# **EMPA Instructions for Geological Samples**

Modified after Johnson Lab Thin Film Instructions

## **Carbon Coating Procedures**

For Edwards Coating System E306A

- 1. Clean polished samples with ethanol and wipe clean.
- 2. Put samples in oven for ~ 1 minute to dry (optional).
- 3. Put a fresh piece of filter paper and clean brass stud on plate.
- 4. If necessary, take out carbon rods and sharpen. (Left-side needs to be flat on the end and the right-side needs to be sharpened ~2-3 mm back and then flattened on end.)
- 5. Put carbon rods back and tighten. (When tightening the right-side, push the spring back and push the carbon rod in, tighten while the spring is loaded so that it will push the carbon rods together.)
- 6. Place samples on filter paper.
- 7. Put bell jar in place over samples.
- 8. Place implosion guard over top of bell jar.
- 9. Turn off airflow by pushing AIR ADMIT button (light turns off)
- 10. Turn handle on front of coater counterclockwise to the ROUGHING position.
- 11. The pressure dial (found at the top-right of the instrument panel) will go up and then will slowly go back down.
- 12. Once the pressure dial reaches the red arrow, rotate the handle clockwise to the BACKING position, then pull the handle out towards you and continue rotating it clockwise (go slowly so that the needle does not rise above the red arrow) until it is in the OPEN position.
- 13. Let sit for ~20 minutes.
- 14. After 20 minutes, SLOWLY turn the rotator knob (top left on instrument panel) until the plate is spinning.
- 15. Press the LT button.
- 16. Turn the POWER CONTROL knob (bottom left on panel) until the carbon starts sputtering. (You want to do this slowly to keep it from sputtering too fast.)
- 17. Let it sputter until the brass stud turns purple (corresponding to a carbon coat  $22\pm1$  nm). The brass stud will first turn orange, then red and then purple.
- 18. As soon as the stud turns purple, turn the POWER CONTROL knob back to zero.
- 19. Turn the rotator knob back to zero to stop the plate from spinning.
- 20. Turn off LT.
- 21. Turn handle to BACKING position (counterclockwise).
- 22. Push AIR ADMIT button to allow air back into the chamber.
- 23. Remove implosion guard and bell jar.

## **SX-100 Insert/Exchange Samples**

- 1. Make sure specimen is clean and dry (place sample in oven for ~ 1 minute).
- 2. Using the KVM switch (located under the monitors) make sure computer 1 (Cameca computer) is selected. (If the KVM switch is "stuck", press the spacebar on the computer).
- 3. In the SX CONTROL window click the "Vacuum" tab.
- 4. Click the "Sample Exchange" button and then click "Yes" to confirm sample exchange.
- 5. In the SX CONTROL window it will give you a series of directions to follow:
  - a. "Turn gun valve to position 1": Turn valve clockwise to position 1. (The gun valve is found on top of the instrument toward the back. You will need to pass position 3 to get to position 1). Wait until it says "Airlock Backup Completed".
  - b. "Open airlock gate valve": The handle is located just to the left of the viewing window. Push it in, lift it up, and release.
  - c. "Move in/out shuttle": Make sure the correct direction is selected using the switch on the outside of the shuttle. Move the shuttle all the way in and then all the way out. Depending on which direction is selected, it will either grab or release your sample.
  - d. "Close airlock gate valve": Turn handle clockwise, push down, and release.
- 6. Click CONTINUE when the airlock gate valve is closed.
- 7. To remove your sample, open the airlock door by de-pressing the black button on the side latch.
- 8. After about 1 minute it will continue to prompt you with directions:
  - a. "Turn gun valve to position 2": Turn valve counterclockwise to position 2 (You will need to pass position 3).
- 9. In the SX CONTROL window it will indicate that the vacuum is ready after about a minute or so.

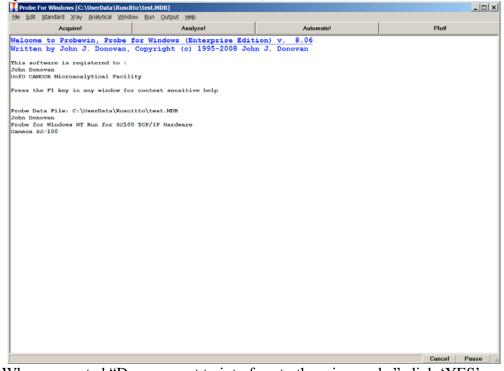
# **Resetting Stage Reference Point:**

- 1. Switch to the CAMECA computer using the KVM.
- 2. Right-click on the "Position" window (lower left of display) and choose "Move to Reference". This will move the stage to what the computer thinks is the reference point.
- 3. Use the joystick and Z-button to focus on the bright spot near the center of the cross etched into the sample holder. Right-click on the "Position" window and choose "Update Reference", then "OK".

## Setting up the Probe for a Run:

This guide is intended for a quick-start and assumes that a setup has already been created and just needs to be loaded.

1. Open Probewin.exe (Probe for Windows)



- 2. When prompted "Do you want to interface to the microprobe" click 'YES'
- 3. Create a new probe run by selecting File >> New.
- 4. Name the file appropriately for your activity and put the file in a folder that makes sense to you. You may also wish to change the sample identifications and who is operating the probe.

File Information		
File Name	C:\UserData\Ruscitto\test.MDB	
Version	8.06 Type PROBE	ок
User	John Donovan	Cancel
Title	Probe for Windows NT Run for SX100 TCP/IP Hardware	Cancer
Department	CAMCOR	
Account #	Group MicroAnalytica	al Facility
Description	Cameca SX-100	×
Date Created	11/14/2008 9:50:57 AM Date Modified 11/14/2008 9:5	0:56 AM
Last Updated	11/14/2008 9:50:57 AM	

5. Next, load an old file setup for the same elemental standards you wish to run by pushing □Acquire! In the new 'Acquire!' window go to □New Sample, □Load File Set-up, then navigate to the old file (use the most recent file with your standards) and click □OK. This will establish the sample setup and standards you wish to run. Then click □OK again.

