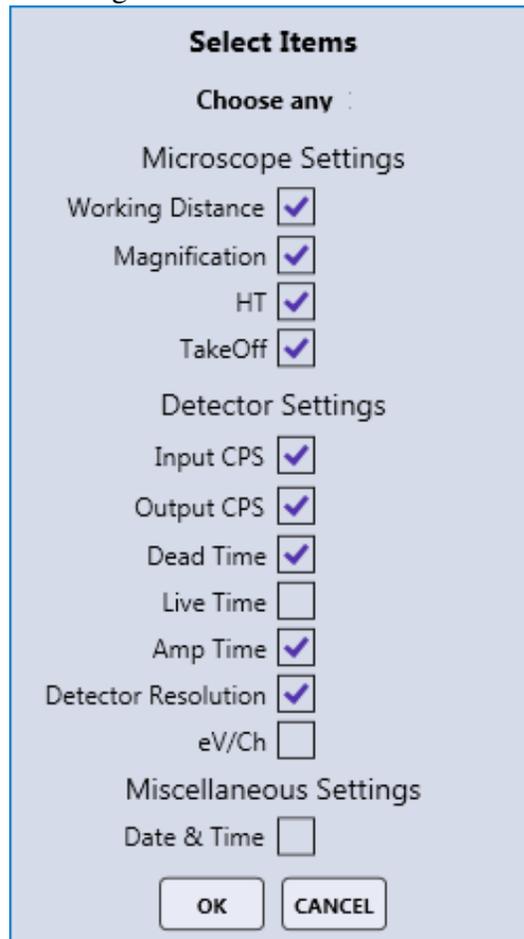


Figure 1.17: Image Folder and Image Type Selection

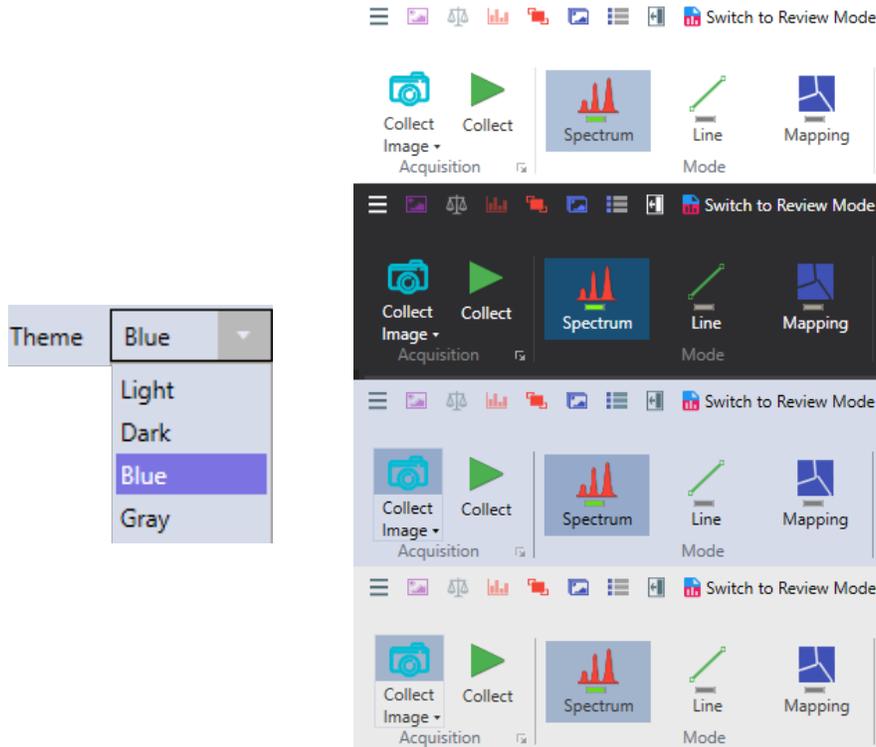


Figure 1.18: Storage Drive Selection



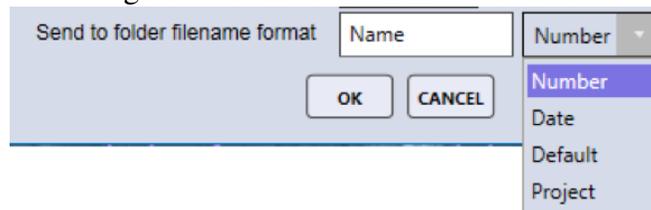
- **Storage Drive:** This selection is to define where the APEX raw data (*Spectrum, Linescan, and Maps*) are saved. Typically, this is the C drive but other internal hard drive locations can be used.
- **Theme:** The APEX™ application supports four different color themes for the entire software display. The use of themes is based on personal preference and APEX™ must be restarted in order for a new theme to take effect.

Figure 1.19: Theme Selection and Color Schemes



- **Send to Folder Filename Format:** APEX™ allows for the precise naming of the files that are created via the *Send to Folder* method. The *Name* text field can be used to define a file name, followed by either a number, date, date-time stamp (default) or project, selected via the drop-down menu.

Figure 1.20: Send to Folder File name



- **Overwrite Spectrum Overlay Color Automatically:** Overwrites default spectrum overlay colors. See section 3.3.4 on page 49 for more information.
- **Activate Multi-user Mode:** Enables/Disables multi-user mode. See section 1.7 on page 15 for more information.
- **Use Windows Authentications:** With **Use Windows Authentications** checkbox checked, the login used for the Windows Operating system is exactly what is required by the APEX software.

See Section 1.8 on page 18 for more information.

- **Report Paper Size:** Chooses between Letter and A4 for the report paper size.

1.5 Project Tree Panel

Projects, samples, and data automatically appear in the **project tree panel**. It is an easy way to look through data and images. Each time a new sample is loaded, a new image is collected, and new spectra are collected, a new branch is created on the project tree. To open the project tree, use the project tree icon in the title bar. To close the project tree, click the project tree icon again or the ← next to the words **Project Tree**. Double click on a Spectrum node, such as *Full Area 1*, and it will be displayed. Each node type has a different icon, being a spectrum, linescan and a Map. The tree is organized with the main node being the project followed by the sample node, the image node, and the data node. Right clicking on a given project node gives an **Open Folder** dialog box. Clicking **Open Folder** will open a Windows Explorer window in the location of the raw data.

Warning: *Do not rename, delete, or move the data using Windows Explorer as this can result in data loss. Use APEX™ data management options instead.*

Figure 1.21: The Project Tree Panel



Project Tree Function Icons

Directly below the project tree nodes are 4 function buttons:

Figure 1.22: The Project Tree Function Icons



- Click on the **T** icon to rename a node on the project tree.
- Click on the **Garbage Bin** icon to remove a node on the project tree.
- Click on the **Blue Open door** icon to reload the data from the current node.
- Click on the **Folder** icon to view the contents of the *Custom Image* folder.

When collecting spectral data, each type of area is named by the collection method used. **Full Area** is the total image area, **Spot** means the beam was not rastered at all and data was collected in one precise

location, **Selected Area** means a portion of the total image area is selected for collection, and **Free Draw** means a custom, hand drawn area was defined via the free draw function. The number at the end indicates the sequence number of the collection.

For example: if you collect three spot locations you would have EDS Spot 1, EDS Spot 2 and EDS Spot 3.

Project, Sample, Share, and Print Icons

In the bottom left corner of the project tree panel, there are four icons labeled: project, sample, share, and print. *For information on the share icon, see section 6.1 on page 77.*

Figure 1.23: Project, Sample, Share, and Print Icons

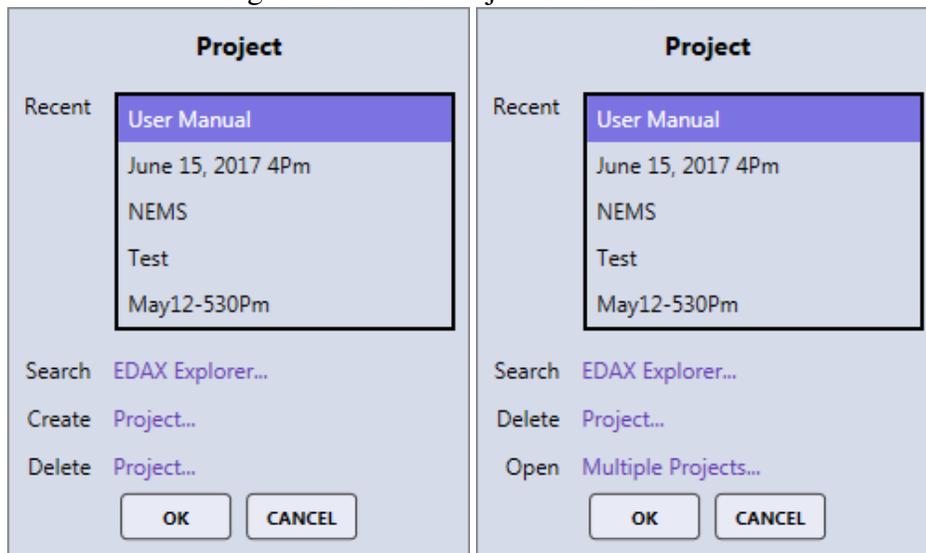


Note: These icons are only visible when the project tree panel is open.

The Project Icon:

Clicking on the project button displays the project selection window below. When in collection mode, the window on the left is displayed. When in review mode, the window on the right is displayed.

Figure 1.24: The Project Icon Windows

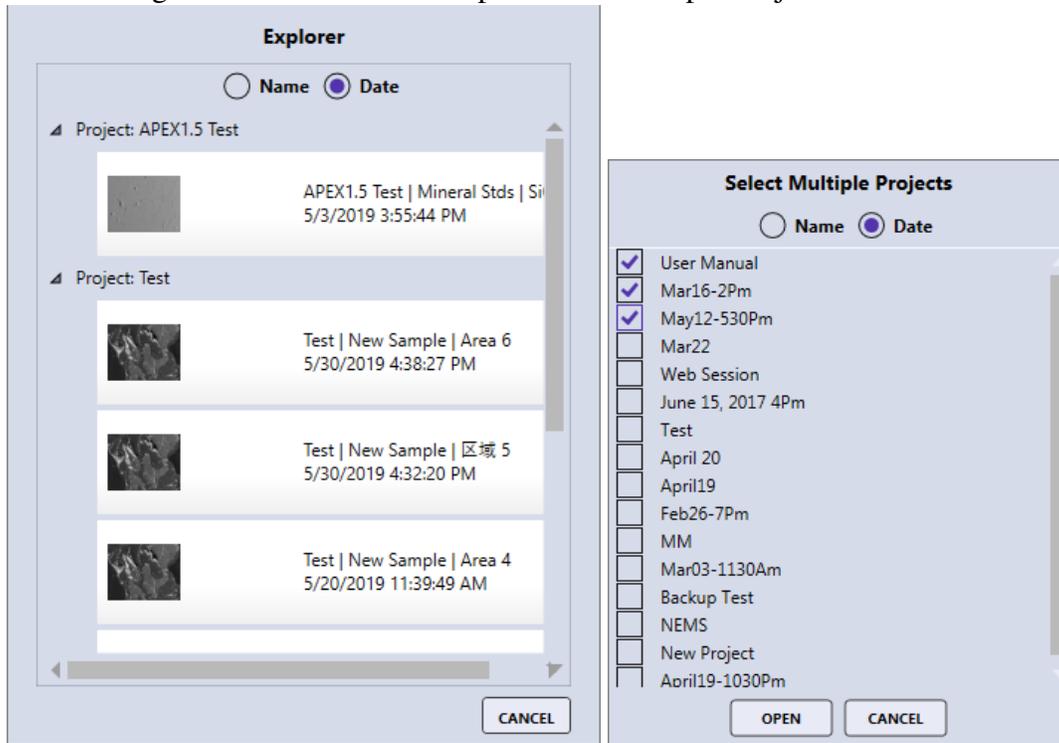


The project window shows the five most recent projects followed by:

- **Search:** Opens a window with the list of all projects on the system. The projects can be sorted by name or by last accessed date, to view the images associated with the data, click on the arrow by the project name.

- **Create:** Creates a new project.
- **Delete:** Opens a window where a saved project can be deleted. To review the selected project, click on the **Open** button. The images from the projects are displayed to remind the user of the contents of the project.
- **Open: Multiple Projects:** When in review mode multiple projects can be opened and loaded to the project tree.

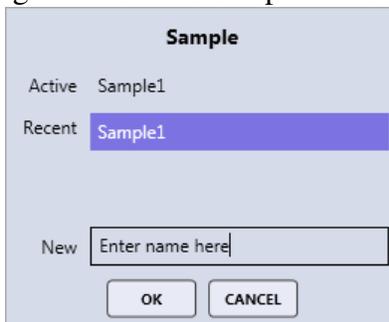
Figure 1.25: The EDAX Explorer and Multiple Project Windows



The Sample Icon:

The sample icon displays the sample selection window. To open an existing sample, double click on the sample in the list. To create a new sample, click on the *New* text-box and enter a name for the new sample.

Figure 1.26: The Sample Window



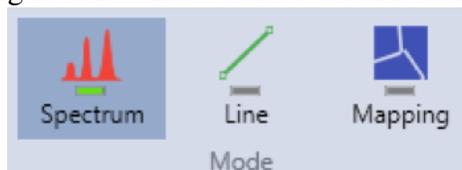
The Print Icon:

The print icon outputs a screen capture of the entire APEX™ window to the printer. To print specific portions of the screen (i.e. the image, spectrum, or quant results) save the item to the custom folder and then open to print.

1.6 Collection Modes

There are three main modes for collection in APEX™: spectrum, linescan, and X-ray map. These modes are used to achieve different types of data sets, depending on the nature of the user's work.

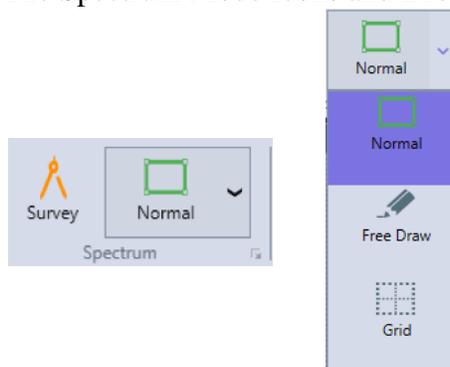
Figure 1.27: The Collection Mode Icons



Spectrum

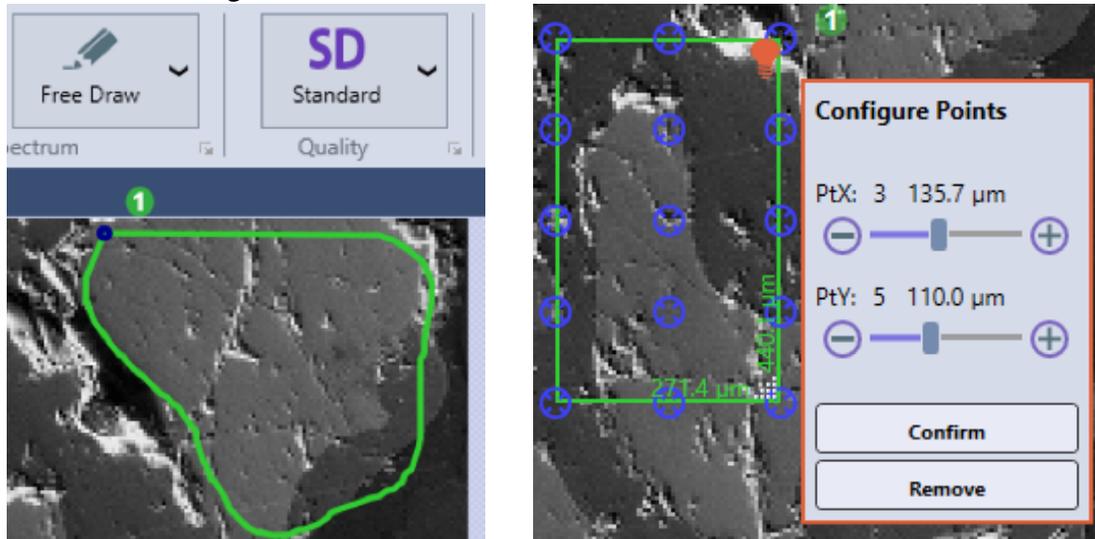
The spectrum mode collects a spectrum of the selected area for a period of time, set by the user. There are two options for spectrum collection: **Survey** and **Normal**.

Figure 1.28: The Spectrum Mode Icons and Drop-down Menu



- When in **Survey Mode** a spectrum collection will start as soon as a point or area is selected in the SEM image. Selection a new point or area will restart the acquisition making it easy to click around in the image and identify features of interest. It is a good, quick way to get an overview of what materials are in a specimen, but **the spectrum will not be saved after collection.**
- The **Normal Mode** has three different settings: normal, free draw, and grid:
 - **Normal:** Allows the user to define analysis locations individually.
 - **Free Draw:** The free draw mode allows to the user to draw any shape onto the image area for analysis.
 - **Grid:** Allows the user to define a matrix of equidistant points for which the spectra will be collected sequentially.

Figure 1.29: The Free Draw and Grid Collection Modes



Linescan

Linescan mode collects a spectrum across a line defined by the user. This mode is especially useful for determining compositional profiles or gradients within the specimen.

X-Ray Map

The X-ray map mode collects spectra for each individual pixel over an entire area, creating a detailed, color-coded image of the specimen's composition. This process takes much longer than collecting a spectrum but provides very useful, in-depth data.

1.7 Multi-user Mode

To activate the multi-user mode for Apex, open up the user preferences dialog window by clicking on the user profile icon on the top right of the screen (see section 1.4). The Activate Multi-user mode checkbox is disabled by default, click on the pencil icon to open up the password dialog box to enable this control (see Figure 1.30). The password for this control is Apex Administrator password or special password. After entering the correct password and pressing login, the checkbox will become enabled and this box can be checked to activate multi-user mode (see Figure 1.31). The next time APEX starts up, a login dialog box will prompt (see Figure 1.32).

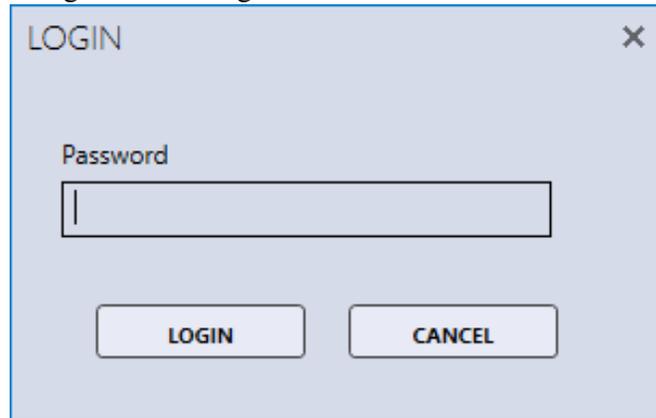
Disabling Multi-user Mode

Disabling Multi-user mode while logged in with a normal user will require the administrator password or the special password to enable the disabled checked boxes. To enter the administrator password, click on the pencil icon and the password dialog box will appear. A password is not required to disable Multi-user mode whenever the Administrator is logged into Apex.

To Create a New User

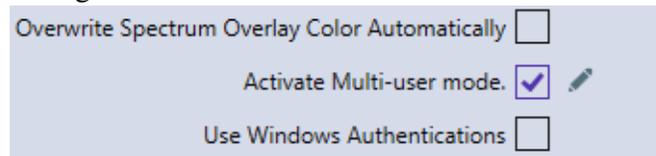
New user can be created in two places.

Figure 1.30: Login Screen to Enable Multi-user



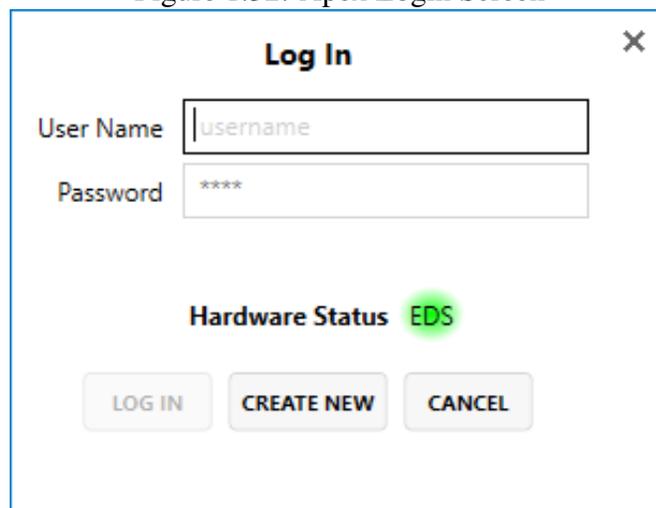
A screenshot of a dialog box titled "LOGIN" with a close button (X) in the top right corner. Below the title is a label "Password" followed by a text input field. At the bottom of the dialog are two buttons: "LOGIN" and "CANCEL".

Figure 1.31: Checkbox to Activate Multi-user



A screenshot of a settings panel with three checkboxes. The first checkbox is "Override Spectrum Overlay Color Automatically" and is unchecked. The second checkbox is "Activate Multi-user mode." and is checked with a purple checkmark. The third checkbox is "Use Windows Authentications" and is unchecked. There is a small pencil icon to the right of the second checkbox.

Figure 1.32: Apex Login Screen



A screenshot of a dialog box titled "Log In" with a close button (X) in the top right corner. Below the title are two input fields: "User Name" containing the text "username" and "Password" containing "****". Below the input fields is a "Hardware Status" indicator showing "EDS" in green. At the bottom are three buttons: "LOG IN", "CREATE NEW", and "CANCEL".

- Whenever Apex starts up in multi-user mode and the login screen is shown (see Figure 1.32). There is a **Create New** button.
- Administrator login can create new users in the **User Profile Dialog** under the **User Account** tab and click on the **Users** button (see figure 7). This button is not visible to other users. After clicking the **Users** Button, a User's window will open with a list of Apex users, below the list is a Create User button.

Figure 1.33: User Account Tab

User Preferences **User Account** Database

User Name

First Name

Last Name

Accounts

1.8 Administrator Feature

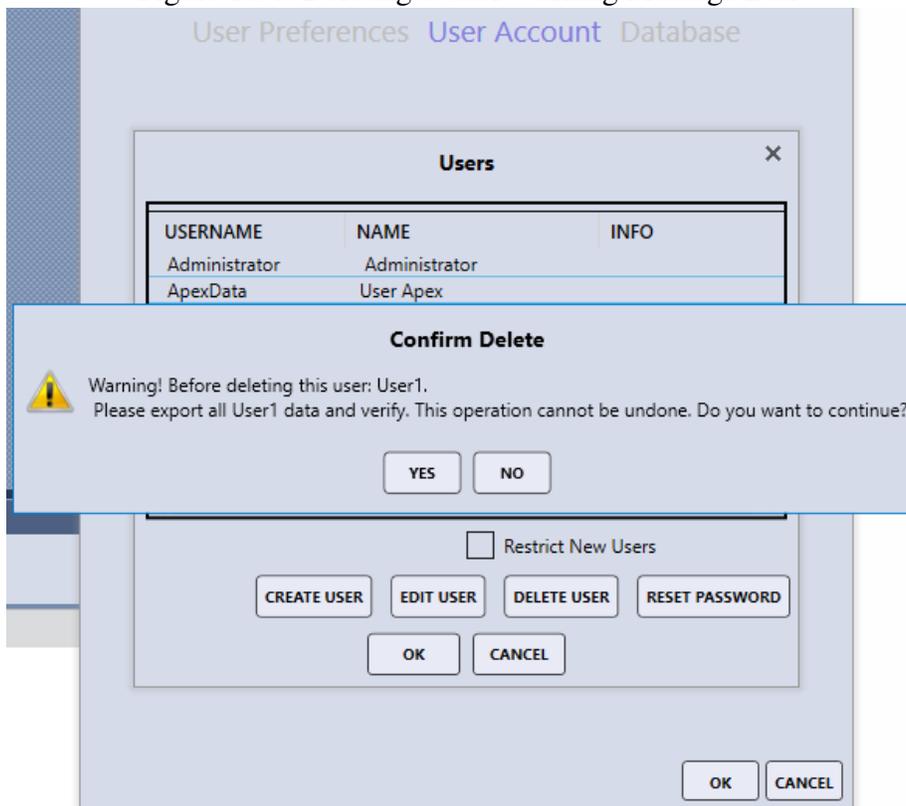
Resetting User Password

Resetting user password can only be done by an administrator. To reset a user's password, first, you need to select the user you in the list and then click on Reset Password button.

Deleting a User

Deleting user password can only be done by an administrator. To delete a user, you need to select the user in the list and click the Delete User button. (see figure 8) A warning dialog box will appear.