Acquire!								
SP1 SP2 38490.0 81480.0	SP3 SP4	<b>SP5</b> 3077.0	<b>x</b> -15663.	-9204	¥ .0 −2	<b>Z</b> 8.000	Progress/Bei	am Deflection
1-TAP         2-LPF           30.00         20.0           1533.         2059	00 5.00 5	PET 5.00 511.3	5-LIF 45.00 10902.			Faraday 1.00 49.9282		₽
Self Time Dependent Intensity (TDI) Correction Sample						wn Acquisition	-15663. um .000000	-9204.0 .000000
New Sample	Good Data Rows: 0		Move	Move Stage			Agnification Beam Mode	0 1252.648 Analog Spot
Elements/Cations	Peak/Scan Options	Acqu	isition Optio	ns		Imaging	Kilovolts	15
Analytical Conditions	Count Times	Sp	Special Options		Pea	king Options	Beam Current Beam Size	50
Combined Conditions	Locate		Rate Meter		St	art Peaking	Col. Condition	

	Load File Setup	
	F:\Userdata\Smeller\06-2007	
	Bi-Ti-Te 06-14-2007.MDB 7/13/2007 8:58:29 PM Bi-Ti-Te 06-15-2007.MDB 6/16/2007 3:25:51 PM	Change Folder
Cancel Setup Setup etup		<u>6-2007</u>
Setup is based by o change the s Load Setup iple and then it setup.	Mary Smeller Bi-Te, Ti-Te	OK Cancel
	Un 48 06-03-07m TO = 40, KeV = 16, Beam = 25, Size = 0 MagAnal = 4000, Mode = Analog Scan	Search for Files
Add <cr></cr>	Samples List         Ann           Un 37 06-03-071         Ann           Un 38 06-03-071         Ann           Un 38 06-03-071         Ann           Un 40 06-03-070         Un 41 06-03-070           Un 41 06-03-070         Un 43 06-03-071           Un 42 06-03-070         Un 43 06-03-070           Un 43 06-03-070         Un 44 06-03-070           Un 44 06-03-070         Un 45 06-03-070           Un 45 06-03-070         Un 47 06-03-070           Un 47 06-03-070         Un 47 06-03-070	Element List bi na Spectro 1 PET (58188. o ka Spectro 1 PET (38683. te la Spectro 4 PET (37280.0 si ka Spectro 2 TAP (27683.0 ti ka Spectro 3 LIF (68278.0)

6. When prompted "Do you want to use the old standard intensities," DO NOT USE THE STANDARD INTENSITIES FROM LAST TIME.

New Sample Type

Standard

Unknown

C Wavescan

Add/Remove Standards

New Sample Name <mark>unknown sample</mark> New Sample Descrij

Note that a new standard sample element sett default on the last unknown sample in the run. analyzed elements in a run, either click one of t outtons above or first create a new unknown si make any necessary changes to the elem

To add standards to the standard list below, ca then click the Standard I Add Standards to Rur the main menu.

OK

Load Elemer

Load Sample

Load File S

Load Multip

NewFileSe	etupLoadStandardData
?	Do you want to load the standard intensity data from F:\Userdata\Smeller\06-2007\Bi-Ti-Te_06-14-2007.MDB (89), if not already loaded?
	Yes Cancel

- Load the column conditions using the 'Probewin' log window menu and choosing Window >> Load Column Conditions. Sort the files by DATE and choose the most recent one. Change the analytical conditions by selecting Window >> Analytical Conditions, set your values and save.
- 8. Check the electron beam position and focus before running any standards:
  - a. Use the KVM switch to access the CAMECA computer.
  - b. In the SX100 CONTROL Window, set beam size to 0  $\mu$ m. Return to the regular computer using the KVM switch.
  - c. Move stage to MgO Standard (so that you can see a fluorescing dot).
  - d. Use screwdrivers to align fluorescing dot within circle on Optical Scope monitor (make sure you are qualified to do this or ask John).
  - e. Focus with reflected light on sample surface
  - f. Focus with SEM onto sample surface
  - g. Select Window >> Save Column Conditions to File.
- 9. In the 'Probewin' window go to □Automate!. Then choose •Unknowns and if there are samples left from a previous run choose □Delete Selected Samples and □Yes to All.

Automate!					_ <u> </u>
Position List (mu	ilti-select) (double-click t	o see data) ———			Automation Actions
Standards	St 308 Fid 1 Obsidian	CAMM 112	_ Move	Stage	Confirm Standard Positions
O Unknowns	St 318 Fid 1 Obsidian	CAMM 66	-		Confirm Unknown Positions
O Wavescans	St 327 Fid 1 Anhydrite		Dig	itize	Confirm Wavescan Positions
O All Samples	St 336 Fid 1 Nepheline St 342 Fid 1 Sodalite (				
	St 357 Fid 1 Kaersutite		D	lot	Peak Spectrometers Peaking
	St 358 Fid 1 Diopside	(Chesterman)		σι	Acquire Standard Samples
	St 374 Fid 1 Orthoclas		Fidu	-inte	Acquire Unknown Samples
Select Stds	St 386 Fid 1 Alamosite St 395 Fid 1 Magnetite		Fidu	ciais	Acquire Wavescan Samples
Select All	St 396 Fid 1 Chromite				Acquire Standard Samples (again)
Go	St 730 Fid 1 Pyrite UC		Repli	cates	A sequire standard samples (again)
Auto Focus	St 757 Fid 1 FeS (Pyrr St 829 Fid 1 TL(Br,I)	hotite)	Cond	itions	Automation Options
Update	St 831 Fid 1 Fluorite U St 835 Fid 1 BaF2 (ba		Sample	Setups	Peak on Assigned Standards           Use "Quick" Standards
Delete All	St 395 Magnet	ite U.C. #3380	File S	etups	<ul> <li>Use Filament Standby Afterwards</li> </ul>
Re-Load	Current Ro		- Multipla	Setups	Use Confirm During Acquisition
			Multiple	secups	Use Beam Deflection For Position
Delete S	elected Samples	Import from AS	SCII (*.POS Fi	le)	Suppress ROM Based Backlash
Delete St	elected Positions	Export Selected	Samples (to *	POS	Confirm All Positions In Sample
	ciectou i contono		Samples (is		Combine Multiple Sample Setups
Row X	Y Z	W (	Grain#F	ocus	
1 -219	02.65 2985.453 -26.	70525 0 1	1 0		Use ROM Auto Focus
					New Sample     Every Point
					O Digitized O Interval 5
					Standard Points To Acquire
					Automate Confirm Delay (sec) 10
					Standard X Increment (um) 15
					Re-Standard Y Increment (um) 15
					Re-Standard Interval (hrs) 6
					🔿 Use Last Unknown Sample
KAV 15 O. F	0 Circ 10 Mar 2004 M	lada Analan Onat Io		A. N. Luna Ia	Use Digitized Conditions
	i0 Size = 10 Mag = 2524 M agAnal = 8000 MagImag =		ample Setup (ro = N	wj Number	O Use Digitized Sample Setups
1111					O Use Digitized File Setups
	File Set	up = NONE			O Use Digitized Multiple Setups
			Deelie		
	Multiple Setups = NONE		Replicates	5 = 1	Run Selected Samples

- 10. In the 'Automate!' window, click on •Standards to make sure you have the correct standard block files in the computer. If it does not include your standards, get John to show you how to find the correct standards file to load.
- 11. Now select the standards you will be using for your experiments (hold the ctrl key while clicking on each one) and look to the right hand column where you will choose •Confirm Standard Positions and •Peak Spectrometers. Then click the □Peaking button. This will bring up another window, click on •ROM based and •Acquire Automated PHA Scan After Peaking. Once these options are selected click □OK followed by □Yes.

Peaking Options	
Elements to Peak (multi-select) – si ka Spec 2 LPET (81480.0) mg ka Spec 1 TAP (38490.0) fe ka Spec 5 LIF (48077.0) ca ka Spec 2 LPET (38431.0) ni ka Spec 3 LLIF (41175.0) mn ka Spec 4 PET (24068.0)	Peak Center Method       OK         ○ Interval Halving       OK         ○ Parabolic Fit       Cancel         ○ ROM Based (see options below)       Cancel         ○ Manual (Pre/Post Scan Only)       Skip P/B Check Before Peaking         ▼ Skip P/B Check Before Peaking       Caussian         ROM Peaking Type       Internal       Parabolic         ● Internal       Parabolic       Maxima       Gaussian         Threshold       .33       .33       .33         Peak Center Options
Double-click element to move to spectrometer peak position	<ul> <li>Display PHA Dialog Prior To Peaking</li> <li>Display PHA Dialog After Peaking</li> <li>Display Spectrometer Pre-Scan for Confirmation</li> <li>Display Spectrometer Post-Scan for Confirmation</li> <li>Use ROM Based Scanning for Pre/Post Scan</li> </ul>
Return To O	n Peak (start analysis) Positions

12. In the 'Automate!' Window, click on □Run Selected Samples followed by □Yes. This will run a series of scans that will allow you to confirm (and refocus) the location of the standard on the block you are using, find the maximum intensity of the peak, take a scan of the peak itself, and compare what your intensity value was before and after you peaked the spectrometer. The focus and location can be changed using the dials labeled X, Y, and Z to the right of the keyboard. Once the position on the standard is established click on □OK in the Confirm window that comes up when it goes to the standard.

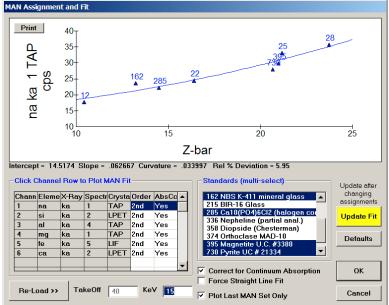
Confirm Positions	5			
St 912 MgO	(elemental) (#1	12)		
<ul> <li>click OK when rea</li> </ul>	sample stage posit ady. If you need mo e Pause button.			Time remaining 7.90
Refl Tran On Off	Remove Faraday	Jog Cancel	Auto Focus Pause	ОК

Information about the peak intensities will be located in the 'Probewin' log window. If there are any major changes in your peaked values, both on or off peak, you should get help from John. Also check to make sure you only have one peak in the PHA scan when you peak the spectrometer. If there is more than one get John. This should be done before every run.

13. Ask John to come in and review your spectrometer conditions (count times on each of the spectrometers and count times on and off peak) before moving forward. If you want to make changes at this point it will be easier than if you proceed to the next step.

### **Running Selected Standards**

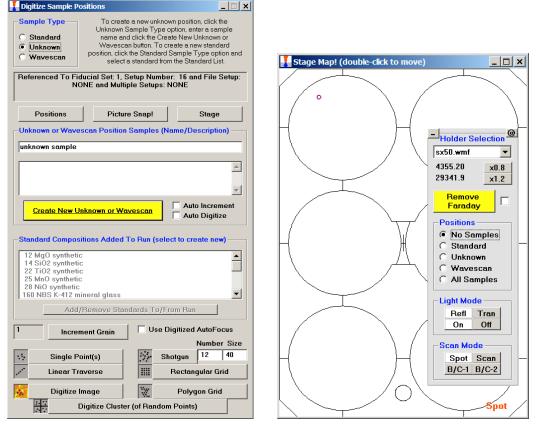
- In the 'Automate!' window, click on ●Standards and □Select Stds. You have previously confirmed standard positions during peaking but you can check that button again if you would like. Check ●Acquire Standard Samples and then click on □Run Selected Samples.
- 2. Once standards have been run, you can check MAN assignments and adjust as necessary. Ask John if you need help.



- 3. It is useful to run some standards that contain none of the elements you are analyzing for in order (and samples that are not used as the standard for a particular element!) to check that you are getting accurate measurements.
- 4. Also Run a standard (like BIR-16 glass) or something else as an unknown and make sure that the measurements agree with what the true values are.
- 5. Again, ask John if you have any trouble.