Figure 1.34: Deleting a User Warning Message Box



Restricting Creating New Users

Restricting the creation of a new user password can only be done by an administrator. (see figure 8). This restricts creating users whenever Apex starts up on the login screen.

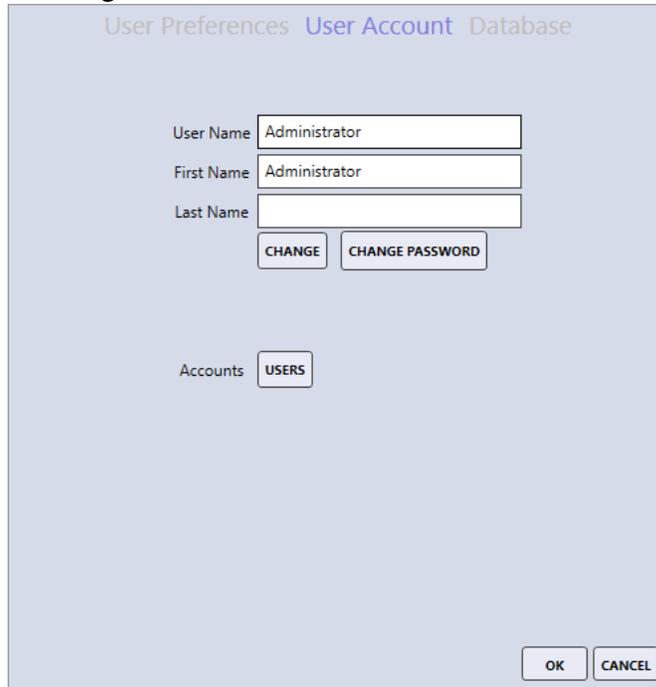
Changing Administrator Password

To change the administrator password, the administrator will need to log into Apex. Open the User Preferences window and select User Account tab (see Figure 1.35). To change Administrator password, click on **Change Password** button, this button is only visible to the Administrator. The Change Password Window will open after the **Change Password** button is clicked. The old password is required and the new password will be asked to enter twice (see Figure 1.36).

Windows Authentication Mode

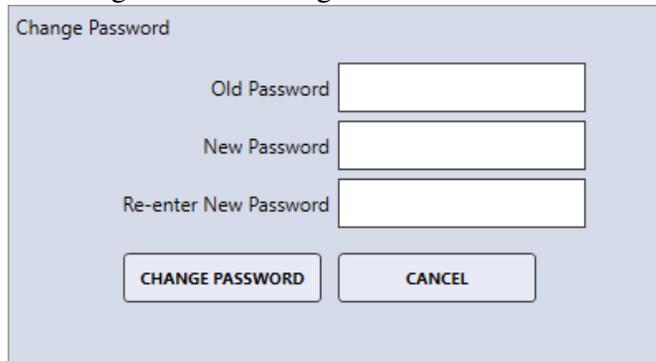
The administrator can enable windows authentication by going to the User Preferences window and checking the **Use Windows Authentication** checkbox. This feature works only when both **Activate Multi-user mode** and **Use Windows Authentication** are enabled (see Figure 1.37). With Windows Authentication checked, the login used for the Windows Operating system is exactly what is required by the APEX software.

Figure 1.35: Administrator User Account



The screenshot shows a software window titled "User Preferences" with sub-tabs "User Account" and "Database". The "User Account" tab is active. It contains three text input fields: "User Name" with the value "Administrator", "First Name" with the value "Administrator", and "Last Name" which is empty. Below these fields are two buttons: "CHANGE" and "CHANGE PASSWORD". At the bottom left, there is an "Accounts" label and a button labeled "USERS". At the bottom right, there are "OK" and "CANCEL" buttons.

Figure 1.36: Change Password Window



The screenshot shows a software window titled "Change Password". It contains three text input fields: "Old Password", "New Password", and "Re-enter New Password", all of which are empty. Below these fields are two buttons: "CHANGE PASSWORD" and "CANCEL".

Figure 1.37: Windows Authentication Mode Enabled

The image shows a 'User Preferences' dialog box with the 'User Account' tab selected. The 'Database' tab is also visible. The 'Use Windows Authentications' checkbox is checked. Other settings include 'Language' set to 'English (United States)', 'Theme' set to 'Blue', and 'Report Paper Size' set to 'Letter'. The 'Activate Multi-user mode' checkbox is also checked. The 'Send to folder filename format' is set to 'Name' and 'Project'. The 'Application Logo' has 'CHANGE' and 'CLEAR' buttons. The 'Status Bar Items' has a 'SELECT' button. The 'Custom image folder location' has a text box and a browse button (...). The 'Default image type' and 'Storage Drive' are dropdown menus. The 'Automatic detector shutdown after inactivity' checkbox is unchecked. The 'Overwrite Spectrum Overlay Color Automatically' checkbox is unchecked. The 'OK' and 'CANCEL' buttons are at the bottom right.

Setting	Value
Application Logo	CHANGE CLEAR
Language	English (United States)
Automatic detector shutdown after inactivity	<input type="checkbox"/>
Status Bar Items	SELECT
Custom image folder location	[Text Box] ...
Default image type	[Dropdown]
Storage Drive	[Dropdown]
Theme	Blue
Send to folder filename format	Name Project
Overwrite Spectrum Overlay Color Automatically	<input type="checkbox"/>
Activate Multi-user mode	<input checked="" type="checkbox"/>
Use Windows Authentications	<input checked="" type="checkbox"/>
Report Paper Size	Letter

Chapter 2

Image and Data Collection

In order to collect a spectrum, line scan, or map, an image must be collected first. There are many different settings to optimize image and data collection, depending on the nature of the work as well as the process used. The settings for image and data collection are outlined below.

2.1 Image Collection

The camera icon on the image toolbar starts or stops image collection. While the image is collecting, the image icon turns **purple** as well as the application status bar.

Figure 2.1: The Image Icon while idle (Left) and while collecting (Right)

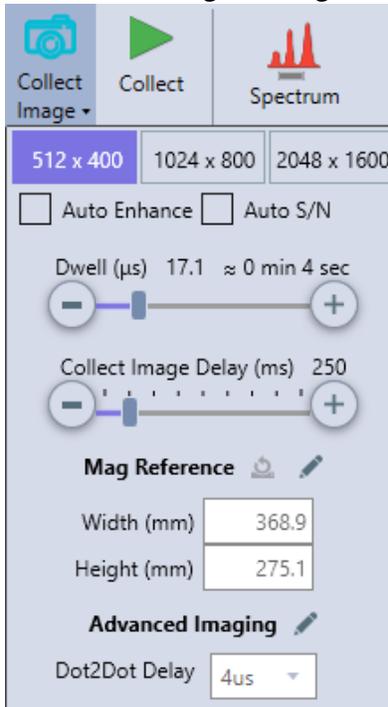


Clicking on the down arrow selection (on the image icon) will display the **Image Collection Parameters** pop up window, shown below. There are three sizes for image collection matrices: 512 x 400, 1024 x 800 and 2048 x 1600 pixels. The larger the values of the matrix, the higher resolution. The selected resolution will appear highlighted on the window.

The quality of the image can be adjusted further using the following settings:

- **Auto Enhance:** This option automatically adjusts the image brightness and contrast after the image is collected. It yields nicely contrasted images.
- **Auto S/N:** This option pre-scans the image area and automatically determines the *Image Dwell Time* number to acquire a low noise (High Quality) image.
- **Dwell(us):** The imaging dwell time (in microseconds per point) can be selected by the user. The larger the number, the longer the collection time, but this yields lower noise and therefore, better quality. Clicking or sliding the scroll bar, shows the time per point and estimated frame time update. *Note: When using the Auto S/N feature, dwell time is selected automatically.*
- **Collect Image Delay (ms):** This setting is the delay time (in ms), set by the user, for the microscope to settle between the external control of the beam, and image acquisition.
- **Mag Reference:** This option is an adjustment factor to fine tune the precision of the *EDAX Micron Marker* in APEX™ for any Electron Microscope. This option is password protected.

Figure 2.2: The Image Settings Window



- **Width:** Adjust this value when using a specimen that has image features of precisely known width.
- **Height:** Adjust this value when using a specimen that has image features of precisely known height. Since the EDAX Image aspect ratio is 1:28 to 1, this height value should be the (width value) / 1.28.

Clicking the **Reset** button, to the right of **Mag Reference** will reset the values to 128 (width) and 100 (height).

- **Advanced Imaging:** This option is password protected.
 - **Dot2Dot Delay:** This is settling time (in μs) when moving the electron beam from one point to another.

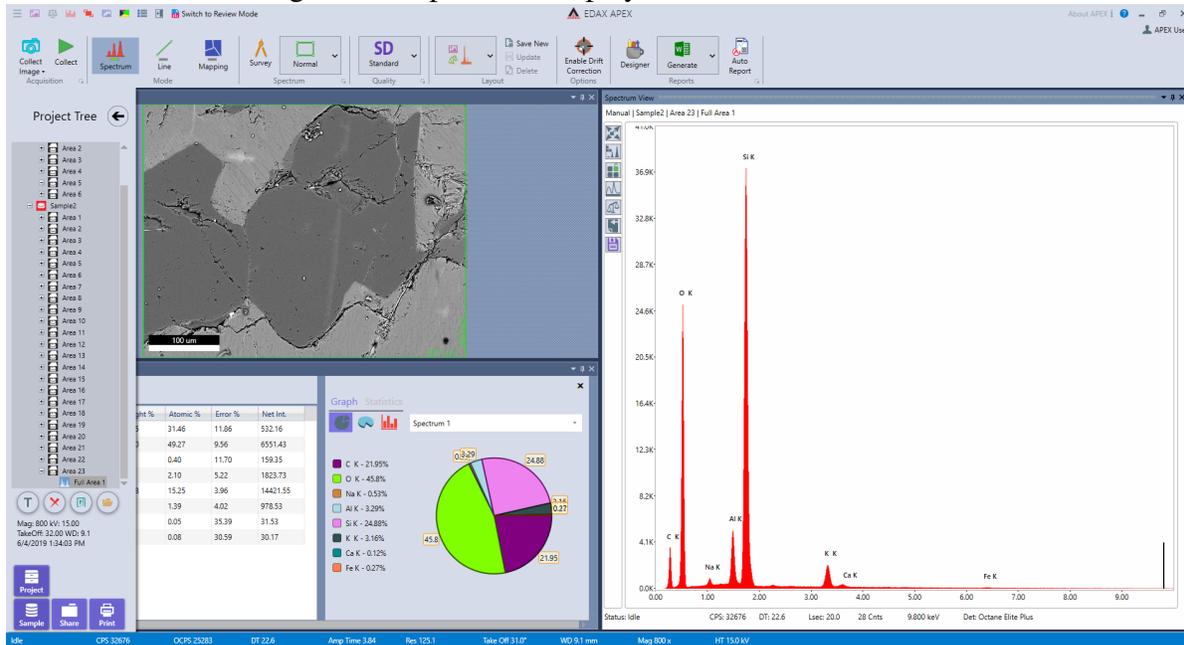
Once the image has been collected, it will appear in the image window. As soon as data is collected, the image will automatically be saved to the project tree. To save the image as an image file on the hard drive, right click on the image and then click **Send to Folder**. The image will be saved in the folder defined in the **User Preferences**.

2.2 Spectrum Collection and Settings

After collecting an image, click on the image area to define a spot, or area(s) over which the spectrum will be collected. If multiple areas are defined, the software will collect spectra at each of them sequentially. Click the **Collect Icon** to start the spectrum acquisition. The spectrum window will immediately start collecting a spectrum for the amount of time defined in **Spectrum Parameters**. During the collection, the elements will automatically be identified after a few seconds, and the quant results will be displayed in the quant window. The name of the spectrum will be shown in spectral view window, as well as the

project tree, as soon as the collection starts. To modify the element list and change the spectrum settings, see section 3.3 on page 41.

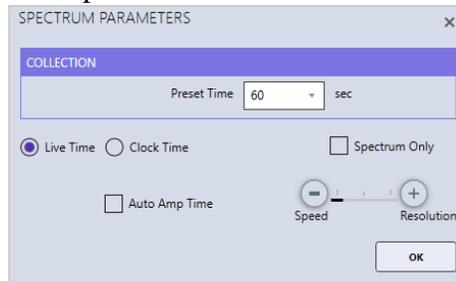
Figure 2.3: Spectrum Display Collection in APEX™



Spectrum Parameters:

The right-side drop-down menu, next to the **Spectrum Quality Icon**, allows the user to select one of the four quality modes for data collection: Quick, SD (standard definition), HD (high definition) and Manual. The collection parameters can be customized by the user for each collection mode. When in spectrum mode, the settings for each quality mode can be modified by clicking the arrow next to the word *Spectrum* on the bottom of the collection toolbar. A pop-up window appears in which the user can set the collection time and choose between **Live** and **Clock** time.

Figure 2.4: Spectrum Parameters → Manual Mode

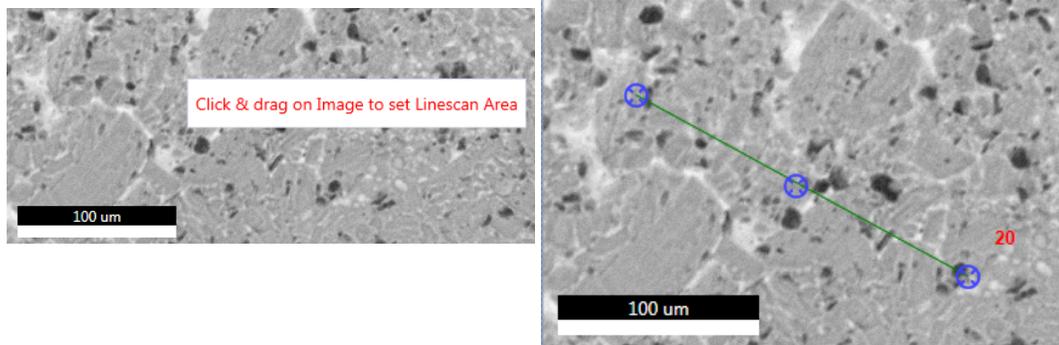


Live time is the amount of time that data is collected, which does not account for dead time. Clock time is the amount of time data is collecting plus processing time (dead time). In the automatic modes (Quick, SD, HD) there is a check-box for **Auto Amp Time** which automatically sets the amp time based on the input counts per second in order to balance throughput and resolution. When the **Manual** quality icon is selected or when **Auto Amp Time** is deselected in the automatic modes, the pop-up window displays a slide bar with Speed and Resolution. Drag the slide bar to one of the three locations to set amp time.

2.3 Linescan Collection and Settings

After collecting an image, click on the **Linescan Icon** to enter linescan mode. A message will pop up over the image area asking the user to draw a line on the image to define the linescan profile for collection. After drawing the line, the end points of the line can be dragged to change the length of the line. To move the line, drag the blue circle in the middle of the line. To delete the line, move the cursor onto the line (outside of the blue circles) and a stop sign appears. Click the stop sign to delete the line.

Figure 2.5: Linescan Setup



Once the line is defined, click the **Collect Icon** to start the linescan acquisition. The software will pre-scan the line selected and determine which elements are present, which will be shown in a pop-up box along with the estimated collection time. Clicking **Confirm Elements** in the pop-up box will immediately display the detected elements on a periodic table where the user can add and remove elements as desired. *Note: If the element list is locked, a spectrum preview will not be displayed.*

During collection, the linescan and spectral displays are shown in real-time. The element list can be modified and custom ROIs can be added in the same way as with mapping (described in section 2.4.1 on page 30). The overlaying elements on the line can be checked or unchecked during collection to enable/disable the display of the given element. All defined elements will be displayed above the image. At the end of the scan a line profile will be displayed.

To stop the linescan data collection, click the **Stop** icon next to the collect image icon. This can be done at any point during the collection and the following menu of options will appear.

Stop Linescan Menu:

- **Stop at Frame:** Allows the collection of the current frame to complete, then stops.
- **Stop Immediately:** Immediate stop of the collection. The data is saved for reviewing. This means that the data collected will have dissimilar collection times before and after the point at which the collection was stopped.
- **Stop Immediately: No Data Saved:** Stops the collection. There will be no data saved.
- **Continue Collection:** Resumes the collection process. No loss of data will occur.

The right-side drop-down menu, next to the **Linescan Quality Icon**, allows the user to select one of the four quality modes for data collection: Quick, SD, HD and Manual. In Quick mode the software will aim to acquire 1.000 X-rays per point on average while the numbers for SD and HD are 10.000 and 20.000 respectively. The collection parameters can be customized by the user for each collection mode. To set the linescan parameters, click the arrow next to the word *Linescan* on the bottom of the collection toolbar in linescan mode and a pop-up box will appear.

Figure 2.6: Linescan Profile

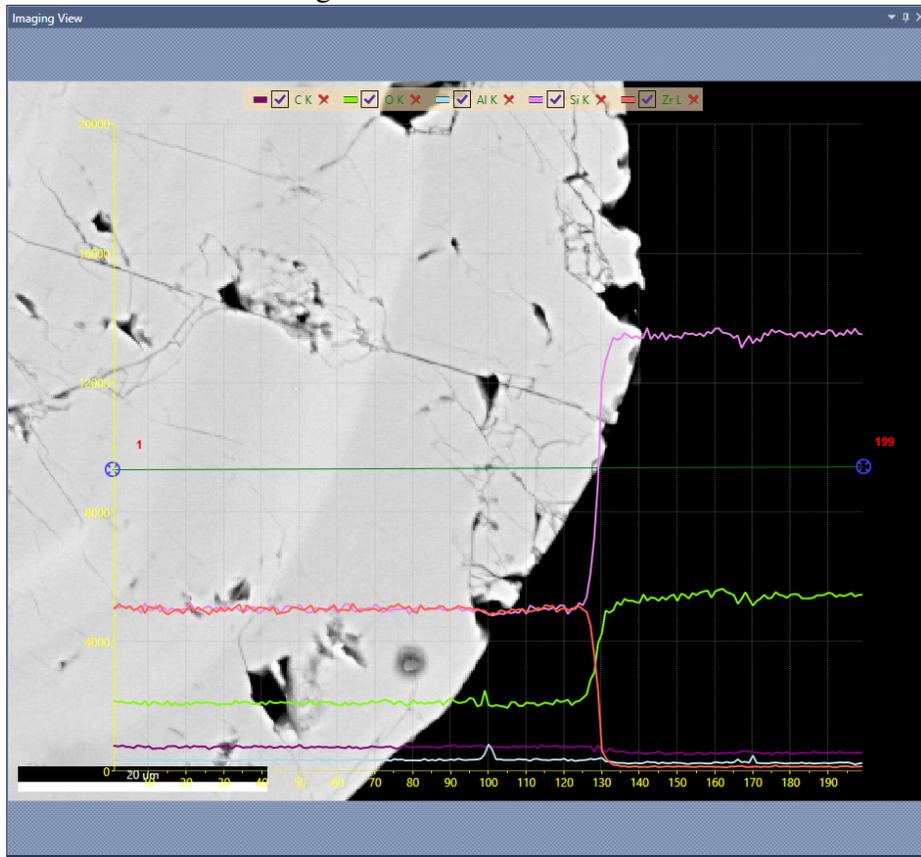


Figure 2.7: Stop Linescan Menu

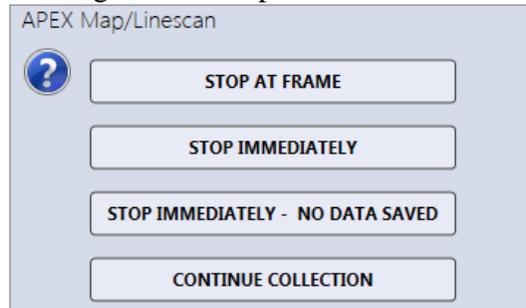
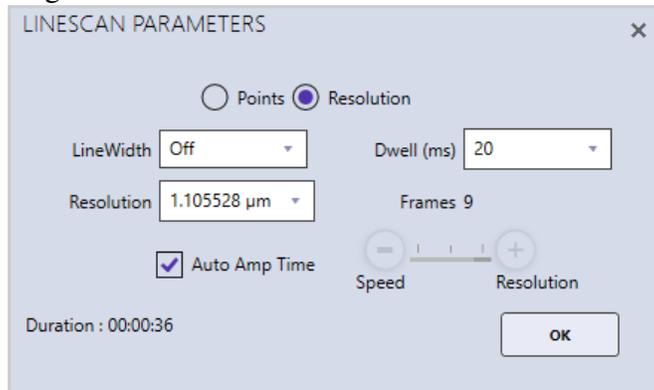


Figure 2.8: Linescan Parameters → Manual Mode



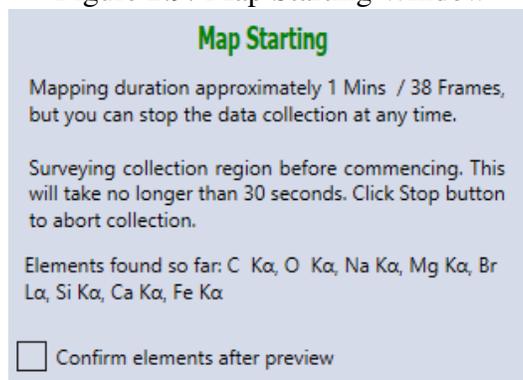
Linescans can be acquired in two possible stepping modes: Points or Resolution. In **Points** mode, the number of points over which data will be collected is manually entered by the user. Enter the number of points and then click *Enter*. In **Resolution** mode, select a resolution value from the drop-down list or type in a number and the number of points used will be calculated automatically.

- **LineWidth:** To scan a line perpendicular to the linescan, instead of individual point locations, change the line width. This is useful for getting a more accurate intensity average for the elements. If the desired line width value is not in the drop-down list, type in the value and press enter.
- **Dwell (milliseconds):** The data collection time per point per frame. If the desired dwell time is not in the drop-down list, type in the value and press enter.
- **Resolution:** When using the *Resolution* radio button selection, this will select the distance between each point collected.
- **Frames:** The number of integrated frames that will be collected. In manual mode, the user can select the number of frames to collect. In the other three modes (Quick, SD or HD), the software will automatically calculate the number of frames to acquire the pre-defined level of data quality. If the desired frame number is not in the drop-down list, type in the value and press enter.
- **Amp Time Selection:** In the automatic quality modes (Quick, SD, HD) there is a check-box for *Auto Amp Time* which automatically sets the amp time based on the input counts per second in order to balance throughput and resolution. When the **Manual** quality icon is selected or when **Auto Amp Time** is deselected in the automatic modes, the pop-up window displays a slide bar with Speed and Resolution. Drag the slide bar to one of the three locations to set amp time.
- **Duration:** The estimated time required to collect the linescan based on the given parameters.

2.4 X-Ray Map Collection and Settings

After collecting an image, click on the **Mapping Icon** to enter mapping mode. By default the entire image will be mapped, see page 28 for instruction on how to change the area. Once the area is defined, click the **Collect Icon** to start the map acquisition. The software will pre-scan the area selected and determine which elements are present, which will be shown in a pop-up box along with the estimated collection time. Clicking **Confirm Elements** in the pop-up box will immediately display the detected elements on a periodic table where the user can add and remove elements as desired. Additionally, the **red delete icon** next to each element map can be used to remove an element. *Note: If the element list is locked, a spectrum preview will not be displayed.*

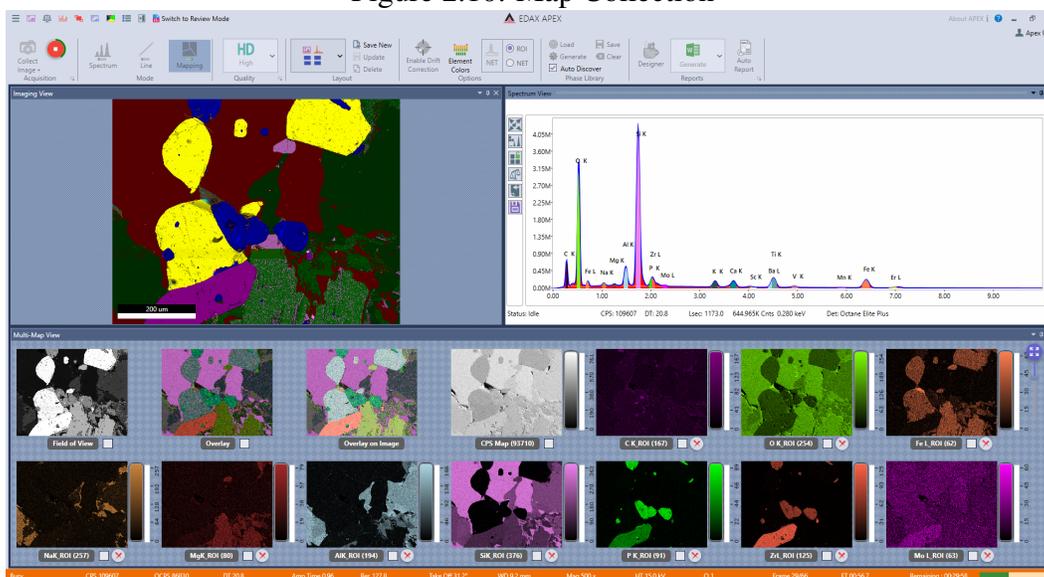
Figure 2.9: Map Starting Window



2.4. X-RAY MAP COLLECTION AND SETTINGS

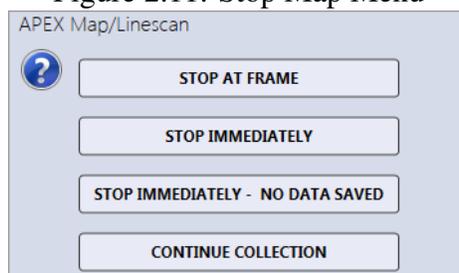
During the collection, the X-ray maps will be displayed in real-time. Clicking the arrow icon in the top right corner of the Multi-Map window will toggle the display to show the default layout or the custom zoom layout. In the custom zoom layout the slider control beneath the arrow icon changes the amount of zoom. The status bar provides useful information about the collection, including: the frame number being collected, the time to collect on frame, the time remaining in the map collection, and a progress bar. On the image view window, there is a green line rastering the map which shows the location of the beam.