# **Digitizing Samples & Running**

1. Go back to the 'Automate!' window and click on □Digitize. You will now be able to input digital positions of samples to analyze:



- In the 'Digitize Sample Positions' window choose ●Unknowns and put a sample name in where you see -Unknown Sample- or a previous sample name you typed in and click □Create a new Unknown or Wavescan then click on the □Stage button to bring up the 'Stage Map' window.
- 3. In the 'Stage Map!' window, double-click on where you think your sample is. Use the stage controls located to the right of the keyboard and locate a good spot. Once you find a good spot, focus on the sample surface (easiest in reflected light), using the Z adjustment knob.

- 4. In the 'Digitize Sample Positions' window, click on □Single Point(s) (or whatever you want) and click □OK once you have established the places you wish to analyze.
- 5. Repeat steps 14-16 until all of your unknown samples have been digitized.
- 6. In the 'Stage Map' window, choose to show locations of the unknowns to double check that you are not looking at the same sample twice or missing one.
- 7. Tip: Picture Snap! is a great tool included in the Probe for Windows software. It simply requires an image file (jpeg, bmp, or gif?) of your mount. Access Picture Snap! from the 'Probewin' window by selecting \_\_\_\_\_ >> Picture Snap! Load your image file and then choose "Calibrate". In the 'Picture Snap Calibration' window, select either •Two Points (for square samples) or •Three Points (for round samples). Use the stage controls and navigate to 2 or 3 points that you can recognize on the image and click □ Read Current Stage Coordinate. When finished choosing reference points click □ Calibrate Picture. Now you should be able to navigate anywhere on your image by double-clicking there, also your digitized positions show up.

Picture Snap Calibration	
Point #1 Calibration	
	Close
X Pixel Coordinate	44
Y Pixel Coordinate 20	64 C Two Points
Pick Pixel Coordinate	
Picture	picture select two
	diagonal coordinate (for rectanglar
X Stage Coordinate 🛛 🛐	1895 samples) or three
Y Stage Coordinate 32	997 points (for round samples subject to
Read Current Stage	Move rotation) on the pictu for which you can
Coordinate	To accurately locate th
	stage positions. The click the Calibrate
Point #2 Calibration	Picture button.
V Divel Constitute	
	Calibrate
Y Pixel Coordinate	Picture
Pick Pixel Coordinate	on
Picture	Do Not Display
X Stage Coordinate	Calibration
Y Stage Coordinate 33	608 X and Y Pixel Coordinates are
Read Current Stage Coordinate	Move actually given in To "Twip" units! (1440
Coordinate	twips per logical inc
Point #3 Calibration	When using a three point calibration, the
X Pixel Coordinate	680 program
Y Pixel Coordinate	772 automatically includes a Z
Pick Pixel Coordinate	correction for stage
Picture	sample tit
X Stage Coordinate	2000
-	2968
Y Stage Coordinate 28	821
Read Current Stage Coordinate	Move To
Coordinate	

8. In the 'Automate!' window choose the •All Samples flag. Then hit the □Select Stds button and establish that you picked the correct standards for your samples.

Then holding down the <control> button choose the unknowns you wish to measure.

9. Now click the following: •Confirm Standard Positions, •Acquire Standard Samples (optional since you may have just done this), •Acquire Unknown Samples, •Acquire Standards Again, and •Use Filament Standby Mode Afterwards (IMPORTANT if you do not want to get charged for beam time after your samples are done!), •Use Confirm During Acquisition, and •Use Digitized Multiple Setups. See picture below for confirmation.

Automate Position L C Standa C Unkno C Wayes	ist (multi-s ards Ur wns Ur	4 Fid 0 7-10	)-07c )-07f	data) ———		Move Stage	Automation Actions  Confirm Standard Positions Confirm Unknown Positions Confirm Wavescan Positions
All San		7 Fid 0 7-1 8 Fid 0 7-1	l-07j l-07k			Plot	Continu wavescan Positions     Peak Spectrometers     Peaking     Acquire Standard Samples
Select S Select	All Ur	11 Fid 0 7-1	1-07o ·11-07p			Fiducials Replicates	<ul> <li>✓ Acquire Unknown Samples</li> <li>✓ Acquire Wavescan Samples</li> <li>✓ Acquire Standard Samples (again)</li> </ul>
Go Auto Fo Updat		14 Fid 0 7-1 15 Fid 0 7-1 514 Fid 1 Si 527 Fid 1 Co	1-07q 1-07r licon metal obalt metal		_	Conditions Sample Setups	Automation Options     ✓     Peak on Assigned Standards
Delete Re-Lo		a 530 Fid 1 Zi	nc metal		≞ -	File Setups Multiple Setups	Use "Quick" Standards Use Filament Standby Afterwards Use Confirm During Acquisition Use Beam Deflection For Position
	lete Selec	ted Samples ted Positions	Ex	Import from port Selecte		.POS File) les (to *.POS)	Suppress ROM Based Backlash Confirm All Positions In Sample Combine Multiple Sample Setups
ło <b>w</b> 1 2 3	X 12913.0 12983.4 13053.0	40 21740.40	Z 81.00000 81.80000 82.60001	0	Grain 1 1 1 1 1	0 0 0	Use ROM Auto Focus     O New Sample C Every Point     O Digitized C Interval
4 5 6	13124.2 13194.0 13265.0	60 22413.60	83.40001 84.20001 85.00002		1 1 1	0 0 0	Standard Points To Acquire     5       Automate Confirm Delay (sec)     10
							Standard X Increment (um)     6       Re-Standard Y Increment (um)     6
		25 Size = 0 lagAnal = 400	) MagImag	ı = 400		le Setup (row) umber = 0	<ul> <li>Use Last Unknown Sample</li> <li>Use Digitized Conditions</li> <li>Use Digitized Sample Setups</li> <li>Use Digitized File Setups</li> <li>Use Digitized Multiple Setups</li> </ul>
	Multiple	File	Setup = N(	JNE	Be	plicates = 1	Run Selected Samples

10. Double-check everything and click □Run Selected Samples. This will bring up a time estimate. Click □YES and the run will start. The standard positions will be checked again. Make sure they are still in focus.

# Accessing your Data

- 1. Go through and make sure you like what you see....
- 2. In the 'Probewin' window, select Output >> (H.W.)... and then select Yes for unknowns. This should export your data to Excel.

# **Tips & Common Problems**

#### Establishing a new file setup

If you are not running an old file setup because you are using a new set of standards for your new compound, you will need to do the following with John's help:

- 1. Wavescans to check for interferences between the elements in your sample. This will also help establish where you will be measuring on and off peak intensities.
- 2. This is especially important for trace elements. Note that by acquiring intensity data for all the elements in each standard you can examine the complete analysis of each and see that you should be able to get close to zero concentrations on standards that do not contain the element of interest. If the concentration is significantly negative then it is likely that one or more off-peak positions is being interfered by a secondary x-ray peak.
- 3. Do a simulation of the samples you will be running in Stratagem to pick the best operating voltages. Low voltages will give small excitation volumes but poor sensitivity.
- 4. Establish which spectrometers should be used for which standards. You will want to avoid crystal flipping within a single sample. Put in proper count times for what you are doing. Check that the count times are approximately balanced for all spectometers to avoid a spectrometer sitting idle (you might as well be counting photons).
- 5. New file setups should be saved once you have finally made them.

#### Common Problems

The filament is not on when you go to do a scan. This is most common when the probe has been idle for a long period of time with the filament off. SX50 Only:

- a. Go to the 'Crosstalk' window and find the 'QuickPad' window above it that comes has a teal background. Use the □HV15 button. 'Crosstalk' should tell you that the Igun is ready.
- b. If this does not turn the filament on and start sending information to the 'Crosstalk' window then get John to help.
- 2. The sample holder is difficult to get out of the instrument when you go to exchange for your new sample holder.
  - a. The holder has a clicking mechanism that locks it into place on the exchange device. If you push in too far you disengage the hold of the mechanism. When you go to pull the sample out don't put the exchange

rod in the entire way. Just go until you feel resistance. This should click the mechanism so you can pull the sample holder out.

- b. Do not force this process. If you are having trouble, get John to help.
- 3. You accidentally put two linear traverses on the same unknown sample or skipped a sample you meant to run.
  - a. Use the 'Stage Map' window displaying the unknowns to show where all of your linear traverses are. Figure out which numbers correspond to the unknowns you want.
  - b. Go to the 'Automate!' window and double click on the sample you need to alter. The linear positions you have digitized should come up in the box below the sample position list. Choose the duplicates and click on □Delete Selected Points then □OK.
  - c. If you have skipped one go to the 'Automate!' window and choose the sample you wish to alter then go back to the 'Digitize Sample Positions' window and choose □Linear Traverse. You can now go about business as normal and add the points you want.

Element Setup Database		
Current Sample:	-Element Setup Da	ta From SETUP.MDB Database
Un 20 * test	I I Jata Curs	or 🕨 🕨 Delete from Database
si ka Spectro 2 LPET (81480.0)	Enter Search Element >>	Total Records = 613
mg ka Spectro 1 TAP (38490.0) fe ka Spectro 5 LIF (48077.0) ca ka Spectro 2 LPET (38431.0	Element/Xray/Cat	ti ka 1 2
ni ka Spectro 3 LLIF (41175.0) mn ka Spectro 4 PET (24068.0)	Spec/Crystal/2d	5  LIF  4.0267  0.000058
o (specified) h (specified)	User Name	Beth Erlund
	Sample Name	TiO2 synthetic
	Date - Time	7/12/2006 11:50:16 AM
	Probe Data File	C:\UserData\Erlund\7-2006\P-04-06_07-
Double click Analyzed Element List to see Element Setups	On/Hi/Lo Pos	68258 68749.5 67833.3
<< Add to Sample	BgdType/Offset	OFF LIN 491.5 -424.699999
	S-Hi/Lo/Exponen	1 1
Delete from Sample	Base/Win/Gain/B	0.56 4 700 1850
	KeV/TO/DT/DIFF	15 40 2.97E-06 0
Add To Database >>		Standard Intensity Data
	Std/PeakToBgd	22 90.294
Close	On/Hi/Lo sec	10 5 5
SETUP.MDB	On/Hi/Lo cps	1090.3 3.9 20.25
SETUP2.MDB (MAN) SETUP3.MDB (Interf.)	Beam/Abs current	19.75995 0
Import Export	Stage Position	-16243 -5075 -3 0
-Wavescan and Peaking Parame	iters —	
Wavescan Hi/Lo/Points/Time	69117.23	6
Peakscan Hi/Lo/Points/Time	69117.23	67398.77 30 8
Start/Stop/PB/Count/Attempts	22.1735	2.21735 5 10 30

Analyze!