Figure 2.10: Map Collection



To stop the map data collection, click the **Stop** icon next to the collect image icon. This can be done at any point during the collection and the following menu of options will appear.

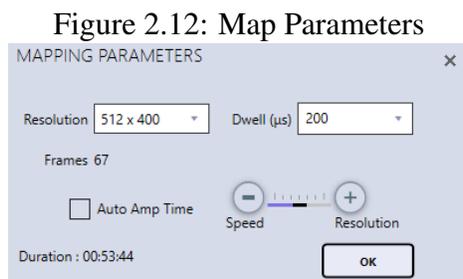
Figure 2.11: Stop Map Menu



Stop Map Menu:

- **Stop at Frame:** Allows the collection of the current frame to complete, then stops.
- **Stop Immediately:** Immediate stop of the collection. The data is saved for reviewing. This means that the data collected will have dissimilar collection times before and after the point at which the collection was stopped.
- **Stop Immediately: No Data Saved:** Stops the collection. There will be no data saved.
- **Continue Collection:** Resumes the collection process. No loss of data will occur.

The right-side drop-down menu, next to the **Map Quality Icon**, allows the user to select one of the four quality modes for data collection: Quick, SD, HD and Manual. In Quick mode the software will aim to acquire 300 X-rays per pixel on average while the numbers for SD and HD are 600 and 1.000 respectively. The collection parameters can be customized by the user for each collection mode. To set the map parameters, click the arrow next to the word *Mapping* on the bottom of the collection toolbar in mapping mode and a pop-up box will appear.



- **Resolution:** There are five different collection matrices that can be used for mapping: 64 x 50, 128 x 100, 256 x 200, 512 x 400, and 1024 x 800 pixels. Use the drop down menu to select a resolution value.
- **Dwell (μ seconds):** The data collection time per pixel per frame . If the desired dwell time is not in the drop-down list, type in the value and press enter.
- **Frames:** The number of integrated frames that will be collected. In manual mode, the user can select the number of frames to collect. In the other three modes (Quick, SD or HD), the software will automatically calculate the number of frames to acquire the pre-defined level of data quality. If the desired frame number is not in the drop-down list, type in the value and press enter.
- **Amp Time Selection:** In the automatic quality modes (Quick, SD, HD) there is a check-box for *Auto Amp Time* which automatically sets the amp time based on the input counts per second in order to balance throughput and resolution. When the **Manual** quality icon is selected or when **Auto Amp Time** is deselected in the automatic modes, the pop-up window displays a slide bar with Speed and Resolution. Drag the slide bar to one of the three locations to set amp time.

Map Area Selection:

As a default, X-ray maps are collected from the entire image area. To collect a map from a portion of the image or to focus on one distinct feature, adjust the green box on the image view window. To change the size of the box, drag the sizer control in the bottom right corner of the box. To shift the location of the box, click the center of the box, hold the mouse button and drag. The preset x-resolution value will be used for map, but the y-resolution value will automatically be re-calculated to preserve an image aspect ratio of 1:28 to 1. The number of mapping points will be displayed on the green box.

Map Element Color Options:

Before starting a map, during a map collection, or after mapping the color of the elements on the periodic table can be customized. Click the **Element Colors** icon in the toolbar and click on specific elements to change their color. The colors set in this window will also be used for mapping elements when in review mode. *Note: This option is only available in live mode so the title of applications window should read EDAX APEX™.*

2.4.1 ROI display, custom ROI and changing elements while mapping:

While maps are collecting a right click in the spectrum view window (described in section 3.3 on page 41) will bring up the option to display the energy ranges used for ROI maps (see Figure 2.15). The ROI regions are displayed with their associated element colors. When adding and removing elements in the spectrum window, and additional option for ROI will be displayed in map mode. This allows the user to create one or more custom energy ranges for mapping as shown in Figure 2.16. When elements or ROIs have been added or removed, a refresh icon will appear in the top right of the spectrum window (shown in Figure 2.17). Clicking the refresh icon will update the map display to reflect the spectrum window elements and ROIs. Removing elements or ROIs can also be done by clicking on the trash can below the relevant map.

Figure 2.15: Display of map ROI energies

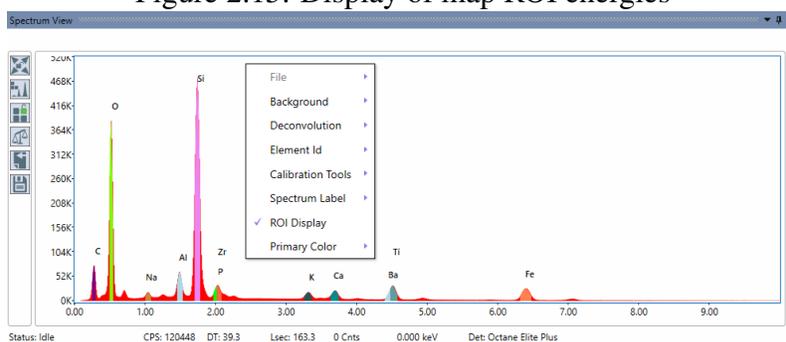


Figure 2.16: Add custom ROI

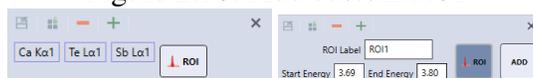
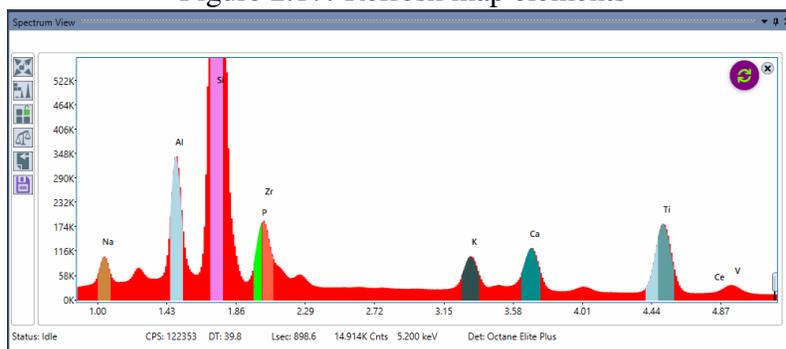


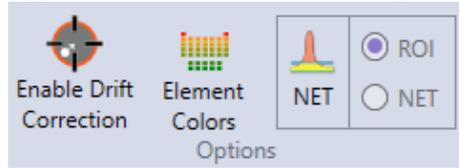
Figure 2.17: Refresh map elements



2.4.2 NET and ROI Map Options:

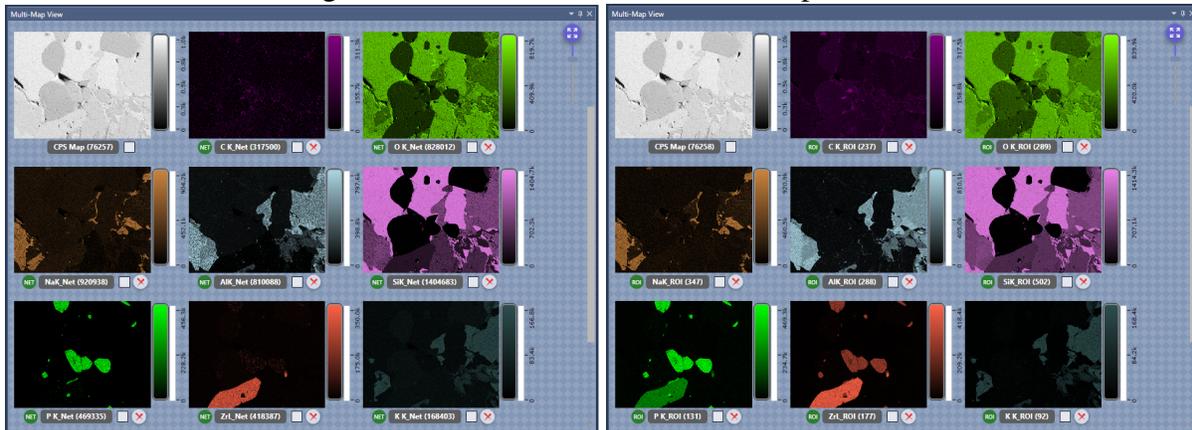
In Mapping Mode, the NET icon appears in the toolbar. If Net maps are desired, the option should be turned on before acquisition is started. When selected, the icon turns gray and allows the user to select NET or ROI map, in real time, via the checkbox.

Figure 2.18: NET and ROI Map Icon



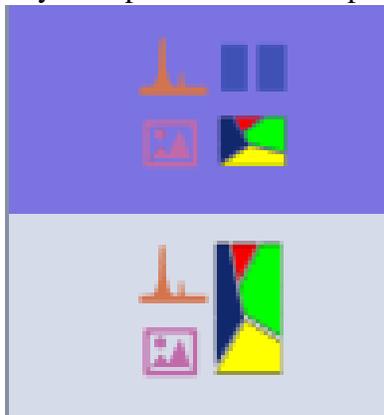
The NET function applies background correction and peak deconvolution to the data while the ROI function displays the map in scaled, raw counts. While data is being collected, use the checkboxes to switch all maps between the two modes. Individual maps can be switched by clicking on the NET/ROI label beneath the map. In order to save a NET or ROI map for a specific element map, select the wanted map using the checkbox. Element maps created with the NET or ROI function on will be labeled accordingly (see images below).

Figure 2.19: NET and ROI Element Map Labels



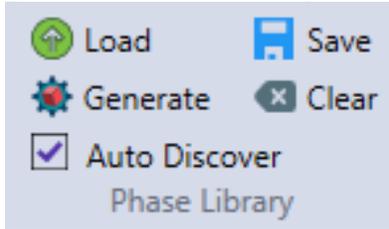
2.4.3 Smart Phase Mapping

Figure 2.20: Default Layout Options Available Specific to Phase Mapping



- **Auto Discover:** When pre-defined phases are loaded, this option will discover new phases based on current element list. If un-Checked (Locked), only the phases selected will be considered during mapping.

Figure 2.21: Phase Library Toolbar



- **Load:** Load previously saved Phase library (*.pml). This should be Team compatible.
- **Generate:** Generate a Phase based on Spectra loaded. The generated Phase is shown in Phase Map View (Grey). The Color selection window will appear to select the color of the phase.
- **Save:** Save Selected Phases as Phase Library.
- **Clear:** Clear loaded Phase Library Phases from Phase Map View.

Phase Button Right-Click-Options before (after?) Collection is started and during collection

- **Extract Spectrum:** Extract selected Phase Spectra.
- **Combine Phase:** Combines 2 selected phases.
- **Delete Phase:** Delete Phase.
- **Select a Color:** Select the color of the phase.
- **Rename Phase:** Rename phase to custom name.
- **Select All Phases:**

2.5 Drift Correction

To turn on/ off **Drift Correction**, use the enable drift correction icon in the toolbar. Once drift correction is turned on, the **Show Drift Control** icon can be used to show or hide the drift view panel.

Figure 2.22: Drift Correction Icons



2.5.1 Drift Correction View Window

The drift correction view window appears on the right hand side of the screen, when enabled and in live mode. It shows the field of view, reference, and current images for the data set being collected. The location of the drifting sample is shown on the graph as well as in the data table, via x, y offset coordinates and their corresponding time.

There are three switch bars in the drift correction window to adjust the settings for drift control, simply click the bar to turn the function on/off. When the bar is purple, the function is on. **Save Drift Image** saves the reference image used for drift control. **Collect Image at Drift** collects and saves the "current image" each time it is adjusted due to drift. **Manual Drift Area** enables the user to set the reference

2.5. DRIFT CORRECTION

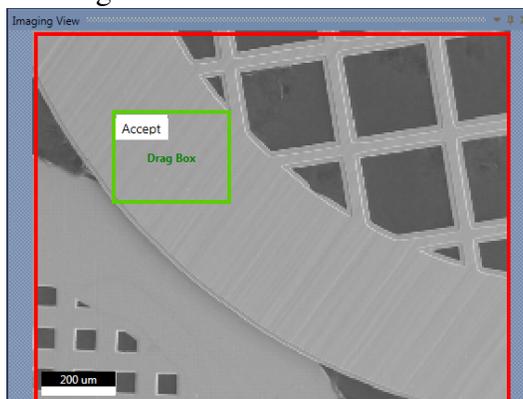
Figure 2.23: The Drift Correction View Window

The screenshot displays the 'Drift Correction View' window. At the top, there are three image thumbnails labeled 'Field Of View', 'Reference', and 'Current'. Below these is a central crosshair with a blue cursor. Underneath the crosshair, the status is 'Requested'. There are three sliders: 'Save Drift Image' (grey), 'Collect Image at Drift' (blue), and 'Manual Drift Area' (blue). At the bottom, a table shows the following data:

ELAPSED TIME	X OFFSET	Y OFFSET	CONFIDENCE	CONTRAST
00:07:04	-12	22.75	20	18.8
00:06:52	-12	22.75	20	18.8
00:06:39	-12	22	19	18.8
00:06:27	-12.75	22	19	18.8
00:06:15	-12.75	22	19	18.8
00:06:03	-12.75	22	19	18.9
00:05:50	-12.75	21.25	19	18.9
00:05:38	-12.75	21.25	20	19
00:05:26	-13.5	21.25	19	19
00:05:14	-13.5	20.5	19	19.1
00:05:01	-13.5	19.75	19	19
00:04:49	-14.25	19.75	19	19
00:04:37	-14.25	19	20	19
00:04:24	-14.25	19	19	19
00:04:12	-14.25	18.25	20	19.1
00:04:00	-14.25	17.5	20	19

area for drift control. When this function is turned on, before data collection starts, the user must select a reference area on the image using the green box and click **select**.

Figure 2.24: Manual Drift Area



2.6 Multifield Scan Table

To turn on/off the **Multifield Scan Table**, use the scan table icon in the title bar: it is the sixth icon from the left. Clicking the icon brings up the scan table window. Multiple areas, including area, point, and free draw spectra as well as linescans can be defined here and then collected as a batch.

Figure 2.25: Scan Table Window

Est. Duration: 128 sec		Import		Export		Delete All		X	
ID	TYPE	SUB TYPE	TIME (SEC)	DWELL	UNIT	FRAMES	RESOLUTION		
1	PointAnalysis	Spot	20	20	L sec				X
2	PointAnalysis	Spot	20	20	L sec				X
	LineScan	Line	68	0.02	sec	17	0.65		X
3	PointAnalysis	FreeDraw	20	20	L sec				X

After each area is defined, it will automatically appear in the scan table window. The dwell time and resolution for each spectra can be entered manually in the **Dwell** and **Resolution** cells. An estimate for the total collection time is displayed in the top left corner of the scan table window.

- **Import:** Reads from a previously stored scan table file. The file must be a *.Amt file.
- **Export:** Saves the table entries to a *.Amt file.
- **Delete All:** Erases all the entries in the table. Clicking the trash can next to a specific entry will delete just that entry.

Chapter 3

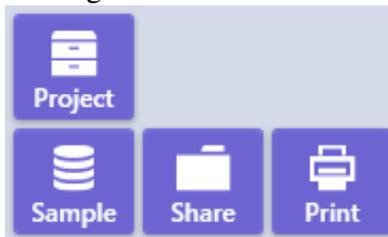
Data Analysis and Display

3.1 Import, Export, and Merge Data

In bottom left corner below the project tree menu, next to the project, sample, and print icons, is the **Share** icon. Clicking the share icon displays a window (shown in Figure 3.2) that prompts the user with three options: Export, Import, and Merge.

Note: In live mode, clicking the share icon brings up the export window. In review mode, the export, import, and merge options are available as well.

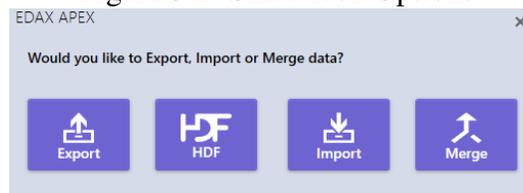
Figure 3.1: Share Icon



Note: These icons are only visible when the project tree panel is open.

Overview of Share Icon Options:

Figure 3.2: Share Icon Options

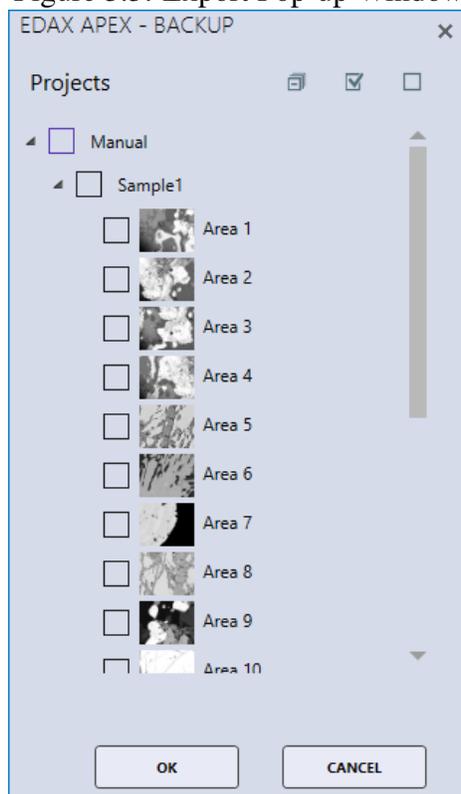


- **Export:** Backs up ALL the selected projects.
- **HDF:** Exports the current project to HDF5 format.
- **Import:** Temporarily displays data that was exported (usually from some other workstation), but does **not** save the actual data to the database.
- **Merge:** Imports the data from a different workstation system, and this data becomes part of the local database. Once data is merged it is permanently on the workstation.

Export Icon:

Clicking the **Export** button will display the following window. Using the check-boxes, select the project(s) to be backed up. In the top right-hand corner of the pop-up window, there are three boxes which enable batch selection of projects.

Figure 3.3: Export Pop-up Window



- **First box: Collapse ALL** → All Project nodes are collapsed.
- **Second box: Check ALL** → All Project nodes are checked (enabled for backup).
- **Third box: Un-Check ALL** → All Project nodes are un-checked. As a default, this is how the window is first displayed.

Next, click the **OK** button and choose a destination folder for data backup and click **Select Folder**. If the selected backup folder already exists the message below will be displayed. Click **Yes** to overwrite and start the backup process. While the backup is running, a progress window will be displayed on the screen. Click the **Stop** button to stop the backup process.

Figure 3.4: Backup Progress Window



Each project is saved as a *Zip* file and each sub-folder is date and time stamped. The database entries are in the *.BAK file, the raw APEX data is in the *.ZIP file, and the a name listing of all the backed up files is in the *.XML file. For information on **Auto Backup Settings**, see section 6.2 on page 79.

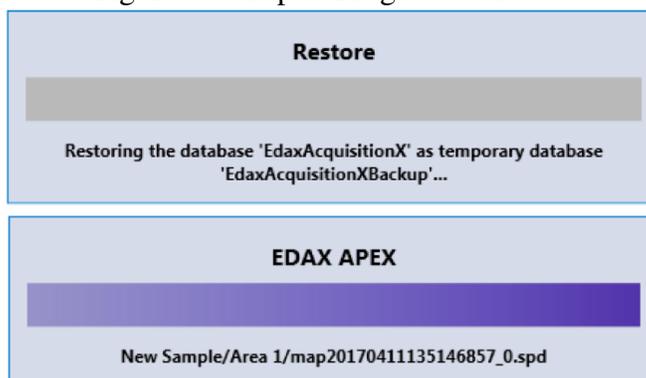
Figure 3.5: Backup File Names

Name	Date modified	Type	Size
 APEX 1.5.zip	6/5/2019 2:17 PM	Compressed (zipp...	11,866 KB
 backupinfo.inf	6/5/2019 2:17 PM	Setup Information	1 KB
 backupInfo.xml	6/5/2019 2:17 PM	XML Document	2 KB
 EdaxAcquisitionX.BAK	6/5/2019 2:17 PM	BAK File	6,752 KB

Import Icon:

The Import function does not permanently import data that was backed up elsewhere. This function only allows for the temporary review of APEX™ data: **the data will not be saved on the current workstation**. To select a *.BAK file to temporarily review, click on the project file and the progress bar will appear while the project is being restored. When it is finished, a notification will pop up, click **OK**. Next, the EDAX data will be loaded into the project and another progress window will appear.

Figure 3.6: Import Progress Windows



Now, the project tree is outlined with blue dashes: this is an indication that the data is only in a **temporary review mode**. Clicking the **Detach** icon, on the bottom of the screen, in the center, will remove the current data and switch back to selecting a project that is saved on the local computer.

Merge Icon:

To **permanently import data** that was backed up (via the Export icon), from another live EDAX system, click the **Merge** button. Select the wanted *.BAK file and the project will be merged back to the local database, becoming a permanent part of the local APEX™ Database. A progress box will appear while the project is merging, shown in Figure 3.8. After the project has been merged, it can be found using the **Project Explorer**.

3.2 Quant View Window

While data is collecting, the quant results will automatically appear and update in the quant window, designated by the user in layout settings. There are multiple options for viewing quant results including: numerics only, graphs, and statistics. Be aware that any quantitative analysis requires the spectra to originate from a flat, homogenous bulk sample.

Figure 3.7: Detach Icon

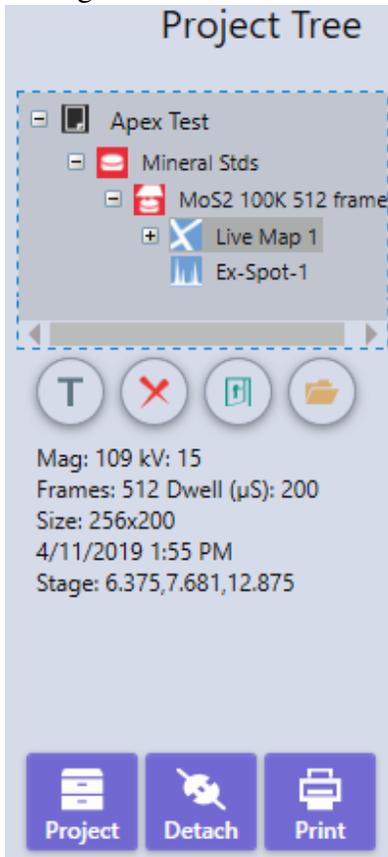


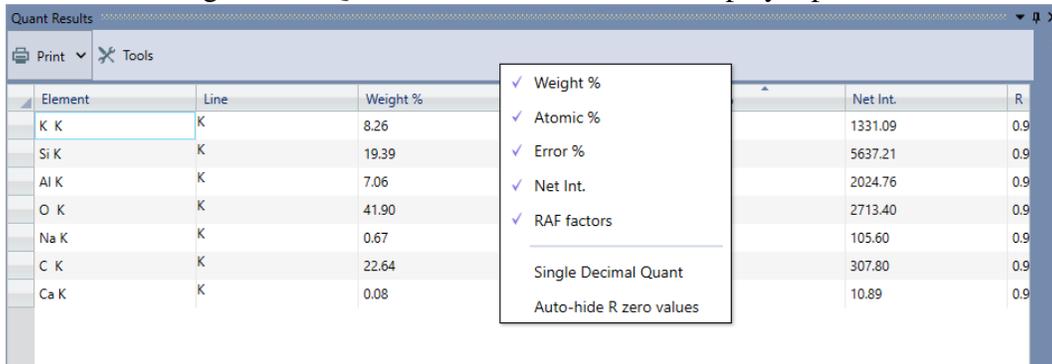
Figure 3.8: Merge Progress Window



Numerics Only View:

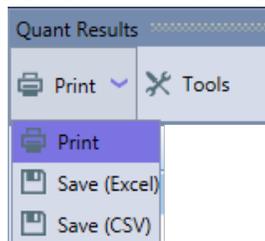
The numerics only view displays the quant results in a table which can be customized by the user. Right click on the **Quant Results Window** to turn on or off (via a check mark) the quant values that will be used for display and reports. The *Single Decimal Quant* option sets the weight and atomic percentages to just a single decimal point of accuracy. The default display setting is two decimal points, be aware that this does not imply that the quant results have two decimal points of precision.