	9										_ 🗆 >
Sample	List (multi-sel	ect) (double-	click to see int	lensity data)		Analyze	Data	KRaws			
C Stand		11 2-MS-14- 12 2-MS-14-			Comt	bine Selected	Samples 3	>Excel			
O Unkn O Wave	Un	13 2-S17-3-a	a_ol		List	Report C	alculation O	otions			
C All Sa	. Un	14 2-S17-3-0 15 2-S17-3-0									
Selec	Un Un	16 2-S17-3-c	12_ol			ause Between : se All Matrix Co		Report			
		17 2-S17-3-e 18 2-S17-3-f			1 05	Se All Matrix Cu	inections ,				
Add To Save S	Setup Un	19 2-S17-3-0 20 *test			▼	te Selected S		Match			
Specified	d Concentrati	onsStanda	ard Assignmer	nts Name,	/Description	Conditions	Elements/	Cations			
TO = 40,   (MaqAnal		am = 50, Size de = Analoq S it Percent		42.666	Total Oxygen Calculated Oxyg Excess Oxygen		Total Weig Z - Bar Atomic We				
Copy	Si02	MqO	FeO	CaO	NiO	MnO	0	H20	Total		
verage:	39.821	46.959	12.110	.147	.195	.163	.000	.000	99.394		
td Dev:	.112	.119	.128	.002	.011	.015	.000	.000	.199		
AF Corr:	1.3939	1.4531	1.1820	1.0895	1.1825	1.2008					
Std Err:	.065	.069	.074	.001	.006	.008	.000	.000	.115		
Rel SD:	.3	.3	1.1	1.4	5.6	9.0	.0	.0	.2		
linimum:	39,700	46.825	11.962			.147	.000	.000	99.185		
				.145	.188						
aximum:	39.922	47.052	12.187	.145	.188	.175	.000	.000	99.582		
	39.922								99.582		
	39.922 ete Selected	47.052	12.187		.207	.175		.000	99.582		
Del		47.052	12.187	.148	.207	.175	.000	.000	99.582		
Del Del	ete Selected	47.052 Line(s)	12.187	.148 ete Selected	.207 Line(s)	.175 Analyze S	.000 Selected Line	.000 (s)			
Del Del Copy 41 G	ete Selected	47.052 Line(s)	12.187	.148 ete Selected CaO	Line(s)	.175 Analyze S	.000 elected Line	.000 (s) H2O	Total		
Del Del Copy 41 G 42 G	ete Selected SiO2 39.700	47.052 Line(s) MgO 47.001	12.187 Undele FeO 11.962	.148 ete Selected CaO .147	.207 Line(s) NiO .207	.175 Analyze S MnO .167	.000 Gelected Line	.000 (s) H2O .000	Total 99.185		
Copy 141 G 142 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		
Aaximum: Del Copy 141 G 142 G 143 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		
Copy 141 G 142 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		
Copy 141 G 142 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		
Del Del Copy 141 G 142 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		
Del Del Copy 41 G 42 G	ete Selected SiO2 39.700 39.922	47.052 Line(s) MgO 47.001 46.825	12.187 Undele FeO 11.962 12.187	.148 ete Selected CaO .147 .148	.207 Line(s) NiO .207 .188	.175 Analyze S MnO .167 .147	.000 Gelected Line 0 .000 .000	.000 (s) H2O .000 .000	Total 99.185 99.417		

Selected Samples	OK Cancel
Un 12 2-MS-14-04-d_ol	EDS Calculation Data Options
	<ul> <li>Do Not Use EDS Element Data</li> <li>Use EDS Weight % Element Data</li> </ul>
	C Use EDS Spectral Element Data
	Assign EDS Spectral Elements
	Integrated Intensity Data Options
	O Do Not Use Integrated Intensities
,	O Use Integrated Intensities
Sample Conductive Coating	
Element Density Thickness (A)	
	Use Conductive Coating
Calculations Options	
	Calculate with Stoichiometric Oxygen
	Calculate as Elemental
Calculate Detection Limits and Sensitivity	
Calculate Projected Detection Limits	Use Particle/Film Calculations
Calculate Homogeneity Ranges Calculate Alternate Homogeneity Ranges	
Calculate Pearson's Linear Correlation Coefficients	
Element By Difference:	h 💌
Stoichiometry To Calculated Oxygen:	Atoms Of To 1 Oxygen
	Atoms Of To 1 Oxygen Atoms Of To To
	H:O Ratio OH = 1, H2O = 2
Formula and Mineral Calculations	
Calculate Formula Based On	Atoms Of Sum  Add specified oxygen, etc. from the
No Mineral End-Member Calculation	Elements/Cations
	button
C Olivine C Feldspar C Pyroxene C Gam	button iet (Ca,Mg,Fe,Mn) C Garnet (Al,Fe,Cr)

Lla 12.2 M	mples			_	ОК			Canc	el
011 12 2-14	IS-14-04-0_01				Sav	e Elen	nent	Setun	
								- <u></u>	
					Sav	e Sam	iple :	setup	
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					Remove	e Vola	tile C	orrecti	on
					1 2	2	А	Б	a
			erference/Time			<u> </u>			
Click Eleme Channel 1	nt Row to Edit Element si	Standard/Int X-Ray ka	erference/Time Analyzed Yes	Dependent Standard 273	t Intensity	_	Assi		s —
Channel 1 2	Element si mg	X-Ray ka ka	Analyzed Yes Yes	Standard 273 273	t Intensity I Inte	(TDI)	Assi	gnment Interf-S 0,0,0,0, 0,0,0,0,	td 0
Channel 1 2 3	Element si mg fe	X-Ray ka ka ka	Analyzed Yes Yes Yes	Standard 273 273 395	i Intensity	(TDI) rf-Ele	Assi	gnment Interf-S 0,0,0,0, 0,0,0,0, 25,0,0,0	td 0 0,0
Channel 1 2 3 4	Element si mg fe ca	X-Ray ka ka ka ka	Analyzed Yes Yes Yes Yes Yes	Standard 273 273 273 395 358	Intensity	(TDI) rf-Ele	Assi	gnment Interf-S 0,0,0,0, 0,0,0,0, 25,0,0,0 0,0,0,0,	td 0 0 0,0 0,0
Channel 1 2 3 4 5	Element si mg fe ca ni	X-Ray ka ka ka ka ka	Analyzed Yes Yes Yes Yes Yes Yes	Standard 273 273 395 358 28	t Intensity	(TDI) rf-Ele	Assi	gnment Interf-S 0,0,0,0, 0,0,0,0, 25,0,0,0 25,0,0,0 0,0,0,0,0	td 0 0 0,0 0,0 0
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Channel 1 2 3 4 5	Element si mg fe ca ni	X-Ray ka ka ka ka ka	Analyzed Yes Yes Yes Yes Yes Yes	Standard 273 273 395 358 28	t Intensity	(TDI) rf-Ele	Assi	gnment Interf-S 0,0,0,0, 0,0,0,0, 25,0,0,0 25,0,0,0 0,0,0,0,0	td 0 0 0,0 0 0 0 0 0