Figure 3.9: Quant Results Window and Display Options



The quant window also has a **Print Menu** in the upper left corner that allows the user to print or save the results to file. To select a method, click the arrow to the right of the **Print Icon** to view the drop-down menu and click on one of the following options:

Figure 3.10: Print Menu Options



- **Print:** Outputs the quant results to the printer.
- **Print** → **Save (EXCEL):** Outputs the quant results to a Microsoft Excel XLSX file.
- **Print** → **Save (CSV):** Outputs the quant results to an ASCII CSV file.

Note: These print options will only print the quant results, not the spectra or SEM image.

Graph View:

Clicking the **Tools Icon** will enable or disable the display of the weight percentage results in graphics form. In this mode, the quant numerical values are limited to four columns. To customize which results are displayed, right click on the quant results window.

There are three graph display modes: **1D-Pie**, **3D-Pie**, and **Bar Graph**. To select a mode, use the icons under the word *Graph*. When using the bar graph mode, there is a drop-down selection. When multiple spectra are loaded, the user can quickly switch between the quant graphs of each spectrum using the drop down menu above the graph.

3.2. QUANT VIEW WINDOW

Figure 3.11: Graph View

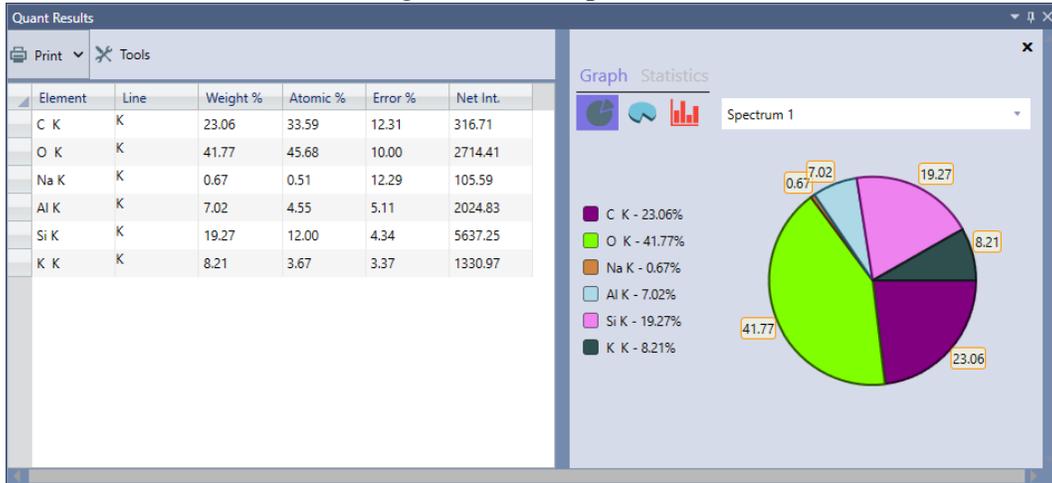
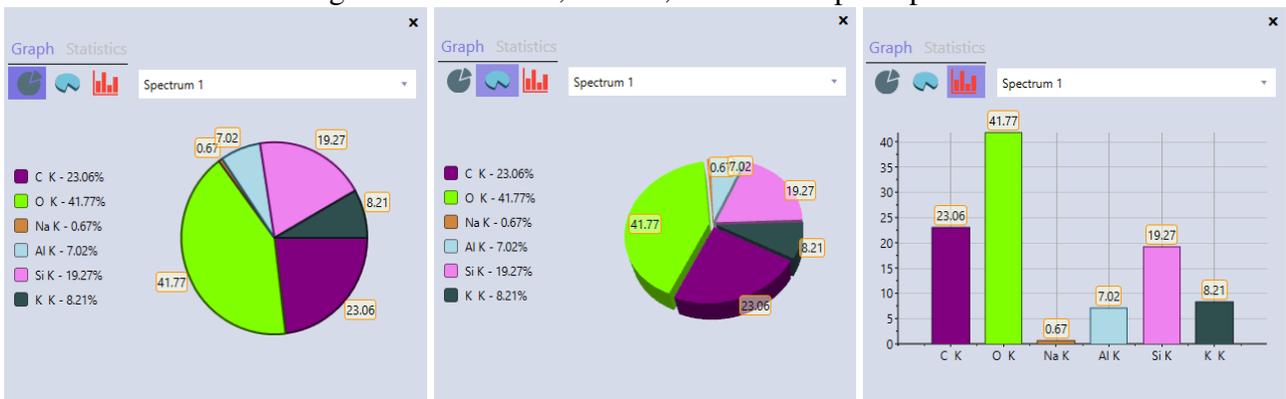


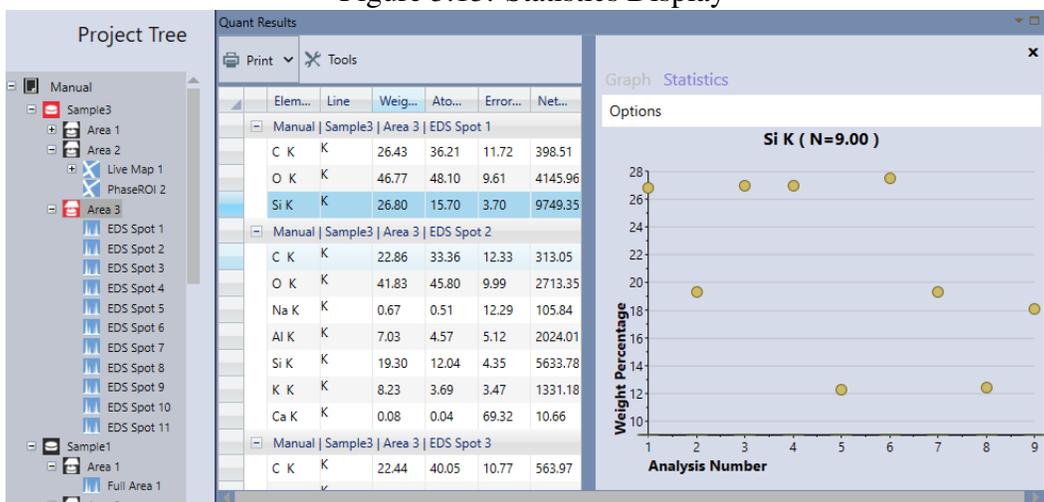
Figure 3.12: 1D-Pie, 3D-Pie, and Bar Graphs Options



Statistics View:

The statistics option allows the user to view the data from multiple spectra simultaneously. First, select the spectra to be reviewed by dragging them from the project tree, into the same spectrum view window. Then, select the element to be examined by clicking on it in the quant results table. Next, click the **Tools** icon and select **Statistics**. The graph will show the weight percentage concentrations for the selected element, for all spectra in the series. This is particularly useful for visualizing trends or checking for homogeneity. To change the element displayed, click on the element name in the quant table.

Figure 3.13: Statistics Display



Click on the **Statistics** → **Options** menu to select one of the eight options, listed below.

- **Max:** Draws a dashed line to mark the highest concentration in the series.
- **Mean:** Displays the mean value of the entire series.
- **Median:** Displays the median number in sorted series.
- **Min:** Draws a dashed line to mark the lowest concentration in the series.
- **N:** Displays the weight percentage values for the series.
- **Q1:** Displays the first quartile.
- **Q3:** Displays the third quartile.
- **Standard Deviation:** Displays the standard deviation (σ) of the series.

3.3 Spectrum View Window

Peak ID:

During or after a spectrum is being collected, the user can alter the Peak ID in order to identify trace elements and other elements of interest or to remove elements. To **Add** an elemental label, left click on the peak in the spectrum, hover the cursor over the question mark that appears, and a window containing the possible elements at that energy will be displayed. This Peak ID window can be dragged to different locations on the spectrum view window and will be displayed until manually closed using the **X** icon in the top right corner.

In the Peak ID window, click on the wanted element to mark the peak with that elemental label and add it to the quant results. To label other peaks on the spectrum, use the + and - buttons to move up or down

Figure 3.14: Statistics Options → Mean

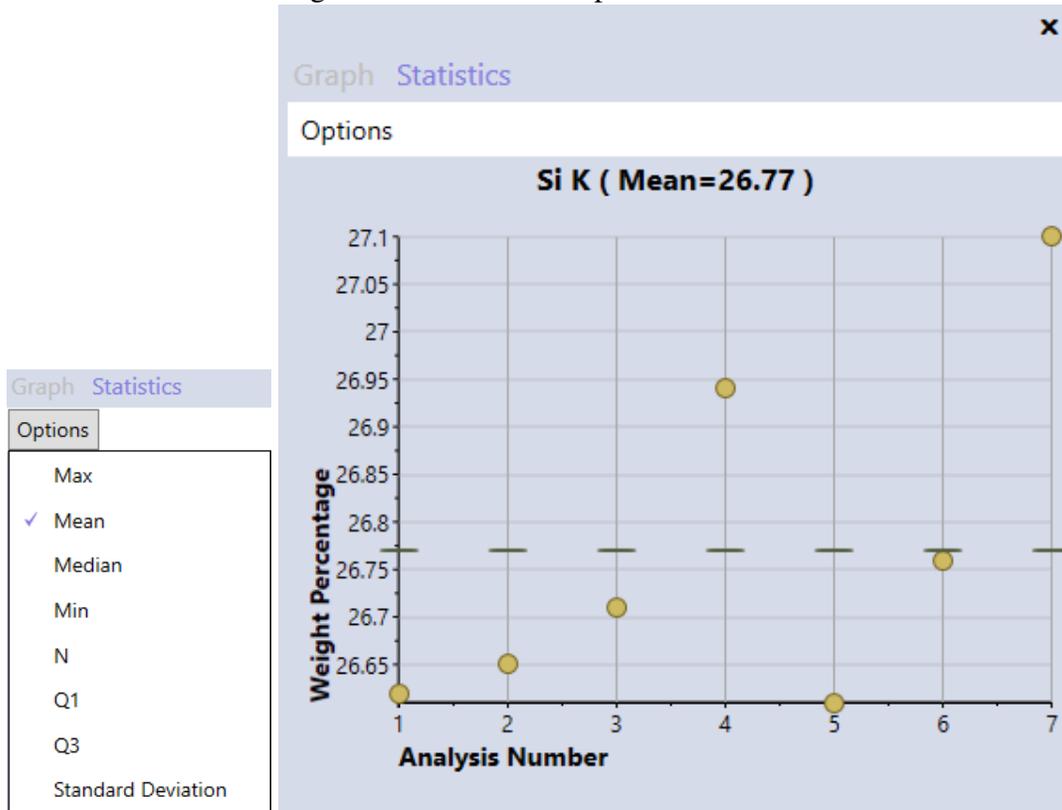


Figure 3.15: Spectrum View Window

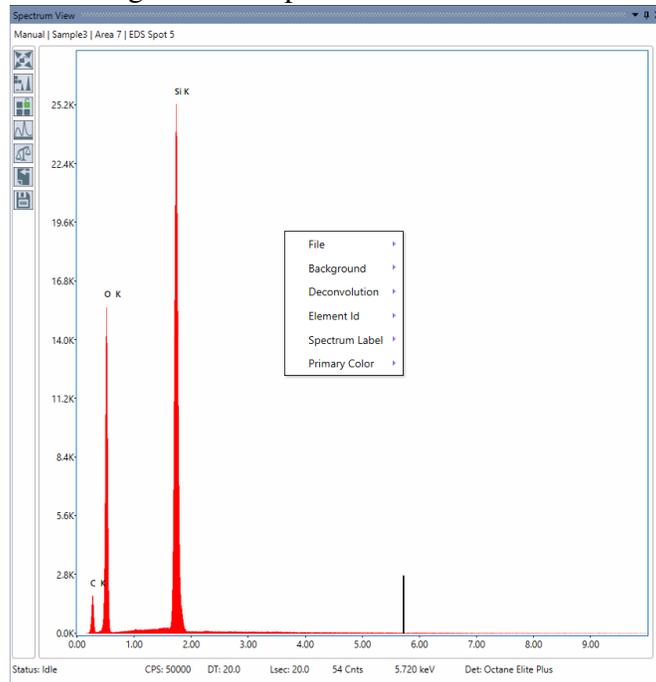
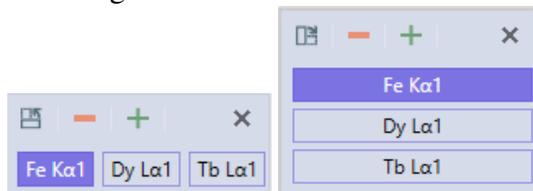
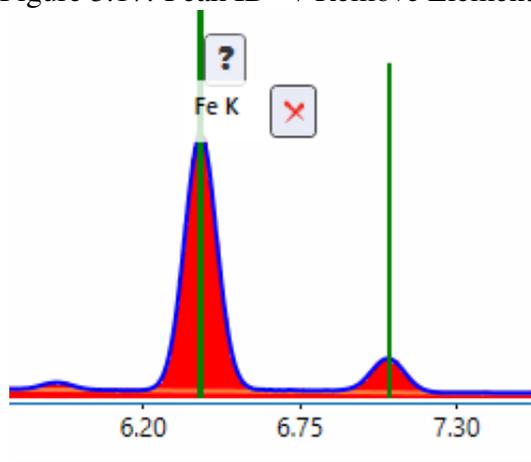


Figure 3.16: Peak ID Window



in energy, or click on a peak manually. To change the orientation of the Peak ID window, use the icon in the top left corner. To close the Peak ID window, use the **X** icon in the top right corner. Hovering the cursor over on an existing elemental label will cause an **X** to appear next to the label. To **Delete** that element, click on the **X**.

Figure 3.17: Peak ID → Remove Elements



3.3.1 Spectrum View Toolbars

The spectrum view window has two toolbars: the vertical toolbar and the pop-up menu, which can be accessed by right clicking on the window.

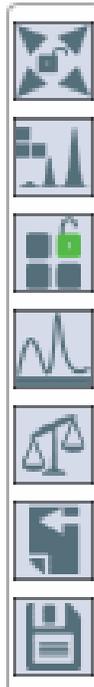
Vertical Toolbar:

The vertical spectrum toolbar is located in the top left corner of the spectrum view window and has six options which are described in detail below.

- **Spectrum Home:** This icon will *Home* the spectral display. There are two modes for the home icon: **Auto** and **Manual**. When the icon is in the **Unlocked Position** it is in auto mode. Simply click the icon to reset the spectrum view and display the spectrum from 0 keV to $\frac{2}{3}$ of the acceleration voltage. When the icon is in the **Locked Position**, it is in manual mode. Hovering over this button will display the **Customize** option. Click the customize button to display the customize pop-up window.

This customize pop-up window can be used to adjust the spectrum display home position by setting the start and end KeV values on the bottom of the spectrum display to find regions of interest. The

Figure 3.18: Vertical Toolbar



Vertical Toolbar Options:

Spectrum Home



Reapply Expert ID



Modify Element List



Show Quantification Results



Send to...



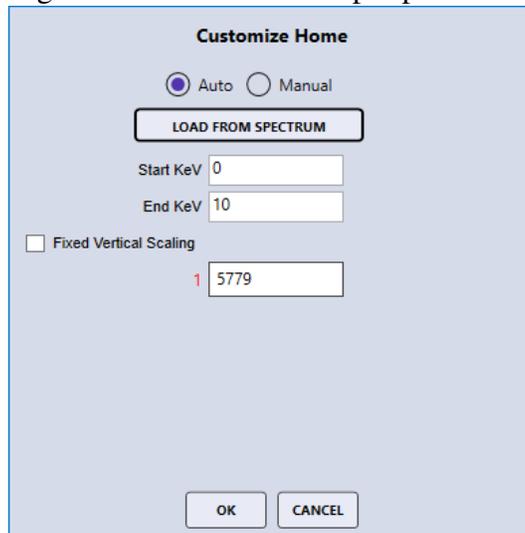
Save Changes



Figure 3.19: Home Icon



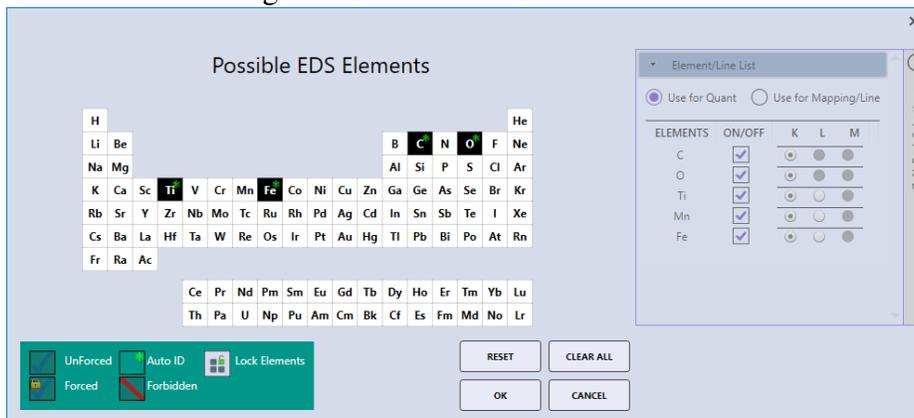
Figure 3.20: Customize Pop-Up Window



Fixed Vertical Scaling option is useful when investigating specific regions and when comparing overlaid spectra. In the bottom part of the customize pop-up window, the color coded spectrum number followed by the full scale counts for the spectrum can be seen. When fixed vertical scaling is applied a box appears where the scale of the counts axes can be changed. The overlaid spectra can now be scaled relative to the display axes by adjusting the full scale counts of the individual spectra.

- **Re-apply element identification:** Re-runs the automatic identification routine.
- **Modify element list:** Allows the user to modify the element list. Clicking this icon will bring up a pop-up window with the periodic table. The user can then select which elements will appear in the peak ID of the spectrum and in the quant results. A * means that the element was found to be present by the automatic element identification routine while a black box on a given element indicates that it is included in the model. Click an element to toggle in on or off.

Figure 3.21: Periodic Table Window

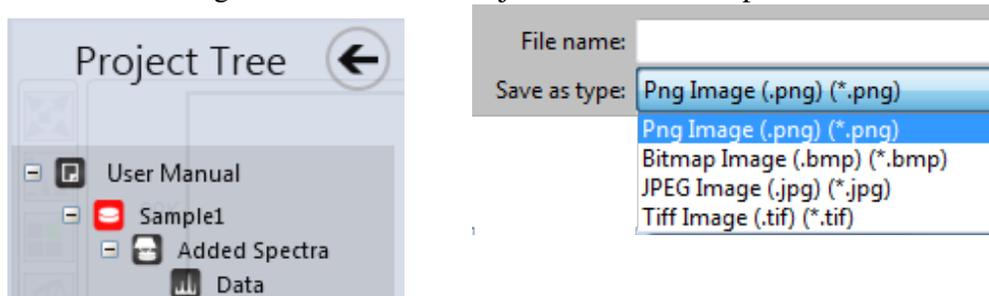


The symbol key in the bottom left corner of the pop-up window shows the different symbols that appear on the table and their meaning. Click on one of the symbols to activate it and then click on the element on which it should be applied. Setting an element to forbidden means that it will never show up in the identification whether it is present or not, if an element is set to forced it will always

show up in the identification whether it is present or not, Setting an element to unforced means that it is included in the model but can potentially be removed on subsequent applications of the automatic identification if it is not found to be present. This pop-up window also gives the user the option to **lock** or **unlock** the elements used for peak ID. When the element list is unlocked, the symbol is **green**. When the element list is locked, the symbol is **red**. Clicking the ← on the right hand side of the window expands the ZAF list control which enables the user to select the energy lines used to quantify and map each element.

- **Show Quantification Results:** This icon displays the quant results in a pop-up window. Since the quant results are displayed in the quant window, in real-time, during its collection, this icon is only needed for certain layout options.
- **Send to...** This icon has three options for sending or saving the current files:
 - **Send to Folder:** Sends the following files to the folder defined in user preferences: SPC (Binary Spectrum File), MSA, CSV, *.BMP (or other image file depending on user preference setting).
 - **Send to Project:** Saves the current spectrum into the project tree. It is copied into a node named *Added Spectra*.
 - **Save As:** Same functionality as the **Send to Folder:** button except that the file output location can be selected in a pop-up window.

Figure 3.22: Send to Project and Save As Options



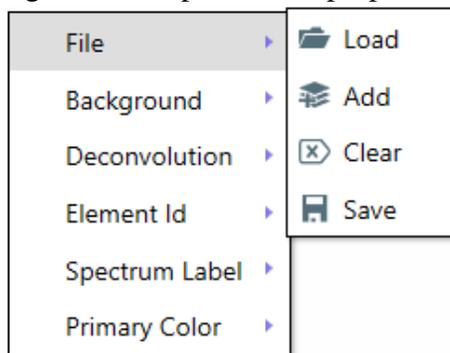
- **Save Changes:** Clicking here will cause any model changes made to the spectrum to be saved to the disk file. This button will turn pink when the spectral model has changed and is not yet saved to the disk file.

Spectrum Pop-Up Menu:

To display the pop-up menu, right click on the spectrum view window. There are six items in the menu, all of which have their own options.

- **File:**
 - **Load:** Read a stored spectrum in .spc file format and display it.
 - **Add:** Add a spectrum to the display usually for overlay purposes.
 - **Clear:** Remove all spectra from the display.
 - **Save:** Copy the currently spectrum displayed to a disk file (*.spc).
- **Background:** A selection to turn on or off the background display. The background color can also be customized here.

Figure 3.23: Spectrum Pop-up Menu



- **Deconvolution:** A selection to turn on or off the deconvolution display. The deconvolution color can also be customized here.
- **Element ID:**
 - *Show Element ID:* Turns the elemental labels on/off.
 - *Show Sum Peaks:* Turns the Sum Peak labels on/off.
 - *Show Esc Peaks:* Turns the Escape Peak labels on/off.
 - *Limit to Quant Labels:* To reduce screen clutter, the user can select to label only the lines that will be used for quant, i.e. only one label will be displayed per element regardless of the number of X-ray lines.
- **Calibration Tools:** EDS Spectrum Calibration methods. See section 7.3 on page 83 for more information on calibration.
- **Spectrum Labels:**
 - *Label Size:* Use this option to select from the six possible font sizes for elemental labels.
 - *Label Border:* Switches on and off the bounding box around element labels.
- **Primary Color:** Use this option to set spectrum primary color. See section 3.3.4 on page 49 for more information.

3.3.2 Spectrum View Advanced Settings

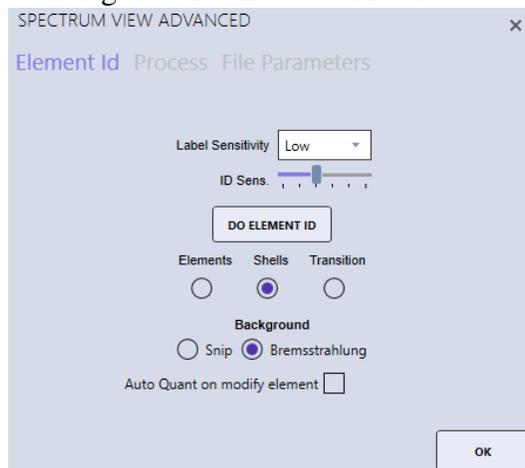
To access the spectrum view advanced pop-up window, click the arrow in the bottom right of the spectrum icon. There are four tabs in the advanced settings menu: element ID, file parameters, process, and spectrum matching (optional). Spectrum matching is described in 3.3.6 on page 52 while the other options and their settings are described below.

Element ID:

The element ID menu allows the user to change the preferences for the element labels and ID sensitivity that appear on the spectra.

- **Label Sensitivity:** The drop down selects the number of labels to show. A setting of low would only put labels on primary elements and lines while high would label minor lines as well.
- **ID Sensitivity:** This selection controls the minimum peak size for an element to be included in an AutoID routine. A setting of 5 would include minor peaks and trace elements but potentially also identify noise peaks while a setting of 1 would only identify primary peaks.

Figure 3.24: Element ID Menu

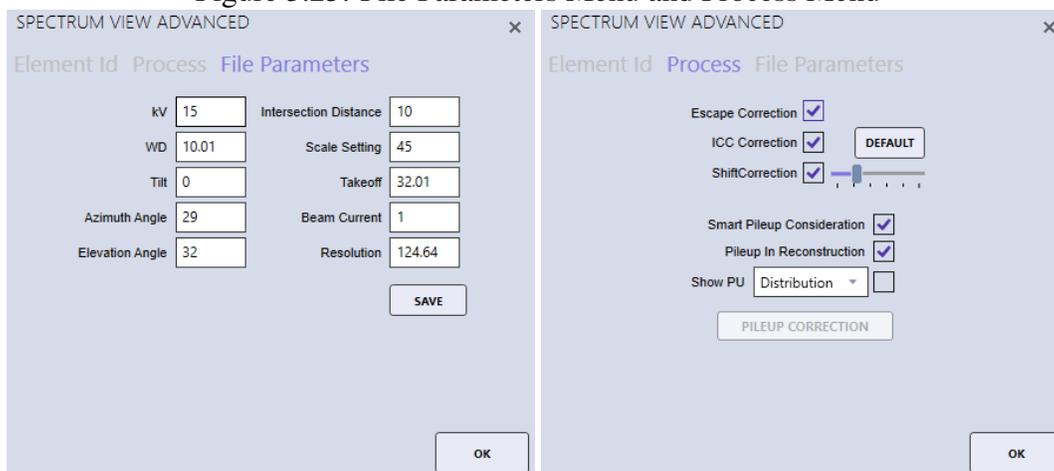


- **Do Element ID:** Performs an automatic Peak Identification on the spectrum currently displayed.
- **Label Display:**
 - *Elements:* Displays only the element name in the element label.
 - *Shells:* Displays the element name followed by the shell (K, L, M).
 - *Transition:* Displayed the element name, shell, and transition symbols.
- **Background:**
 - **Snip:** Applies a pure mathematical background approximation method (Statistics-sensitive Non-linear Iterative Peak-clipping).
 - **Bremsstrahlung:** Applies a full physical algorithm-based Bremsstrahlung calculation.

File Parameters:

The file parameters menu displays the current parameters for the spectrum displayed. These values are automatically determined from the microscope and the preset settings. To make changes, type a new value into the parameter box and click **Save**. This will write the values displayed back to the actual spectrum file (*.spc).

Figure 3.25: File Parameters Menu and Process Menu



Process:

The process menu is used to enable or disable correction factors and pileup consideration. Escape peaks are caused by a Si X-ray being fluoresced by an incoming X-ray from the sample and consequently escaping the Si detector crystal. They will be seen as a small peak downshifted by 1.74 keV relative to the X-ray that caused the fluorescence. Incomplete charge collection is a term used to describe when not all the electrons/charge for a given peak is collected/measured which typically leads to a low energy tail. In the energy range below roughly 700 eV the incomplete charge collection leads to a peak shift which can be compensated by the shift correction.

At increased count rates it is common to see sum peaks and filling of the gap between two adjacent peaks. This is generally referred to as pileup which is caused by two X-rays hitting the detector almost simultaneously. The Smart Pileup Consideration is enabled by default and includes the pileup in the spectrum model. Be aware that in order for the pileup correction to work, the spectra should originate from homogenous regions.

- **Escape Correction:** Displays *Escape Peaks* on spectral display.
- **ICC Correction:** Applies *Incomplete Charge Collection Correction* method to the spectrum.
- **Shift Correction:** Applies low energy *Shift Correction* for light elements to the spectrum.
- **Smart Pileup Consideration:** Enables the calculation of pileup peaks based on spectrum and count rate.
- **Pileup in Reconstruction:** Includes the calculated pileup in the deconvolution overlay in the spectrum window.
- **Show Pileup:** When enabled the user can choose to see the pileup distribution (the number of counts that stem from pileup effects) as a yellow line in the spectrum window, or to see the corrected spectrum, where pileup has been subtracted.

3.3.3 Additional Spectra Overlay Methods:

There are two additional methods for overlaying spectra. The first is to click on the sample name, in the project tree. All of the spectra from that sample will be overlain. The second method is to drag the desired spectra from the project tree to the spectrum display to create an overlay. The spectra that was dragged over first's elements will be displayed using spectral overlay mode.

3.3.4 Spectrum View Color Settings:

- **Setting Spectrum Primary Color:** Clicks the **Primary Color** menu item and then **Spectrum Primary Color** (see Figure 3.26 Left). A color dialog box will appear with a list of colors that are defined for the system display (see Figure 3.26 Right). When more than 1 spectrum is loaded, this menu item is not visible.
- **Setting Spectrum Secondary Overlay Colors:** Apex 1.5 offers a new feature to overwrite default spectrum overlay colors. The default option for this feature is turned off. To enable, you must go into the User Property window and check the box next to the label "Overwrite Spectrum Overlay Color Automatically" (See Figure 3.27).

To set the secondary colors for spectra, more than 1 spectrum needs to be open. Toggle buttons are located at the bottom left of the spectrum view window. The first toggle button will take the color from the primary spectrum color and cannot be changed here (See Figure 3.28 Left). The second one onwards will be able to change the colors by right clicking on the button to show menu item

3.3. SPECTRUM VIEW WINDOW

Figure 3.26: Setting Spectrum Primary Color

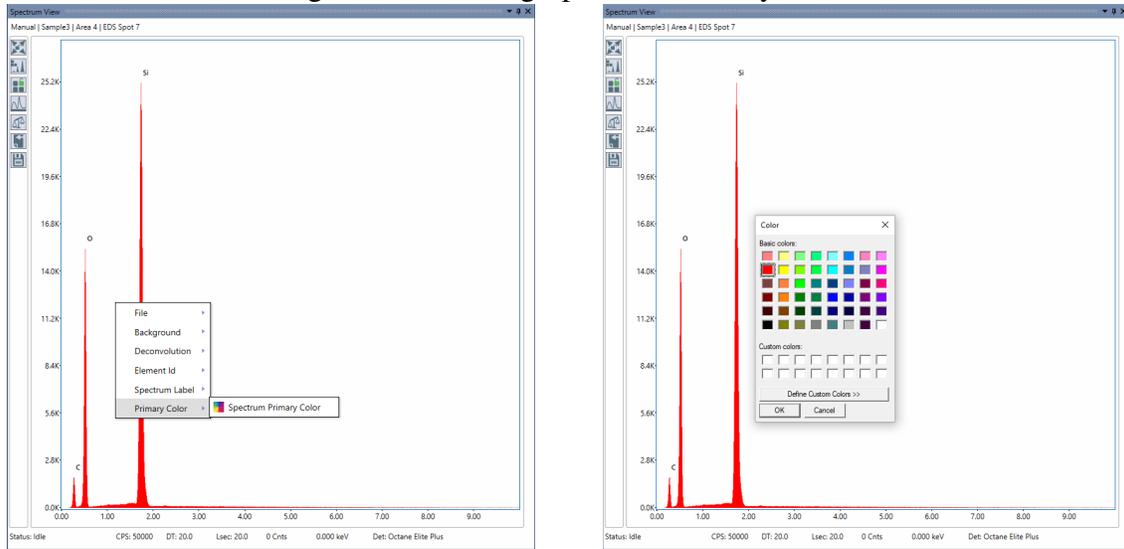
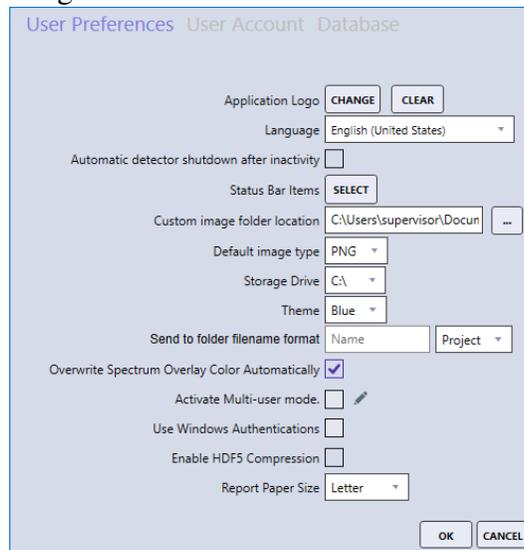


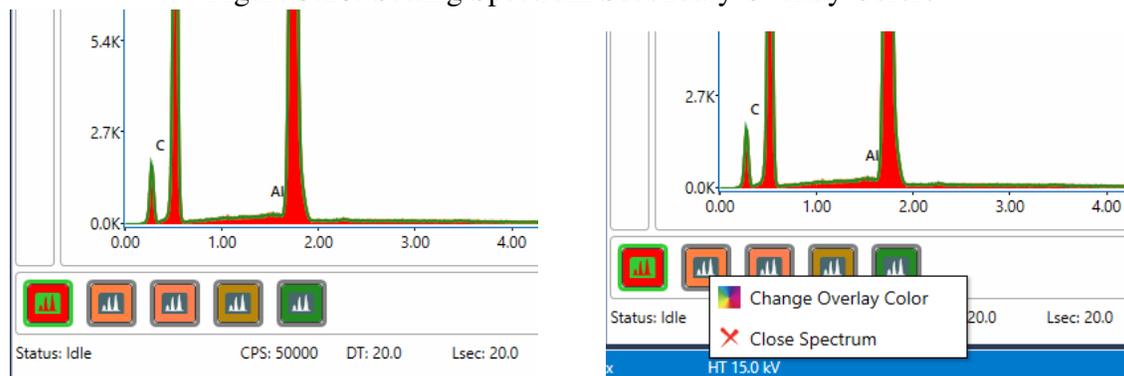
Figure 3.27: User Preference Window



“Change Overlay color”. Right click on the toggle button to change overlay color for the spectrum (See Figure 3.28 Right).

- **Closing a Spectrum when Multi-spectra are Opened:** To close a spectrum, right click on the toggle button and click Close Spectrum button (See Figure 3.28 Right).

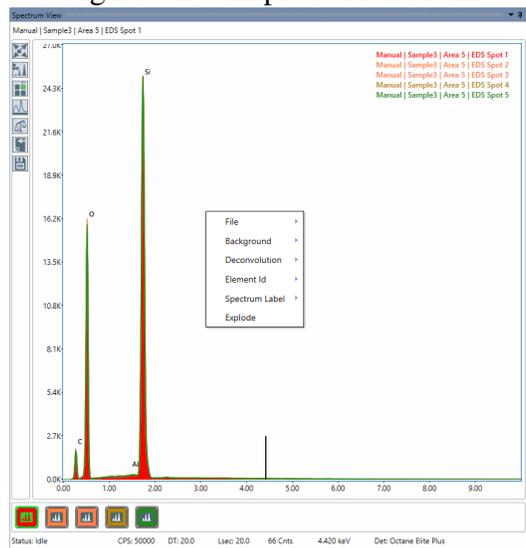
Figure 3.28: Setting Spectrum Secondary Overlay Colors



3.3.5 Multi-spectra View

Whenever there is more than one spectra loaded, there is feature that can open each spectrum into a Multi-Spectra View. To use this feature, right click on the spectrum view window to open the context menu. Click the menu item “Explode”, this will open the Multi-Spectra View. (See Figure 3.29)

Figure 3.29: Explode Menu Item



There are three view modes available on the Multi-Spectra view window (see Figure 3.30).

- **List View:** this view will display all spectra vertically (see Figure 3.31).
- **Carousel view:** A carousel view provides scrolling animation to create the effect of a spectrum movement when scrolled. This view has four predefined configuration: Diagonal, Ellipse, Parabola, and Zigzag (see Figure 3.32).

3.3. SPECTRUM VIEW WINDOW

- **Grid View:** this view arranges each spectrum from left to right based on available space. There is a zoom control to resize each spectrum (see Figure 3.33).

Figure 3.30: View Modes

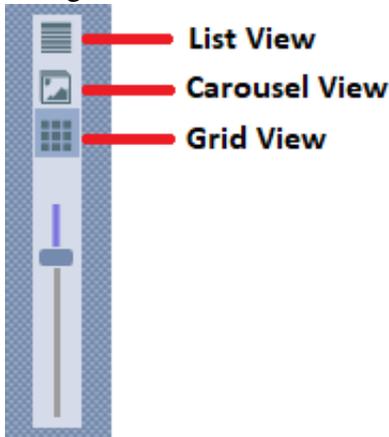
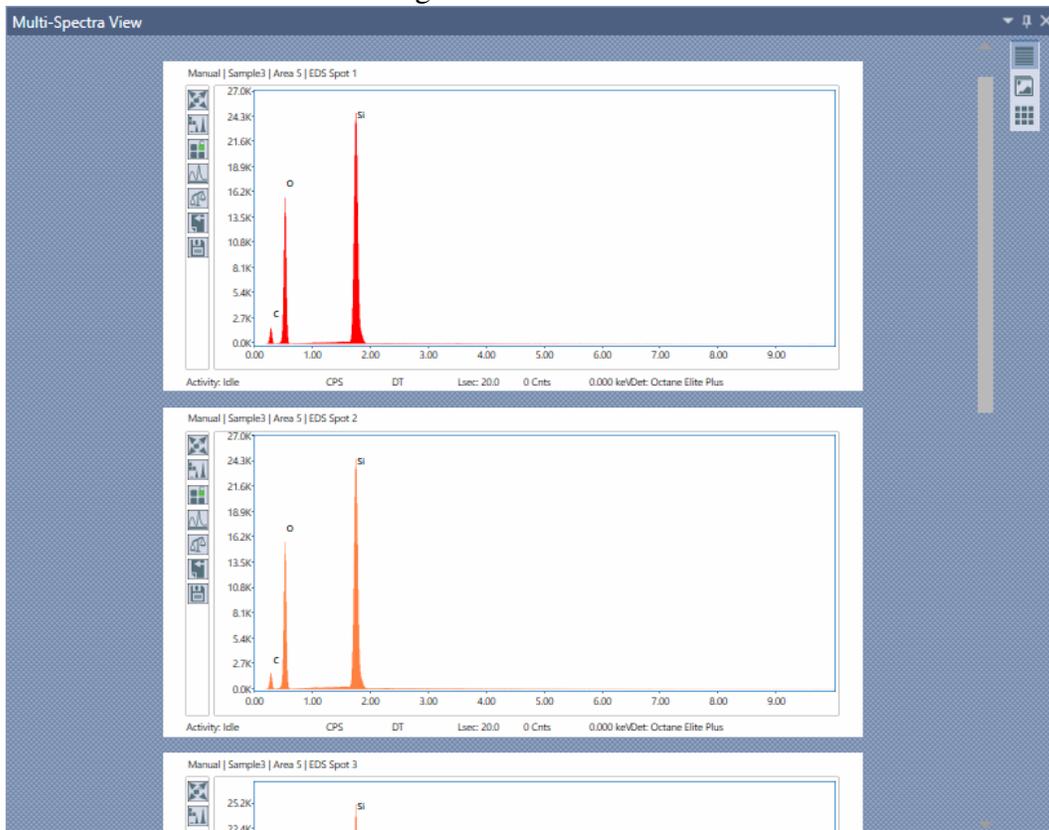


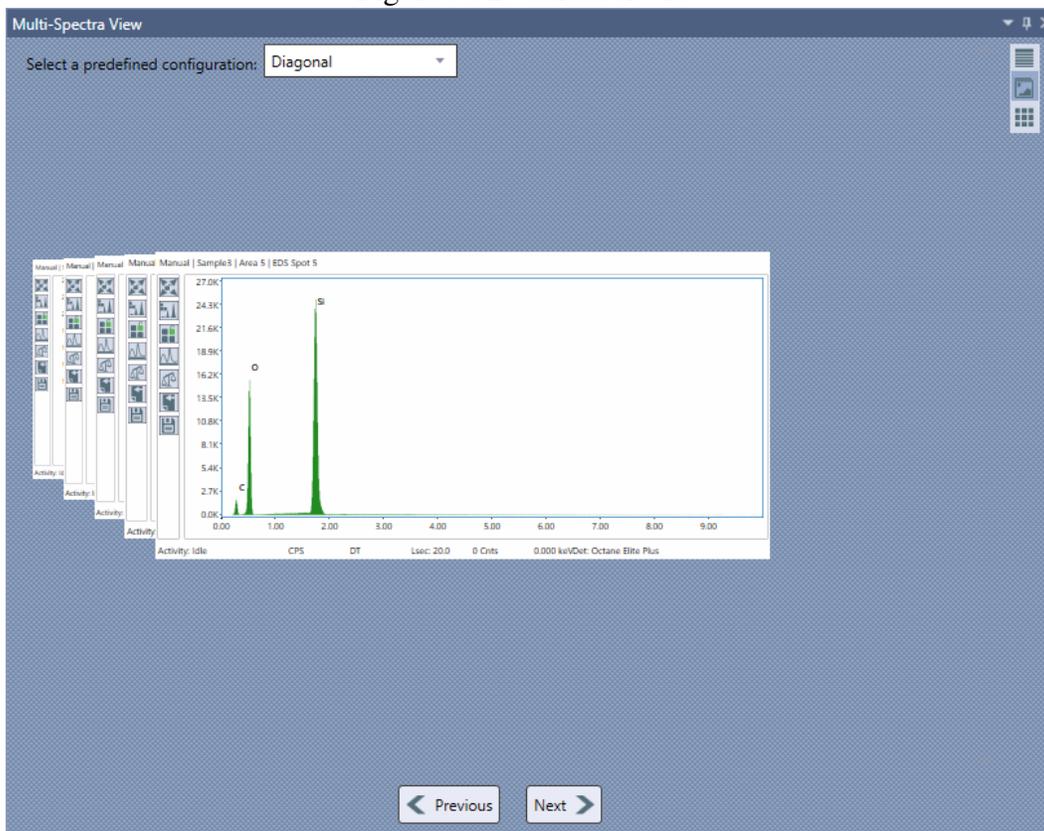
Figure 3.31: List View



3.3.6 Spectrum Matching (Optional):

- **Match Method:** There are two types of matching possible, Chi-Squared fit on Concentration or on the Raw Spectral Channel Data. Use the drop-down menu to select a method.

Figure 3.32: Carousel View



- **Match Sensitivity:** The minimum fit threshold required to report a match to the unknown. Adjusted the threshold by using the slider bar to set a percentage.
- **Library→Open:** Use this option to load a saved spectrum match library file. Click open and select a file from the local computer.
- **Library→Match:** Runs a spectrum matching search using the currently defined match library for the best possible matches against the currently displayed spectrum. The spectrum matches will be displayed in overlay on the spectrum display. The name of the currently loaded spectrum match library file will be displayed below the open/ match icons.
- **Search:** Displays a setup window for defining, reviewing or modifying a match library file. To load an existing match library *double click* on the name in the spectrum matching library panel, or click on the name and then the **Load** button. To create a new library or modify an existing select the project(s) or project nodes that contain the desired match spectra and click the **Search** button at the bottom left of the window. This will populate the search result list, where individual spectra can be selected to display them in the mini-spectrum view. Spectra can be removed from the list by the delete button. Once the list is complete, the library can be saved by clicking on the **Save** button. If desired, a filter can be added to the search via the **Add** button above the search window. There are three filter types for searching: **Date**, **Element**, and **Analysis conditions**. After setting a new search filter, click **Search**.
- **Date:** Allows the user to filter search results based on the spectra date. The start and end date must be provided.
 - **Element:** Allows the user to filter search results based on the elements in the spectra. See below for details.

3.3. SPECTRUM VIEW WINDOW

Figure 3.33: Grid View

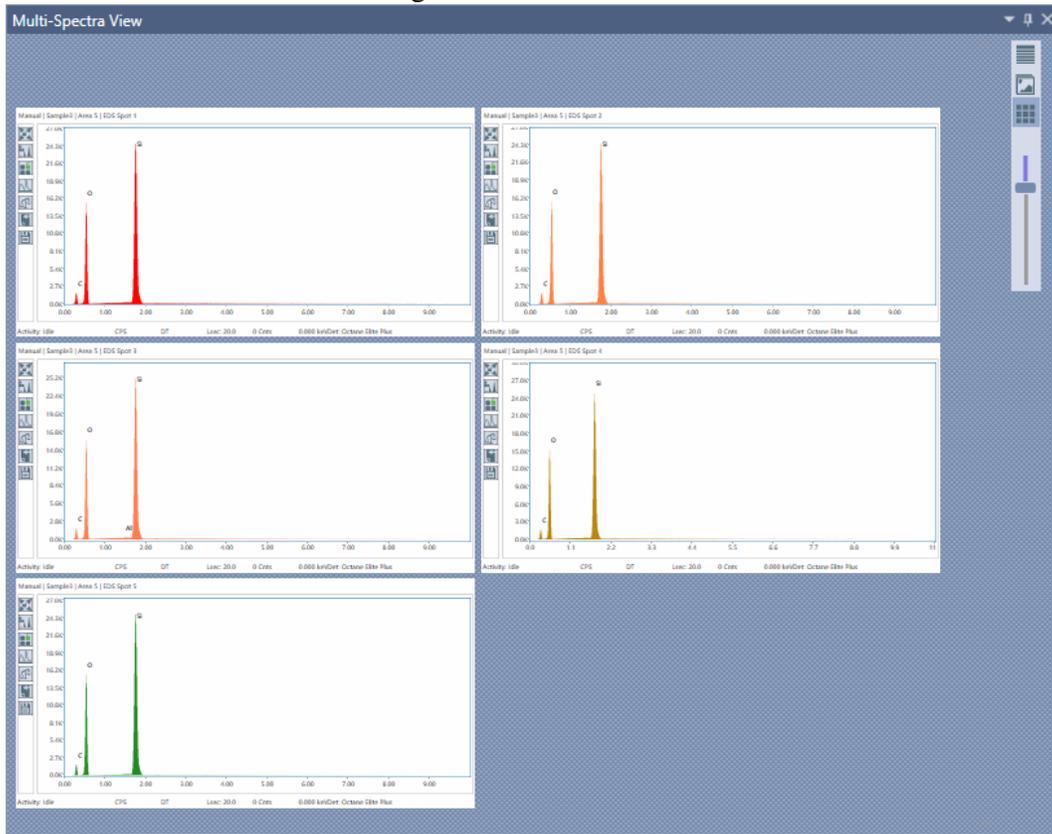
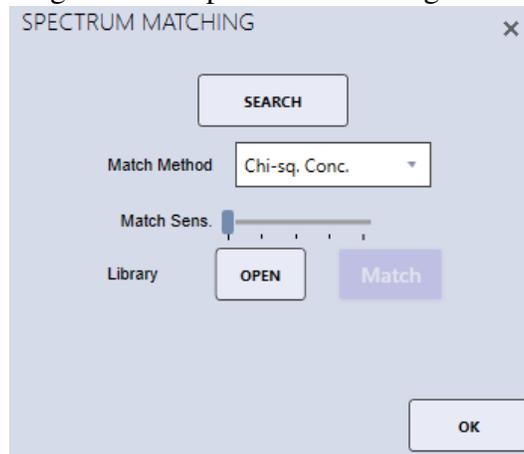


Figure 3.34: Spectrum Matching Menu



3.3. SPECTRUM VIEW WINDOW

Figure 3.35: Spectrum Search Window

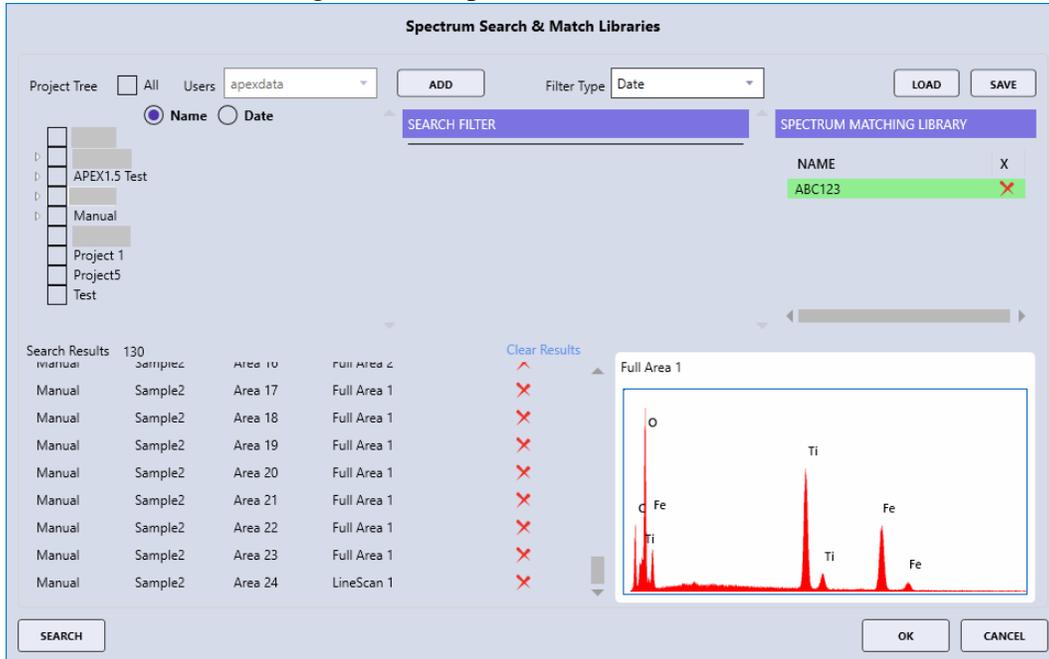
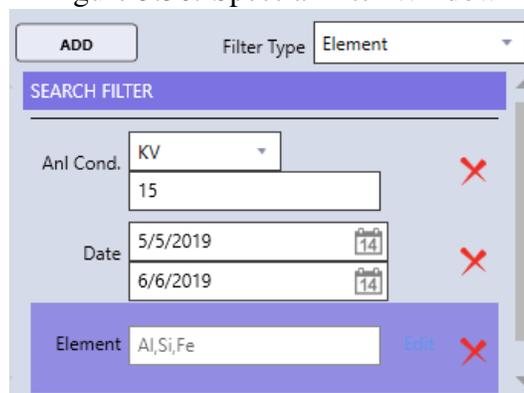


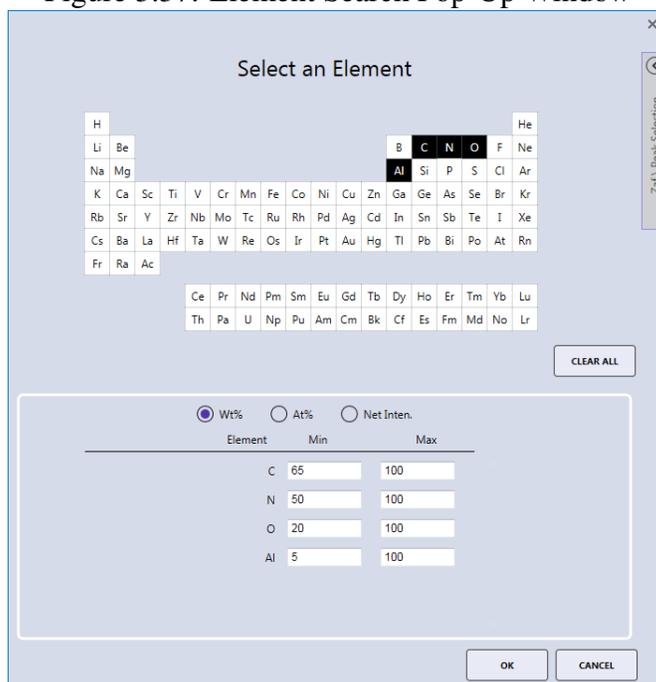
Figure 3.36: Spectra Filter Window



- **Analysis Conditions:** Allows the user to filter search results based on the kV or name of the spectra.