## Acquire! (example run & off)

Acquire!				
SP1 SP2 38490.0 38431.0	SP3 SP4 23951.0 32472.0 48	<u>SP5 X</u> 077.0 -6052.0 274	Y Z 68.0 -40.000	Progress/Beam Deflection TAP LPET LPET TAP LIF
Mg-TAP Ca-LE 27.65 74. 13395. 10453	.29 13.73 6	TAP         Fe-LIF           .67         15.00           97.         1059.	Faraday 1.00 9.99170	F S
Current Sample: Un 11 Combined Conditions Sa			l or Unknown Acquisition	<u>Mg Ca K Al</u> Fe Na Ci K Al Fe -6052.0 27468.0 um .000000 .000000
Data Rows: 0	Good Data Rows: 0	Sta	art Wavescan	
New Sample	РНА	Move	Stage	Magnification 8000 Beam Mode Analog Spot
Elements/Cations	Peak/Scan Options	Acquisition Options	Imaging	Kilovolts
Analytical Conditions	Count Times	Special Options	Peaking Options	Beam Current 50 Beam Size 10
Combined Conditions	Locate	Rate Meter	Start Peaking	Col. Condition
Acquire!				_ 🗆 🗙
SP1 SP2	SP3 SP4	SP5 X	Y Z	- Progress/Beam Deflection
38490.0 81480.0	41175.0 24068.0 48	077.0 -1566392	04.0 -28.000	
1-TAP 2-LF		PET 5-LIF	Faraday	
30.00 20.		.00 45.00	1.00	-
1533. 205		11. 310902.	49.9282	⊕
Current Sample: Un 20 Self Time Dependent In	) * test tensity (TDI) Correction San		l or Unknown Acquisition	-156639204.0
Data Rows: 0	Good Data Rows: 0	Ste	art Wavescan	um .000000 .000000

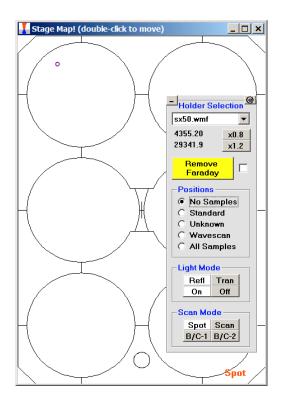
Data Rows: 0	Good Data Rows: 0		Start wavescan	px 0	0
Ne <del>w</del> Sample	РНА	Move	Stage	Magnification Beam Mode	1252.648
Elements/Cations	Peak/Scan Options	Acquisition Option	lmaging		Analog Spot
Analytical Conditions	Count Times	Special Options	Peaking Options	Beam Current Beam Size	50
<b>Combined Conditions</b>	Locate	Rate Meter	Start Peaking	Col. Condition	

Selected S					ок			Canc	el
Un 20 *te	est				10	ad Eler	nent S	etun	
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			ations Paramete	ers (click emp	ka ka oty row to	o add) -	ka On-F	ka Peak	6
Channel	Element	X-Ray	Acquired	ers (click emp Spectro	ka ka oty row to Cryst	o add) - al	On-F	<sup>&gt;</sup> eak	
Channel 1	Element si			ers (click emp	ka ka oty row to	o add) - al	On-F 814	<sup>&gt;</sup> eak 80.0	b
Channel 1 2	Element	X-Ray ka	Acquired Yes	ers (click emp Spectro 2	ka ka hty row to Cryst LPET	o add) - al	On-F	2eak 80.0 90.0	
Channel 1 2 3	Element si mg	X-Ray ka ka	Acquired Yes Yes	ers (click emp Spectro 2 1	ka ka oty row to Cryst LPET TAP	o add) - al	On-F 814 384	<sup>&gt;</sup> eak 80.0 90.0 77.0	
Channel 1 2 3 4	Element si mg fe	X-Ray ka ka ka	Acquired Yes Yes Yes	ers (click emp Spectro 2 1 5	ka ka oty row to Cryst LPET TAP LIF	o add) - al	On-F 814 384 480	Peak 80.0 90.0 77.0 31.0	
Channel 1 2 3 4 5	Element si mg fe ca	X-Ray ka ka ka ka	Acquired Yes Yes Yes Yes Yes	ers (click emp 2 1 5 2	ka ka oty row to Cryst LPET TAP LIF LPET	o add) - al	On-F 814 384 480 384	Peak 80.0 90.0 77.0 31.0 75.0	
Channel 1 2 3 4 5 6	Element si mg fe ca ni	X-Ray ka ka ka ka ka ka	Acquired Yes Yes Yes Yes Yes Yes	ers (click emp 2 1 5 2 3	ka ka ty row to Cryst LPET TAP LIF LPET LLIF	o add) - al	On-F 8140 3849 480 3841 411	Peak 80.0 90.0 77.0 31.0 75.0	
Click Elemo Channel 1 2 3 4 5 5 6 7 8	Element si mg fe ca ni mn	X-Ray ka ka ka ka ka ka	Acquired Yes Yes Yes Yes Yes Yes Yes	ers (click emp 2 1 5 2 3	ka ka ty row to Cryst LPET TAP LIF LPET LLIF	o add) - al	On-F 8140 3849 480 3841 411	Peak 80.0 90.0 77.0 31.0 75.0	
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Channel 1 2 3 4 5 6 7	Element si mg fe ca ni mn o	X-Ray ka ka ka ka ka ka	Acquired Yes Yes Yes Yes Yes Yes Yes No	ers (click emp 2 1 5 2 3	ka ka ty row to Cryst LPET TAP LIF LPET LLIF	o add) - al	On-F 8140 3849 480 3841 411	Peak 80.0 90.0 77.0 31.0 75.0	
Channel 1 2 3 4 5 6 7	Element si mg fe ca ni mn o	X-Ray ka ka ka ka ka ka	Acquired Yes Yes Yes Yes Yes Yes Yes No	ers (click emp 2 1 5 2 3	ka ka ty row to Cryst LPET TAP LIF LPET LLIF	o add) - al	On-F 8140 3849 480 3841 411	Peak 80.0 90.0 77.0 31.0 75.0	