When in **Element** mode, clicking the **Add** button brings up a pop-up window that allows the user to define which elements to filter search results based on by using the periodic table and input the elemental concentration or intensity min/max range.

Figure 3.37: Element Search Pop-Up Window



After the spectra have been selected and the preferences for spectrum matching have been set, click the **Match** button in the spectrum matching menu. The software will perform the matching process to the active spectrum that is currently displayed. The first three spectra from the match library file will be displayed overlaid the original spectrum. In the top right of the main spectrum window, the names of the matched spectra and their matched fit percentage, set by the match sensitivity option, are displayed.

3.4 Linescan View → Image Window

When in linescan mode, the spectral lines of each element appear in the image window, overlaid on the image. The user can check or uncheck the boxes on the top of the image to display the profiles of each element.

In the image below, all elements have been unchecked except the Fe K profile, therefore; only the Fe K is now displayed. To send the image to the folder defined in User Preferences, right click on the image and select **Send to Folder**.

3.5 Multi-Map View Window

When in mapping mode, the **Multi-Map View** window displays the different types of maps that the software compiles, as thumbnails in the same window. The name, data type (Field of View/SEM image,

Figure 3.38: Spectrum Matching Overlay

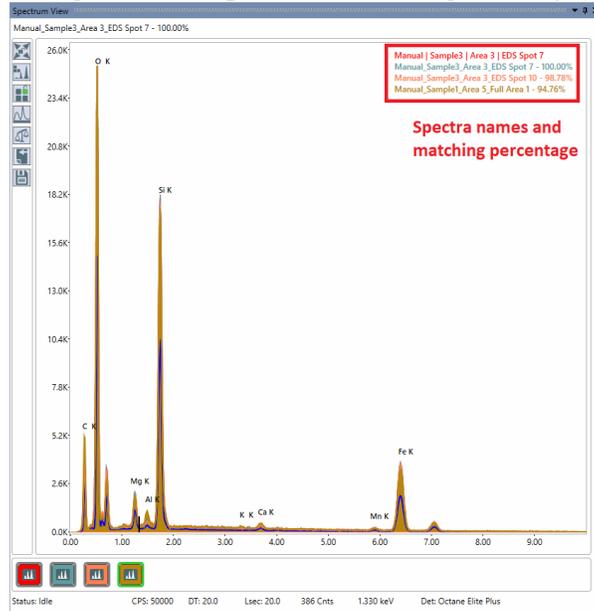


Figure 3.39: Linescan View

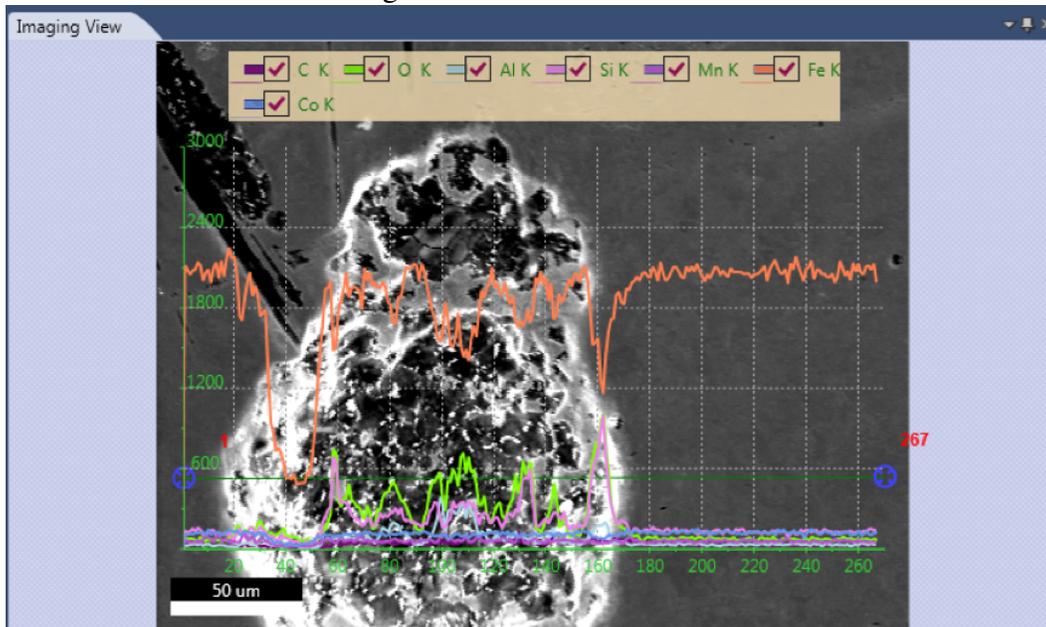
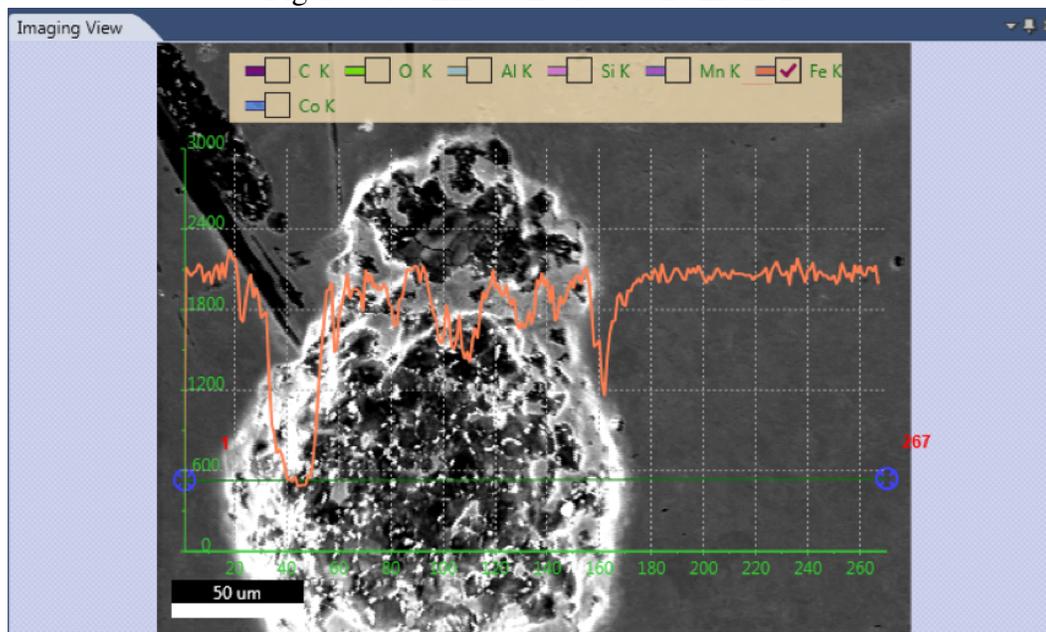


Figure 3.40: Linescan View: One Element



CPS map, region of interest (**ROI**), net intensity (**NET**), weight percentage (**Wt%**), or atomic percentage (**At%**)), and the maximum intensity of each map is displayed below the map. Maps are automatically collected in ROI mode or optionally NET but can be post processed in ROI, NET, Wt% or At% mode.

The status bar, on the bottom of the screen, displays the **Frame**: frame number currently being collected over the total number of frames, the frame time (**FT**): how long each frame takes to collect, the **Remaining**: the time remaining for map collection, and a **Progress Bar**: a visual representation of how much of the map is completed.

Image-Map Overlay:

Clicking a specific map thumbnail will transfer that image to the main image view. Clicking on several maps will result in an overlay of the maps onto the large single image view. The maps with **checked** check boxes will be displayed. To add a map to the overlay, click the check box. To remove a map from the overlay, uncheck the check box.

Overlay on Field of View and CPS map/CPS normalization

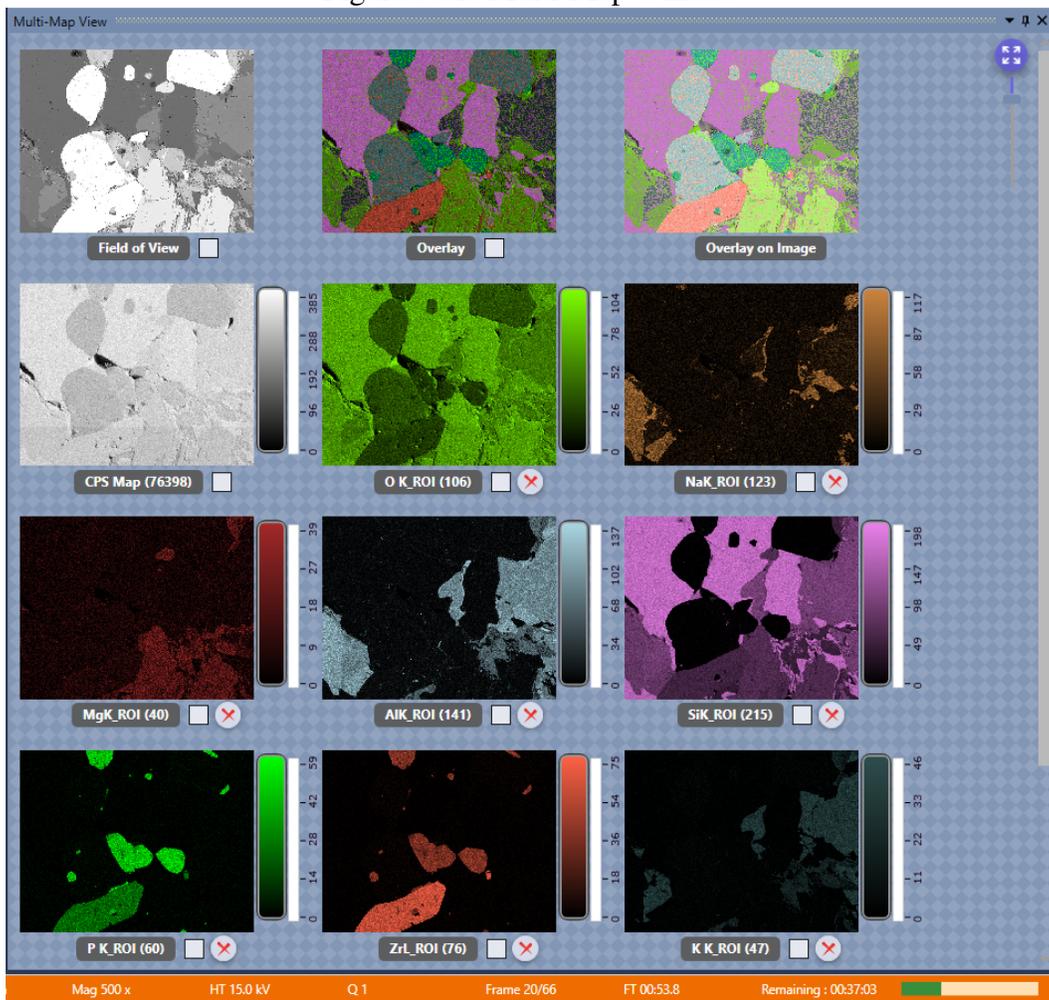
If the Field of View is selected along with one or more elemental maps, the elemental maps will be transparent to show the SEM image below. If the CPS map is selected along with one or more elemental maps, a CPS normalization will be applied to the elemental maps.

Zoom:

Clicking the zoom arrow icon, located in the upper right side of the multi-map view window, turns on/off the **Manual Zooming Function**. When manual zoom is on, the scroll bar, below the zoom icon, can be used to set the amount of zoom applied to the thumbnail display. The amount of zoom also affects the number of maps displayed on the screen. When the scroll bar is all the way at the top, it is at the

3.5. MULTI-MAP VIEW WINDOW

Figure 3.41: Multi-Map Window



maximum zoom factor and only one map will be displayed. Depending on the amount of zoom applied, there is a vertical scale **Intensity Bar** to the right of each map showing its corresponding intensity scale.

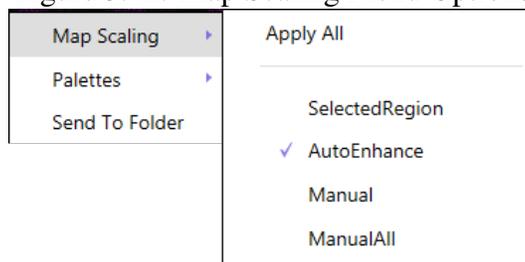
3.6 Mapping Pop-Up Menu:

To display the **Mapping Pop-up Menu**, right click on any of the maps. The menu has three main functions: **Map Scaling**, **Palettes**, and **Send to Folder**. The functions and their options are explained below.

Map Scaling:

Map scaling enables the user to select a range of values, based on the collected intensities, for the map display.

Figure 3.42: Map Scaling Menu Options



- **Apply All:** When checked, the intensity settings will be applied to all maps in the display.
- **Selected Region:** Allows the user to define a low and high threshold in the histogram to extract a spectrum from. See below for histogram details.
- **Auto Enhance:** Suppresses hot and cold pixels and enhances contrast by using 95% of the total histogram data for display. The intensity bar advanced options are not accessible in auto enhance mode. See below for intensity bar advanced options.
- **Manual:** Allows the user to manually adjust the intensity of one map.
- **Manual All:** Applies the manually set intensity value to all maps. This mode is most useful for quantitative maps where all maps can be scaled to one value.

Intensity Bar Advanced

: In modes other than *Auto Enhance Mode*, the vertical intensity bar changes to display more advanced features. There are two **red** arrow sliders and two **grey** round sliders to select other optional modes. The **red** sliders are used to adjust the contrast of the map. The contrast of the map below has been adjusted by lowering the upper red slider. The left map's upper slider is at a value of 86 counts while the right's is at 21 counts.

Histogram Settings

: The histogram used for spectrum extraction is compiled by sorting map pixels based on their intensity. These intensities are then normalized and displayed as a histogram. Clicking the **Bottom Grey Round Button** will display the histogram of the map data. Clicking on the button again (which is now rainbow colored), will **Close** the histogram window.

Figure 3.43: Intensity Bar Advanced: Contrast Adjustment

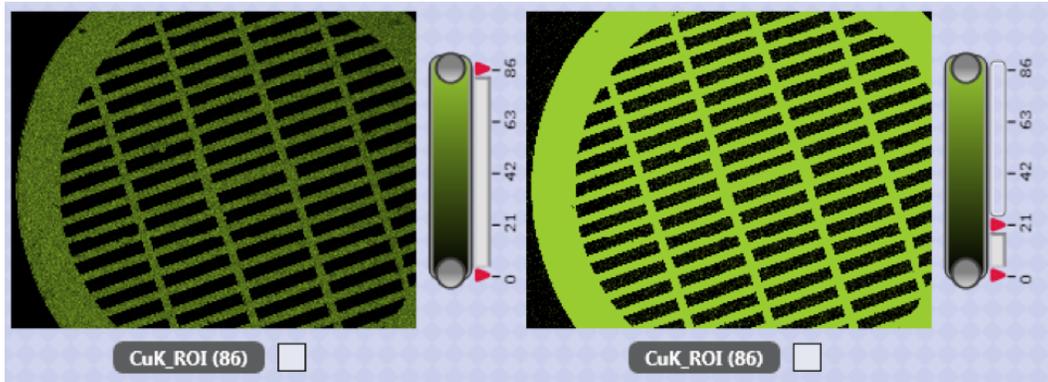
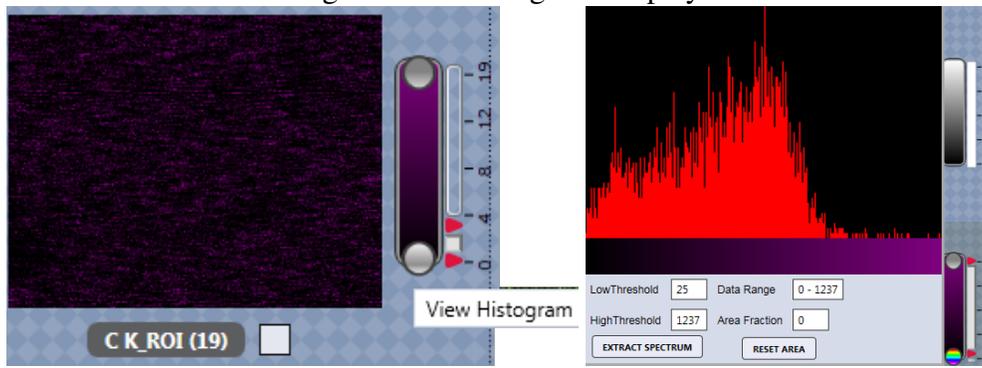


Figure 3.44: Histogram Display



Below the histogram, the upper and lower threshold values for spectrum extracted can be entered. After entering a range of values, the data range and fraction of the total area selected will be displayed. Click **Extract Spectrum** to apply these values. To reset the threshold values, click **Reset Area**. Clicking the upper gray round button will extract and display the map's **Intensity Range Spectrum**. The range of values is displayed in the title bar of the spectrum.

Palettes:

The palette function allows the user to set the color palette to one of the two options: **Color** and **Thermal**.

- **Apply All:** When checked, the currently defined palette settings will be applied to all maps in the display. To define specific maps to the current palette, uncheck this option.
- **Color:** Displays maps using 256 shades of a single color.
- **Thermal:** Displays maps using a standard thermal palette with 256 shades between black and white.

Send to Folder:

The **Send to Folder** option sends the currently selected image or map to the folder specified in the user preferences window. The map is saved as an image and .csv file.

Figure 3.45: Intensity Range Spectrum

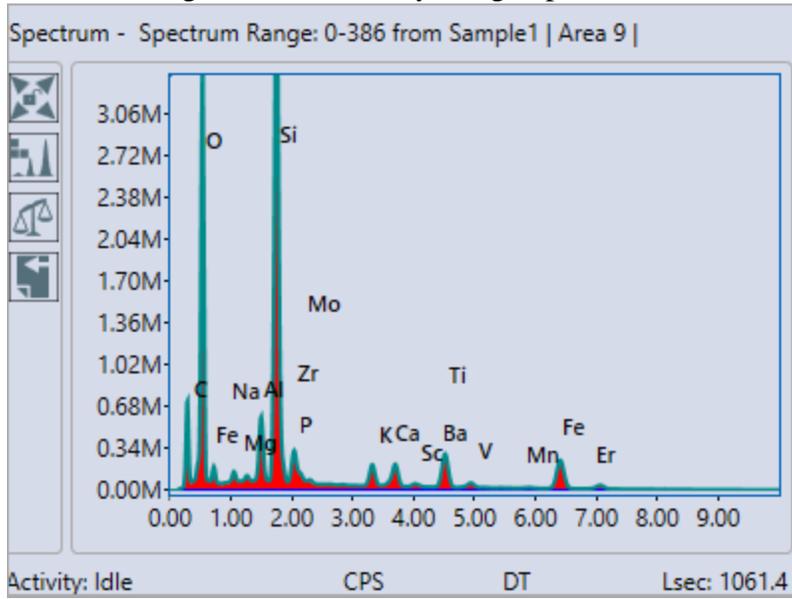


Figure 3.46: Map Scaling Menu Options

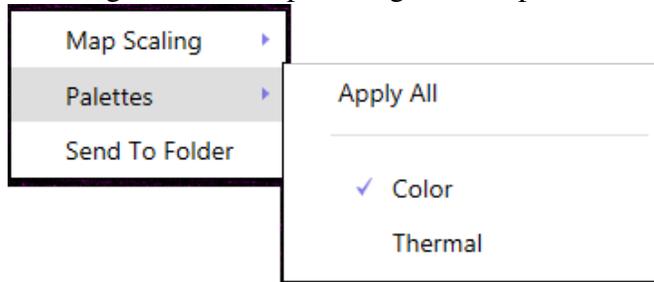
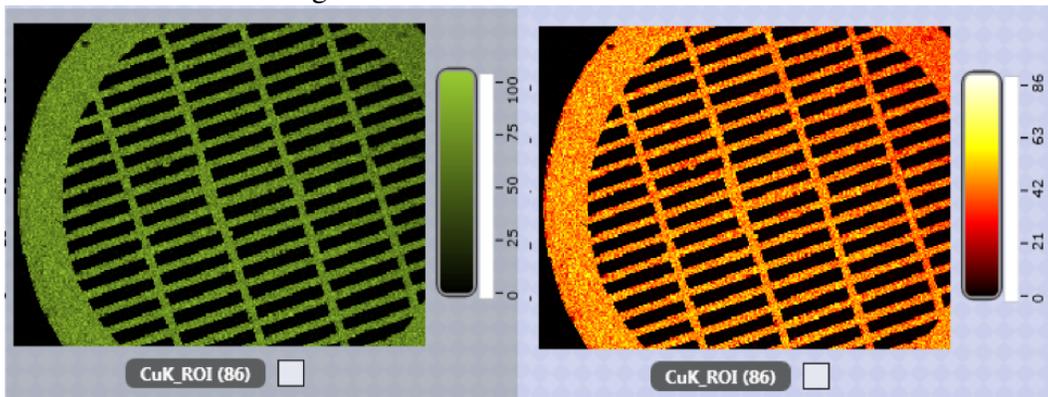


Figure 3.47: Color vs. Thermal Palette



Chapter 4

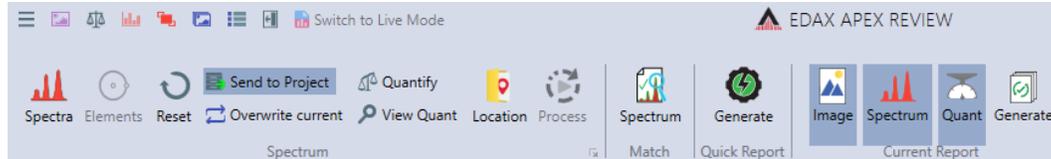
Review Mode and Toolbars

After data has been collected using one of the three collection modes, it can be reviewed and revised in review mode. To enter review mode, click the **Switch to Review Mode** icon in the title bar toolbar.

4.1 Spectrum Review

The first block of the spectrum review toolbar is for **Auto Reprocessing** multiple spectra. This is primarily used if a series of spectra need to be analyzed for an element that was omitted in the original run.

Figure 4.1: Spectrum Review Toolbar



- **Spectra:** This icon brings up a window in which the user can select which spectra will be processed.
 - **Projects:** Located at the top of the spectra processing window, this drop down menu allows the user to select which projects will be processed. The projects can be sorted by **Name** or **Last Accessed Date**. The window has two columns: **Project Spectra** and **Selected Spectra**. Use the arrows to copy the desired spectra to the right column. Only spectra with checked boxes will be copied. When all the desired spectra appear in the **Selected Spectra** column, click **OK**.
- **Elements:** Use the elements icon to modify the original element list. A pop-up window is displayed which allows the user to add or remove elements from the quant results. Use the add and remove icons on the left side to control these functions. All elements with blue checks checks will appear in the quant results while all elements with red slashes will not.
- **Reset:** Clears all changes made so far.
- **Send to Project:** Saves all processed spectra to the current project.
- **Overwrite Current:** Once the spectra are processed, use this icon to overwrite the original element list.
- **Quantify Spectra:** Reapplies quant to all selected spectra.

Figure 4.2: Spectra Processing Window

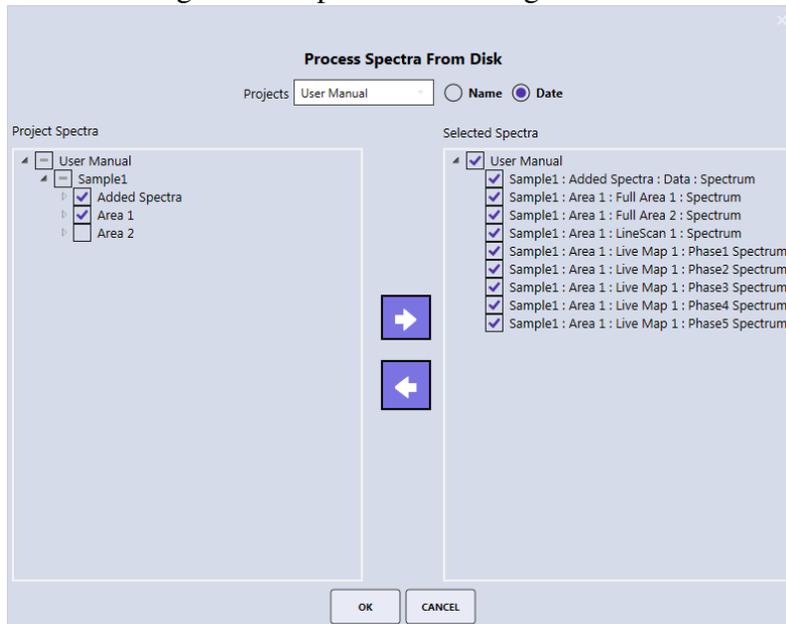
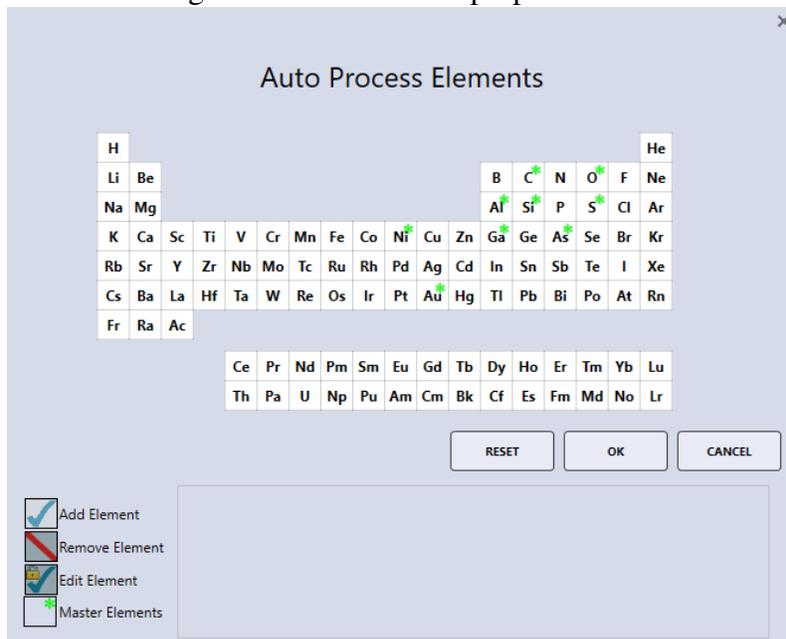


Figure 4.3: Elements Pop-up Window

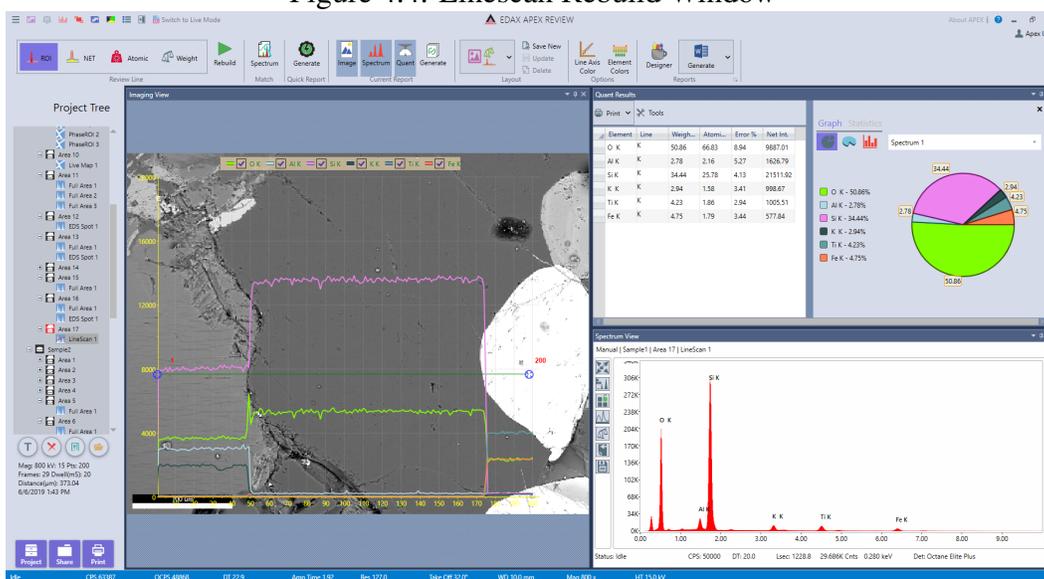


- **View Quant:** Outputs all quant results from the spectra to the quant window.
- **Location:** Defines a folder location where the summary XLS file will be stored.
- **Process:** Starts the spectral batch processing.

The arrow in the bottom of the spectrum portion of the toolbar brings up the Spectrum Advanced View window. See section 3.3.2 on page 47 for more information. The **generate** icon is used to create a report. See section 5 on page 69 for more on reporting.

4.2 Linescan Review

Figure 4.4: Linescan Rebuild Window



Clicking on any point on the line in the imaging view will display the associated spectrum and quant results. To remove an element from the overlaid display in the imaging view, uncheck its corresponding check box. To add an element to the display, check its corresponding check box.

Linescan Review Toolbar:

Figure 4.5: Linescan Review Toolbar

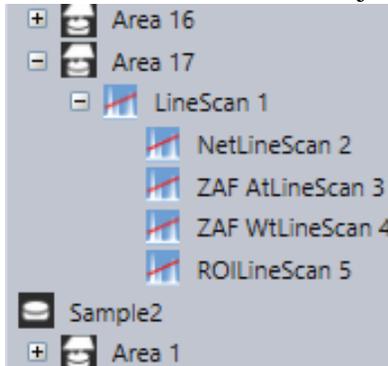


- **ROI, NET, Atomic, Weight:** These icons allow the user to select the wanted output data. Linescan data can only be acquired live in ROI mode but the rebuild options enables users to define NET, atomic %, and weight % linescans. Additionally, elements can be added or removed from the element list. To select a rebuild method, click one of the four icons.

- **Rebuild:** After selecting an icon, click the **Rebuild** icon. The periodic table will be displayed and elements can be added to or removed from the linescan rebuild. Click the **OK** icon to start the rebuild process. To stop the linescan rebuild process, click the **Stop** icon. The rebuild time will depend on the number of points and elements in the linescan.

In the project tree, each rebuild is placed under the original linescan's collection and is given a sequence number. The rebuilds are also named according to the type of rebuild performed: NET, ZAF Weight, ZAF Atomic, and ROI.

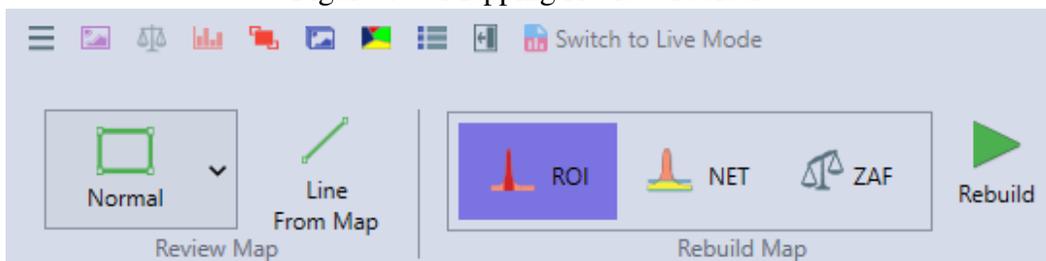
Figure 4.6: Linescan Rebuild Project Tree



4.3 Mapping Review

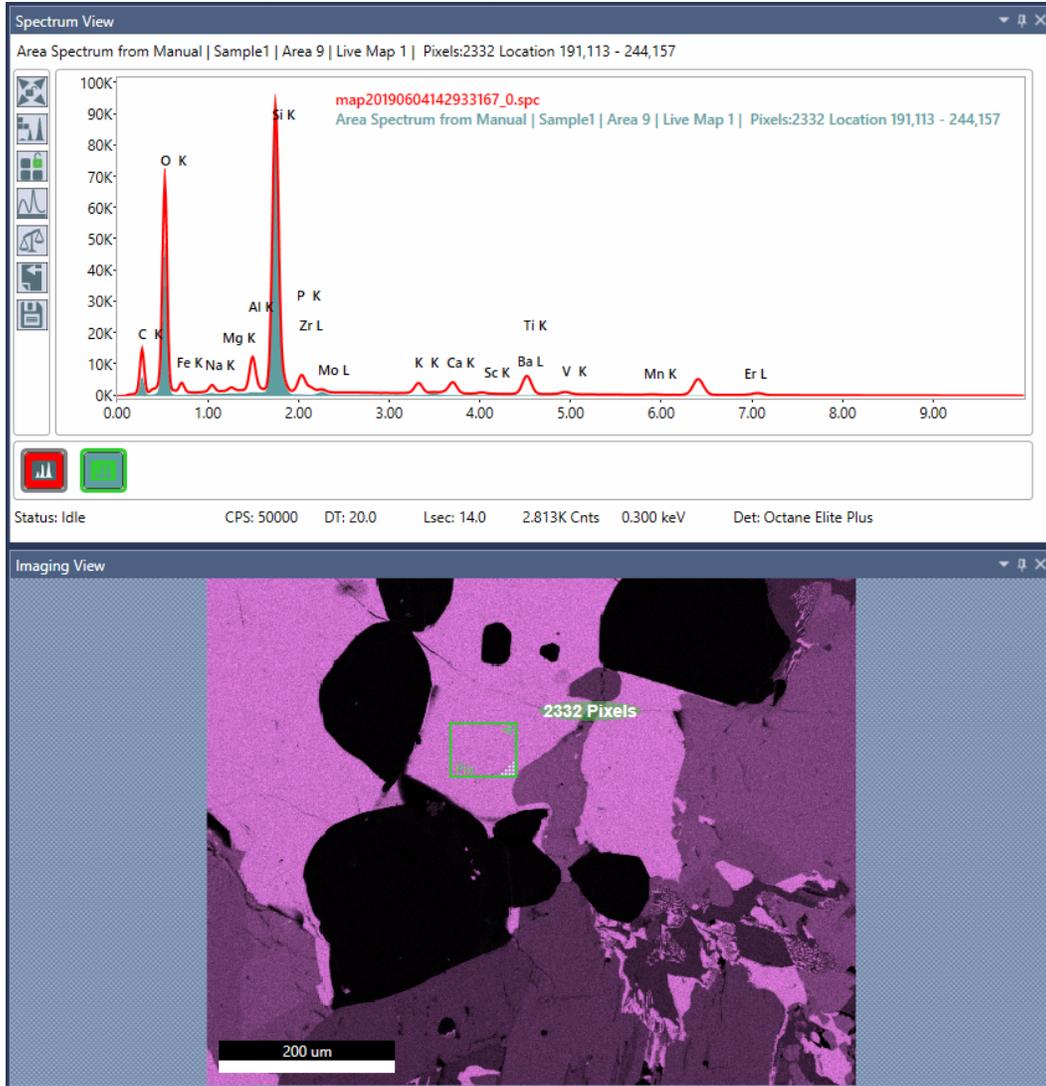
After collecting a map, there are two options in review mode: **Review** and **Rebuild**. Review mode enables users to select a portion of the existing map and extract the data from that selection. Rebuild mode reprocesses the map with the ROI, NET, or ZAF option.

Figure 4.7: Mapping Review Toolbar:



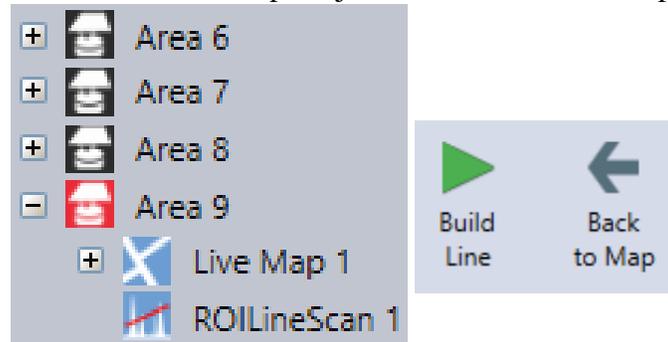
- **Review Map:** Extracts the spectrum from spot or rectangular area selected by the user.
 - **Normal:** Enables the user to select a rectangular area for extraction. Click the **Normal** icon and select an area on the image view. The number of pixels selected is displayed on the image and the spectra. The spectral display will automatically update each time the area is redefined.
 - **Free Draw:** Enables the user to select an area, via drawing, for extraction. Click the **Free Draw** icon and select an area on the image view. If a point location is defined, left click and drag on the X/Y values next to the point to move to a new spot. The spectral display will automatically update each time the area is redefined.

Figure 4.8: Mapping Review → Normal Mode:



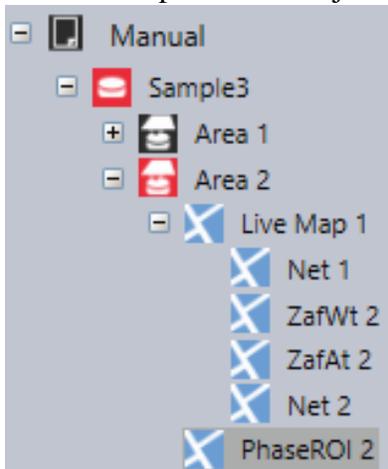
- Line from Map:** This option extracts a line profile from the collected X-ray map. Click the **Line From Map** icon and then draw a line on the map to see a profile. The current element list will be displayed on the image view. Click **OK** to start the linescan generation. After the linescan is created, it will appear on the project tree below the map data with a sequence number. Each linescan will also be labeled according to the type of extraction: ROI, NET, or ZAF. To build another linescan, use the **Back To Map** icon to return to the mapping display.

Figure 4.9: Line from Map Project Tree and Back to Map Icon:



- Rebuild Map:** Maps can be rebuilt into three types of data: **ROI**, **NET**, or **ZAF**. The ROI maps display is in scaled raw counts, the NET maps display in background subtracted counts per second, and the ZAF (quant) maps from a scale of 0-100 weight% or atomic%. In the project tree, each map rebuild is assigned sequence number named by the type of rebuild. In the ROI and NET modes, a single output data set will be created, but rebuilding using ZAF mode creates NET, ZAF Atomic %, and ZAF Weight % datasets.

Figure 4.10: Map Rebuild Project Tree:



- Rebuild:** Use this icon to start the rebuilding process. The rebuild list of elements will appear on the screen for selection at the start of the process.

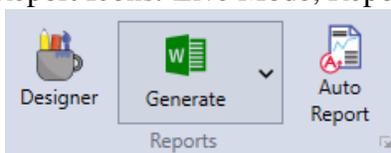
Chapter 5

Reporting and Printing

5.1 Report Generation: Live Mode

APEX™ allows users to easily create reports in Microsoft Word or PowerPoint, while in still live mode. The report icons, in the top right corner of the collection toolbar, enable the user to generate a report using pre-existing template or design a template. To use a pre-existing template, select one of the options from the drop down menu. A preview of the report will be displayed as the mouse is hovered over each option.

Figure 5.1: Report Icons: Live Mode, Report Generating



Report Designer

To create a report template for future use, click the **Designer** icon on the collection toolbar. This will open a blank template that can be customized.

On the right side of the screen, select a report type from the drop down menu and then select *Insert Across* or *Insert Down* to specify the layout of the report. Use the **Insert Spectrum** and **Insert Image** icons to add wanted features to the report. Currently the template only supports one spectrum and one image per page. Extra pages and a company logo can also be added to the template using the corresponding icons. To save the template, enter a file name in the box and click the blue **Done** icon. This template will now appear in the Report Template Menu for future use.

Auto Report

Clicking the **Auto Report** icon will enable Auto Report and change the icon color (shown in Figure 5.5). When Auto Report is enabled, the report engine will generate a report as soon as data collection finishes (orange dots will appear under the **Generate** icon while the report is loading). New data collection will be added to the report automatically as long as **Auto Report** is turned on. Since the report engine works independently, data collection and review can continue while the report is being generated.

Figure 5.2: Report Template Drop Down Menu

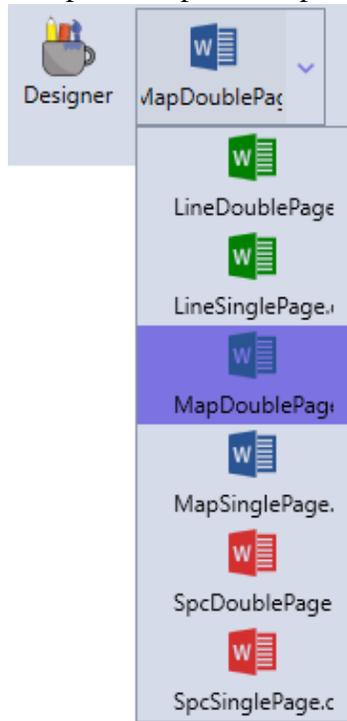


Figure 5.3: Blank Word Report Template

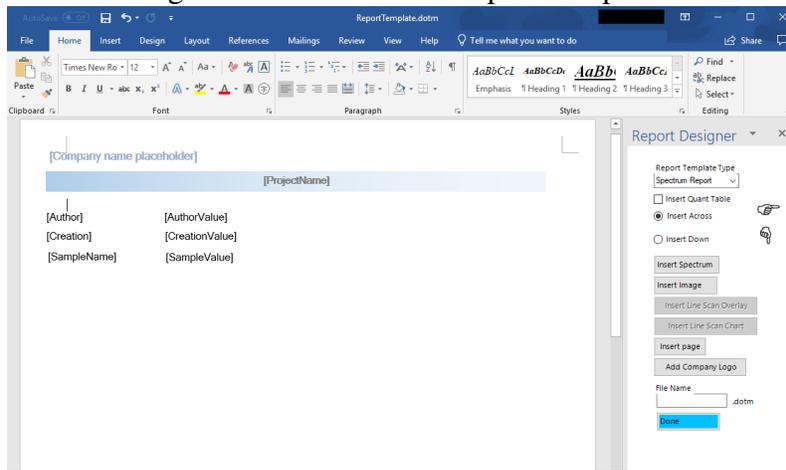


Figure 5.4: Populated Word Report Template

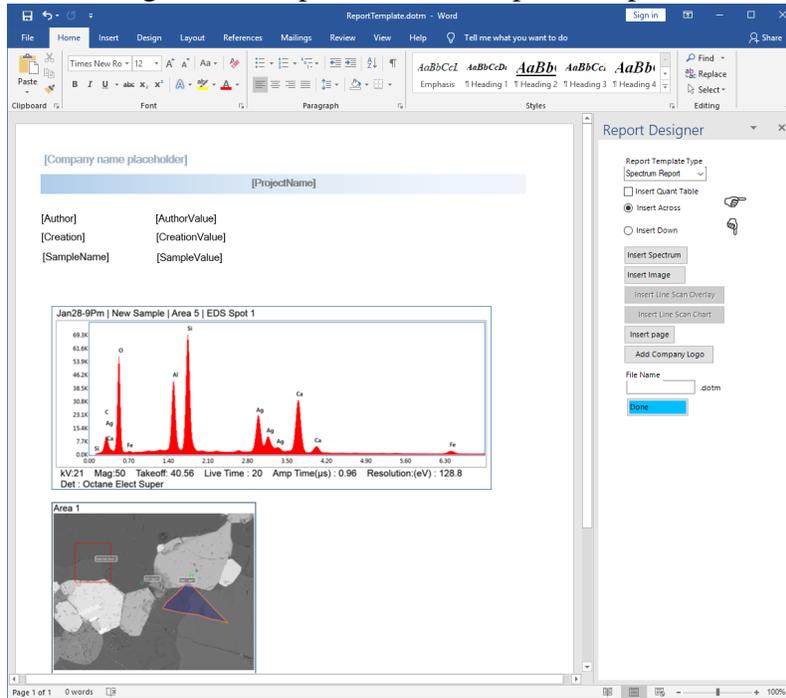
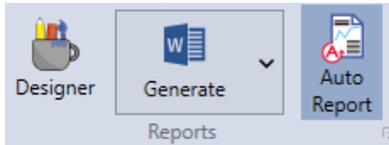
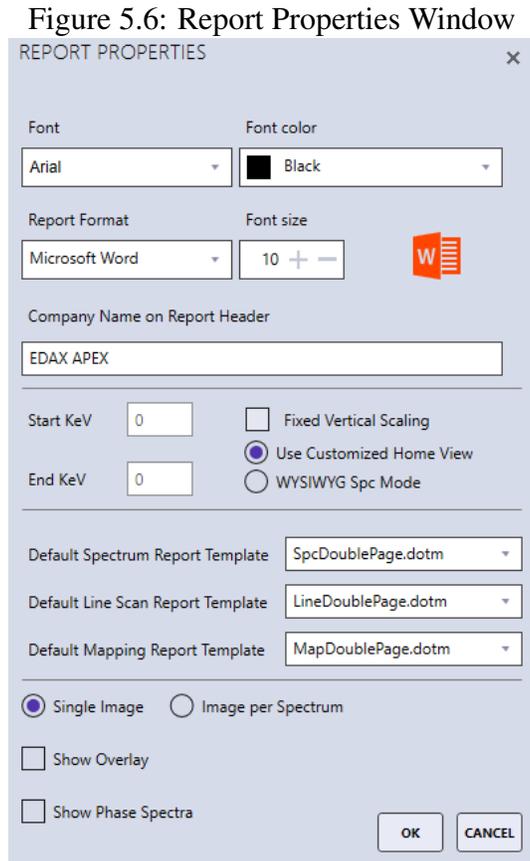


Figure 5.5: Word Report Icons: Auto Report On



The report template, for auto reporting, for each collection mode, can be specified using the drop down menu. *Note: The auto report function will **not** generate a report if a template is not specified.* The number of images included in the report as well as the option to display map overlay can also be customized using this menu.

Report Properties Window



To access the Report Properties Window, click the arrow icon next to the word **Reports** in the collection toolbar. This window enables the user to customize the font and formatting of reports. To select a font type, color, and size for reports, use the drop down menus next to these options. Use the checkboxes to enable or disable **Fixed Vertical Scaling**. Start and End KeV values are loaded from the Customized Home View on the Spectrum view and are read only values. When **Use Customized Home View** radio button is selected, the spectrum on the report will have the corresponding start and end KeV values. **WYSIWYG Spc Mode** will generate the spectrum on the report the same as on the screen.

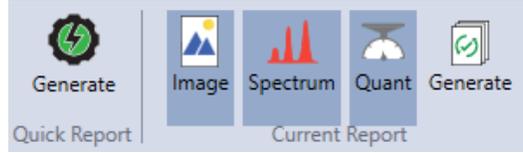
5.2 Spectrum or Linescan Report: Review Mode

To generate a report, not using Microsoft Word or PowerPoint, the software must be in **Review Mode**. To enter review mode, click the **Switch to Review Mode** icon on the title toolbar. Review mode can also be accessed by double clicking on a project tree node. This will load that specific data-set in review mode.

Figure 5.7: Switch to Review Mode Icon:

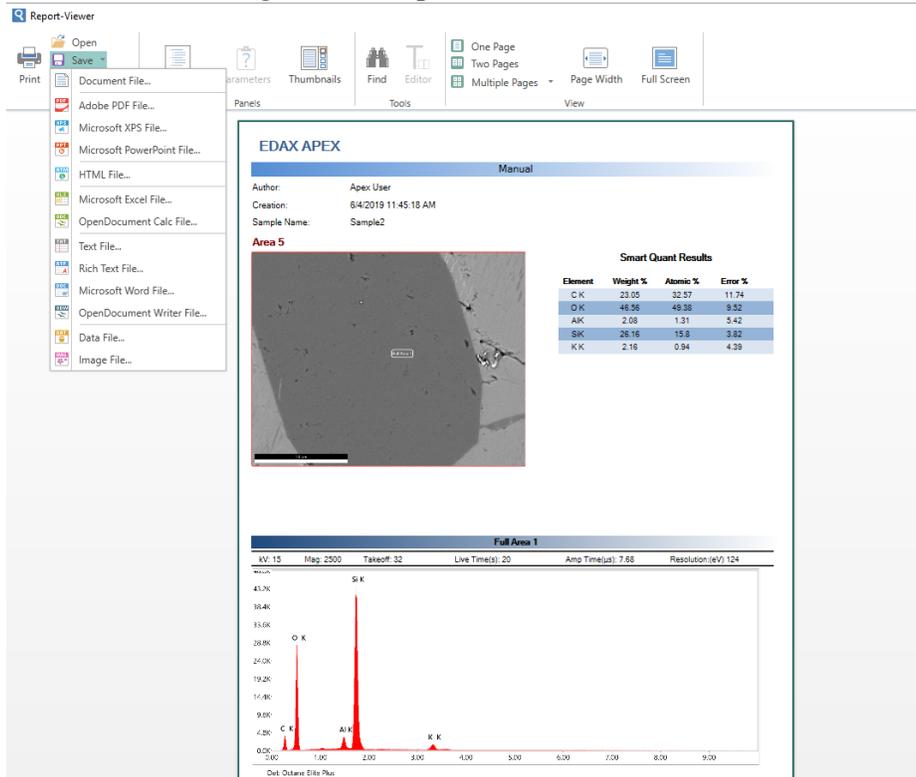


Figure 5.8: The Report Toolbar:



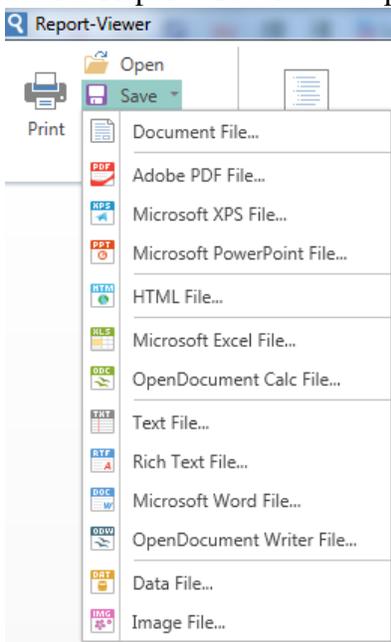
There are two options for creating reports: **Quick Report** and **Current Report**. The quick report mode creates multiple page reports with all data while the current report mode offers a selection of which data to include. To create a report, click one of the two **Generate** icon located in the *Quick Report Area*, on the left, or the *Current Report Area*, on the right. Clicking the **Image**, **Spectrum**, and **Quant** icons will add or remove them from the current report. When an item is selected, it is highlighted grey and will appear in the report. When in *Linescan Mode*, checking or unchecking the element check boxes displayed on the image overlay will add (checked) or remove (unchecked) elements from the report.

Figure 5.9: Report Viewer Windows:



Clicking the **Generate** icon will open the report in the **Report Viewer**. From there, the report can be saved as a number of different formats, such as: PDF, XPS, PowerPoint, Excel, and HTML. To access the save options in report viewer, simply click on the **Save** icon and a drop-down menu will appear. The report can also be sent directly to an Outlook email account via the **Email** option. The display of the report can be adjusted using the **Zoom** function in the bottom right of the report viewer.

Figure 5.10: Report Viewer Save Options:



Multiple Spectra Report:

Double click on an area or sample in the project tree to display all of the spectra under that node. The wanted spectra can also be dragged and dropped in the display window to show multiple spectra. Once the spectra are displayed, to generate a report with one spectrum per page, click **Quick Report**→**Generate**. To generate a report with all the spectra overlaid on one display, click current report→generate. In current report mode, use the spectra, quant results, and image icons to display/hide items from the report.

5.3 X-Ray Map Report: Review Mode

When in mapping review mode, use the **Quick Report** or **Current Report** option to create a report. Use the check-boxes next to each element map to select (checked) or remove (unchecked) maps from the report.

- **Quick Report:** When quick report is selected, all of the collected maps (except the CPS map) will be sent to the report.
- **Current Report:** When current report is selected, only the maps selected (via their check boxes) will be sent to the report. Use the spectrum icon to add (highlighted) or remove (not highlighted) the **Sum Spectrum** from the report.

5.4 Print Results

There are multiple options for printing data and images collected in APEX™. Items sent to the printer can also be saved as PDF files for easy access and sharing.

- **Print Image:** To print an image, use the **Send to Folder** option on the image view. Then, open the saved image the folder and print the image.
- **Print Spectrum:** To print a spectrum, use the *Send to Folder* option on the spectrum view. Then, open the file to print.
- **Print Quant:** To print quant results, use the *Print Icon* in the quant menu. Click the icon and then select a printing method.
- **Print Screen:** To print the entire APEX™ screen, use the print icon in the bottom left corner of the project tree.
- **Print Report:** To print a report, generate a report in report viewer. Then, click the *Print Icon* in the top left of the screen.

Chapter 6

Data Handling and Backup

Note: The contents of this section may be duplicated in other parts of the manual. They are reiterated here due to their importance.

6.1 Export and Backup Data

The export, import, and merge functions can be located via the icons in the bottom left of the project tree.

- **Export:** Backs up ALL the selected projects.
- **Import:** Temporarily displays data that was exported (usually from some other workstation), but does **not** save the actual data on the local computer.
- **Merge:** Imports the data from a different workstation system, and this data becomes part of the local database. Once data is merged it is permanently on the workstation.

Export Icon:

Clicking the **Export** button will display the following window. Using the check boxes, select the projects to be backed up. In the top right-hand corner of the pop-up window, there are three boxes which enable batch selection of projects.

- **First box: Collapse ALL** → All Project nodes are collapsed.
- **Second box: Check ALL** → All Project nodes are checked (enabled for backup).
- **Third box: Un-Check ALL** → All Project nodes are un-checked. As a default, this is how the window is first displayed.

Next, click the **OK** button and choose a destination folder for data backup and click **Select Folder**. If the selected backup folder already exists the message below will be displayed. Click **Yes** to overwrite and start the backup process. While the backup is running, a progress window will be displayed on the screen. Click the **Stop** button to stop the backup process.

Each project is saved as a *Zip* file and each sub folder is date and time stamped; *i.e.* *Backup on Tue 04.11.2017 At 15.05 PM*. The database entries are in the *.BAK file, the raw APEX data is in the *.ZIP file, and the a name listing of all the backed up files is in the *.XML file.

Figure 6.1: Export Pop-up Window



Figure 6.2: Backup Progress Window

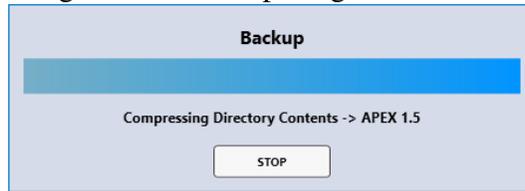


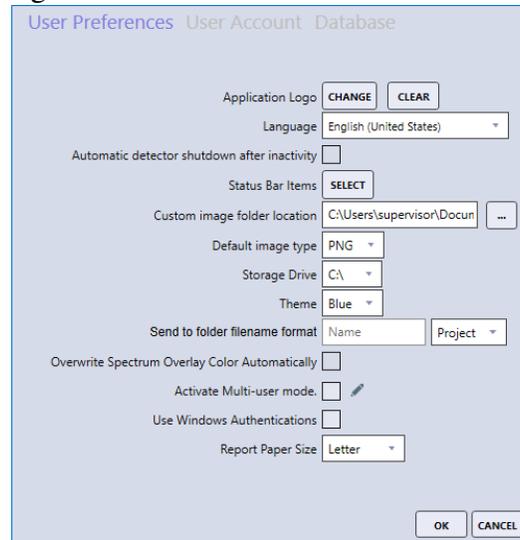
Figure 6.3: Backup File Names

Name	Date modified	Type	Size
APEX 1.5.zip	6/5/2019 2:17 PM	Compressed (zipp...	11,866 KB
backupinfo.inf	6/5/2019 2:17 PM	Setup Information	1 KB
backupInfo.xml	6/5/2019 2:17 PM	XML Document	2 KB
EdaxAcquisitionX.BAK	6/5/2019 2:17 PM	BAK File	6,752 KB

6.2 Automated Data and Database Backup

To provide the easiest, most reliable, powerful data and database backup capabilities available from Microsoft, the Windows Scheduling function has been added to the APEX™ software. In the user preferences menu, use the **Auto Backup Location** option to select a place to backup data. Use . . . button to select an existing location or create a new one. Network and removable drives can be used for data backup.

Figure 6.4: User Preferences Auto Backup



Use the **Auto Backup Schedule** → **Set Schedule** button to select the trigger for when data backup(s) will take place (shown in Figure 6.2). Checking the **Incremental Backup** box will only backup items that were not previously backed up. This process is very fast and efficient because only the new data will be backed up. If there was no previous backup data in the defined folder, a full data backup will be executed. The **Save Database** option includes a copy of the sql database along with the data backup. This option is enabled by default and recommended so that the system can be rolled back in the event of database corruption, only disable it if the backup size is an issue.

Clicking the set schedule button brings up a window that displays the current settings for backups that are defined to take place. Use the **New...**, **Edit...**, or **Delete** buttons to fine tune the backup schedule. When creating a new trigger, there are many different options (shown in Figure 6.5), however, the *On a Schedule* option is typically used. *The recommended settings for the backup are daily at 3 A.M. with the incremental backup and save database options selected. These settings will vary depending on the nature of the system.*

Figure 6.5: Trigger settings

Once set, this backup will always run unless it is changed. The APEX™ software does not need to be running in order for the backup to take place. The EDAX (*.BAK) data backup file will be generated automatically and contains the APEX SQL Databases.

To test the auto backup function, set today's date as the **Start Date**, set the **Time** to two minutes from the current time, and click **OK** to close the auto backup window. A backup folder with the date and time

of the backup will be created in the location defined in user preferences containing a *.ZIP file for each project. The APEX backup speed is based on many factors, but typically the backup rate is between 5-20 GB per minute.

CAUTION: The Restore function will erase all data and APEX™ database from the system, and replace it with the data and database from a version that was previously backed up using the *Auto Backup Schedule*.

6.3 Manual Data Backup

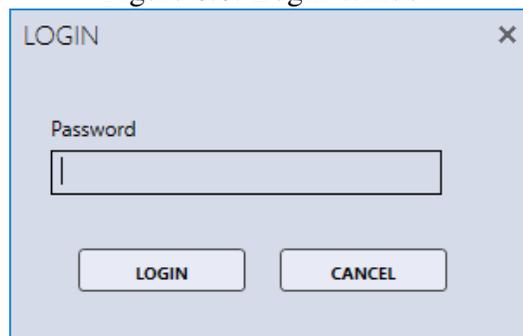
On a Microsoft Windows 7 or Windows 10 workstation, all data collected by APEX™ is saved in the folder and subfolders found at: C:\ProgramData\EDAX\ApexData. The two APEX™ SQL Database files are located in: C:\ProgramFiles\MicrosoftSQLServer\MSSQL12.SQLEDA2\MSSQL\DATA\EdaxAcquisitionX.mdf and DATA\EdaxAcquisitionX.ldf.

The raw APEX™ data is much larger than the database files. It would be prudent to back up the first folder listed above and the two database files to an external source or server to assure there is never a loss of any critical data. However, the frequency of the backups should be often enough to minimize any crucial data loss.

6.4 Restore the APEX™ Database

In the user preferences menu, click to **Restore Entire Database** to restore previous data and databases. This will prompt the user with a login window in which the appropriate EDAX password can be entered.

Figure 6.6: Login Window



Next, click **Login** and a window will be displayed to select an EDAX *.BAK file to restore a previous database and data set. After selecting a file, the restore process will begin and a pop-up progress bar will appear. When the restore is complete, a **Restore Complete** window will be displayed. Reboot the workstation after restoring a database.

Figure 6.7: Restore Progress Window

Note: Network and removable drives CANNOT be used in the restore process.

Chapter 7

Advanced Settings

7.1 Detector Cooling and Slide Control

To access the **Detector Cooling and Slide Control Settings**, click the arrow below the collect icon in the **Acquisition** field of the live view. A pop-up window will be displayed showing the Detector Cooling and Slide Control options. This window displays the detector status and can be used to turn cooling on or off for relevant detector models.

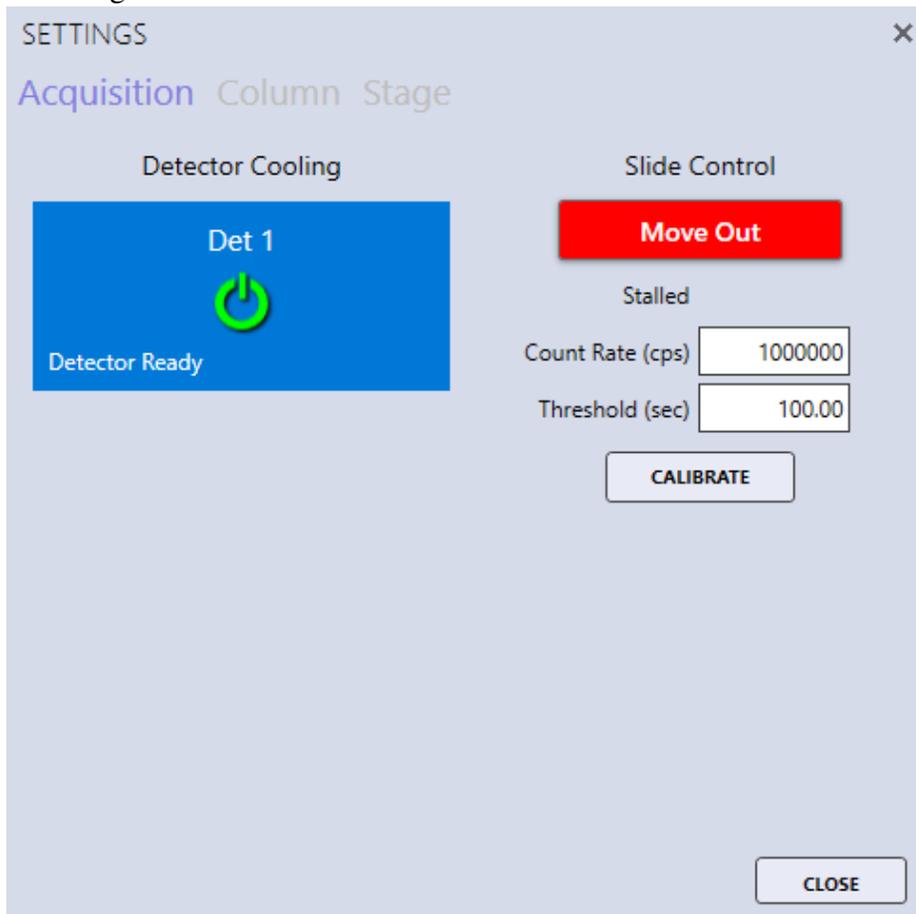
Figure 7.1: Advanced Panel Options



APEX 1.5 introduces a new Slide Control feature. To allow users to manipulate any EDAX slides which may be installed.

Figure 1 shows the advanced panel button circled. Click on this button to open the advanced panel. The advanced panel opens on the right of the APEX window

Figure 7.2: Advanced Panel with Slide and Detector Control



Moving the Slide

Before moving the slide in make sure the detector is ready. To move the slide click the “MOVE IN” button. Once the slide is in the button label changes to “MOVE OUT” and the color changes to green. The slide status will state Slide In. To move the slide out click the “MOVE OUT” button.

Count Rate and Threshold

The Count Rate determines the maximum counts the counts the slide will tolerate while in the IN position. The Threshold is the time limit that the slide will tolerate the maximum count rate before moving out. Figure 4 shows the slide in an “Auto Retracted” state after passing the maximum count rate and threshold.

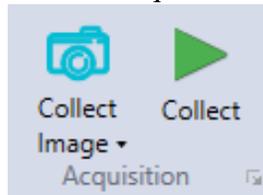
Calibrating the Slide

To calibrate the slide click the Calibrate button. The button will be disabled until the calibration is complete. Slide calibration finds the slides analyze and retract positions.

7.2 Microscope Column and Stage Control

The EDAX Column and Stage control options are only available for certain microscopes and must be installed and configured. To access the **Column and Stage Control Settings**, click the arrow below the collect icon in the **Acquisition** field of the live view. A pop-up window will be displayed showing the Column/ Stage control options. This window is a floating window which enables users to make adjustments while collecting an image and see those changes immediately.

Figure 7.3: Acquisition field



To switch on or off the **Microscope High Tension**, slide the **HT On/Off** slider control. To turn off the high tension after a lengthy analysis, use the **Auto Beam-OFF** check box before starting the analysis. This function is typically used for X-ray maps, linescans, or multipoint spectral analysis.

Click **Stage** to show the stage control options. Use the **X** and **Y** boxes to specify a stage location. Click **Set XY** to move the stage to that location. Click **Read Positions** to update the X and Y values after the stage has been moved via the controls on the microscope.

Note: If the stage and column control options are not available, this window can still be used to set the magnification and KV to match the SEM conditions prior to the analysis.

7.3 Spectral Calibration

It is recommended that the spectral calibration is verified periodically. When the spectrum deconvolution does not match the collection spectra, the software should be calibrated. Typically this is done using an Aluminum and Copper specimen. Load this type of sample into the SEM and adjust the beam current for

Figure 7.4: Column Control

SETTINGS X

Acquisition Column Stage

AUTO FUNCTIONS

AUTO FOCUS STI FINE FOCUS Auto Beam-OFF

AUTO BC COARSE FOCUS

HT On/Off

HT 25.0 kV BRIGHTNESS 40.92 %

MAGNIFICATION 800 CONTRAST 56.57 %

WD 10.12 mm BEAM BLANK 0

SPECIMEN CRT 1 nA SPOTSIZE 12

COARSE FOCUS FINE FOCUS

READ STATUS

CLOSE

Figure 7.5: Stage Control

SETTINGS X

Acquisition Column Stage

X: 0.000 Z: 0.000

Y: 0.000 T: 0.000

R: 0.000

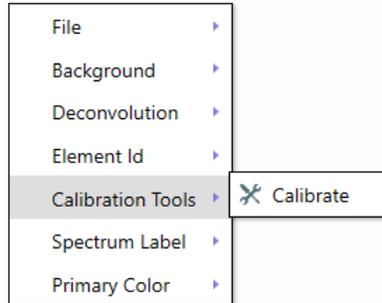
SET XY

READ POSITIONS

CLOSE

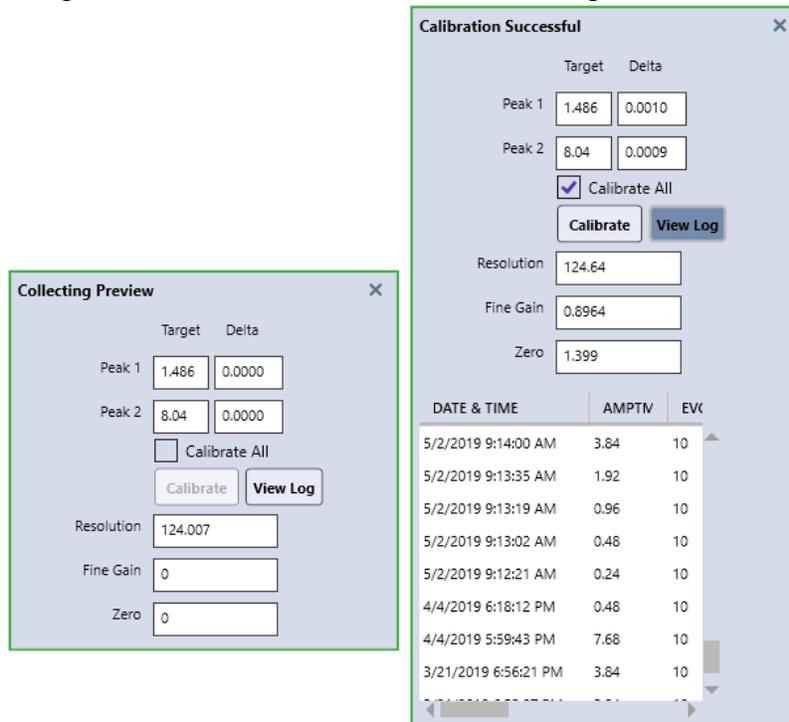
roughly 15,000 CPS. The high tension should be set to **above 25 kV** and the SEM field of view should be adjusted so the Al K and Cu K peaks are of roughly equal height in the spectrum view. Right click on the spectrum view window and select **Calibration Tools** from the options menu. Then click **Calibrate**.

Figure 7.6: Calibration Menu



APEX will immediately collect a spectrum for a short period of time. If an Aluminum and Copper specimen is being used, the target energies are preset in the software and the calibration can be started using the **Calibrate** button. If a different specimen is being used for the calibration, the two target energies must be entered manually, in keV, in the **Peak 1** and **Peak 2** boxes before clicking the **Calibrate** button. It is recommended the energies be large, non-overlapping peaks several keV apart in energy and above 1 keV.

Figure 7.7: Calibration Collection and Complete Windows



Clicking the **Calibrate** button will start the spectrum acquisition and when the two peak energies are within specification, the calibration is complete. During the calibration, the window title will display that calibration is in progress. The window can be moved around by clicking on the title and dragging. The **Delta** values are the difference (in keV) between the target and measured peak energies. Click

the **Stop** button to abort the calibration process at any time. Calibration may take a few iterations to complete, but when Peak 1 is within 1 eV and Peak 2 is within 1.5 eV of the target values, the calibration should complete. If the calibration does not complete in several minutes, click **Stop**. The calibration routine should be run for all amp times.

When the calibration is complete, **Calibration Successful** will be displayed at the top of the calibration window. Use the **View Log** button to display the previous calibrations performed on this system. The log file of calibrations can be found at C:\ProgramData\EDAX\Dpp4Calibration.xml. The log file contains the date and time of the calibration, the amp time and eV/channel used, the fine gain, the zero, the input CPS, the peak energies, the dead time, the detector number, the detector resolution at Mn K α , and the detector temperature.

7.4 APEX™ Tutorials Panel

Click the **Show/Hide the Tutorials Panel** icon in the title toolbar to display the tutorials panel (see page 4 for a description of the title toolbar). It contains useful How-To videos with voice-over, explaining some APEX™ processes and workflows. The **Play**, **Pause**, **Stop**, and **Full Size View** options are located below each video.