Element Setup Database		
Current Sample:	-Element Setup Da	ta From SETUP.MDB Database
Un 20 * test	I d Data Curs	or 🕨 🕨 Delete from Database
si ka Spectro 2 LPET (81480.0)	Enter Search Element >>	Total Records = 613
mg ka Spectro 1 TAP (38490.0) fe ka Spectro 5 LIF (48077.0) ca ka Spectro 2 LPET (38431.0	Element/Xray/Cat	ti ka 1 2
ni ka Spectro 3 LLIF (41175.0) mn ka Spectro 4 PET (24068.0)	Spec/Crystal/2d	5  LIF  4.0267  0.000058
o (specified) h (specified)	User Name	Beth Erlund
	Sample Name	TiO2 synthetic
	Date - Time	7/12/2006 11:50:16 AM
	Probe Data File	C:\UserData\Erlund\7-2006\P-04-06_07-
Double click Analyzed Element List to see Element Setups	On/Hi/Lo Pos	68258 68749.5 67833.3
<< Add to Sample	BgdType/Offset	OFF LIN 491.5 -424.699999
	S-Hi/Lo/Exponen	1 1
Delete from Sample	Base/Win/Gain/B	0.56 4 700 1850
	KeV/TO/DT/DIFF	15 40 2.97E-06 0
Add To Database >>		Standard Intensity Data
	Std/PeakToBgd	22 90.294
Close	On/Hi/Lo sec	10 5 5
• SETUP.MDB	On/Hi/Lo cps	1090.3 3.9 20.25
SETUP2.MDB (MAN) SETUP3.MDB (Interf.)	Beam/Abs current	0
Import Export	Stage Position	-16243 -5075 -3 0
-Wavescan and Peaking Parame	ters	
Wavescan Hi/Lo/Points/Time	69117.23	67398.77
Peakscan Hi/Lo/Points/Time	69117.23	57398.77 <b>30</b> 8
Start/Stop/PB/Count/Attempts	22.1735	2.21735 5 10 30

Channel	Element	Spectro	Crystal	On-Peak	Hi-Peak	Lo-Peak	MaxCountF	actor	Wave	Peak	Quick
1	si ka	2	LPET	20.00	5.00	5.00	10000000 2		6.00	8.00	2.00
2	mg ka	1	TAP	30.00	5.00	5.00	10000000 3	.00	6.00	8.00	2.00
3	fe ka	5	LIF	45.00	5.00	5.00	10000000 3	1.00	6.00	8.00	2.00
4	ca ka	2	LPET	20.00	5.00	5.00	10000000 4	1.00	2.00	8.00	2.00
5	ni ka	3	LLIF	30.00	5.00	5.00	10000000 3	1.00	4.00	8.00	2.00
ò	mn ka	4	PET	30.00	5.00	5.00	10000000 3	1.00	2.00	8.00	2.00
normālizati tensity disp	-	used for the ample, ente	lify the e x-ray r 1 (nA)	182 se Calculate Spectrome Motion an Acquisitio Time	d ter d <u>Mg</u>	2 3 LPET URB	P	2			OK Cance
eturn To ( ystal Flip	On-Peak T ) Time	120	secs	Time		Si					Measu Nomin
ystal Flip et Column <mark>k and Sca</mark>	) Time ) (TKCS) T In	ime 2 s	secs secs	0 se		Si					
ystal Flip et Column <mark>k and Sca</mark> Click Elem	) Time ) (TKCS) T )n nent Row to	ime 2 s	secs secs	0 se n Parameter	[5			0#00	•	li-Off	Nomina Bear
ystal Flip et Column <mark>k and Sca</mark> Click Elem	) Time (TKCS) T in hent Row to Element	ime 2 s	secs secs and Scar tro Cry	0 se n Parameter /stal 0	rs In-Peak	Hi-Peak	Lo-Peak 80937.4	Offse		li-Off 542,500	Nomina Bearr
ystal Flip et Column k and Sca Slick Elem Channel	) Time ) (TKCS) T ) ) nent Row to Element si ka	ime 2 s	secs secs	0 se n Parameter /stal 0 ET &	[5		Lo-Peak 80937.4 37358.3	Offse -25.5 9.152	523 5	li-Off 542.500 1144.00	Nomina Bear
ystal Flip et Column k and Sca Click Elem Channel	) Time (TKCS) T In nent Row to Element	Edit Peak	secs secs and Scar tro Cry	0 se n Parameter /stal 0 ET & P 3	rs In-Peak 31480.0	Hi-Peak 82022.5	80937.4	-25.5	523 5 234 1	542.500	Nomina Beam Lo-Off -542.60
ystal Flip et Column k and Sca Click Elem Channel	o Time o (TKCS) T on pent Row to Element si ka mg ka	ime 2 s control control contro	secs secs tro Cry LPI	0 se Parameter /stal 0 ET E P 3	rs In-Peak 31480.0 88490.0	Hi-Peak 82022.5 39634.0	80937.4 37358.3	-25.5 9.152	523 5 234 1 867 5	542.500   1 44.00	Nomin: Bearr Lo-Off -542.60 -1131.7
ystal Flip et Column k and Sca Click Elem Channel 2 3 4	o Time (TKCS) T nent Row to si ka si ka mg ka fe ka ca ka ni ka	Edit Peak t Spect 2 1 5 2 3	secs secs tro Cry LPI TA LIF LPI	0 se n Parameter /stal 0 ET 8 P 3 ET 8 F 4	IS In-Peak 31480.0 38490.0 18077.0 38431.0 11175.0	Hi-Peak 82022.5 39634.0 48660.2 39737.3 41758.7	80937.4 37358.3 47568.6 37165.4 40591.3	-25.5 9.152 38.30 -31.4 32.09	523 5 234 1 867 5 114 1 977 5	542.500 1144.00 583.199 1306.30 583.699	Nomine Beam -542.60 -1131.7 -508.40 -1265.6 -583.70
ystal Flip et Column k and Sca Click Elem Channel 2 3 4 5 5 5	o Time (TKCS) T nent Row to Element si ka mg ka fe ka ca ka	ime 2 s control control contro	secs secs tro Cry LPI TA LIF	0 se n Parameter /stal 0 ET 8 P 3 ET 8 F 4	In-Peak 31 480.0 38 490.0 18077.0 38 431.0	Hi-Peak 82022.5 39634.0 48660.2 39737.3	80937.4 37358.3 47568.6 37165.4	-25.5 9.152 38.30 -31.4	523 5 234 1 867 5 114 1 977 5	542.500  144.00 583.199  306.30	Nomin Beam Lo-Off -542.60 -1131.7 -508.40 -1265.6
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ystal Flip et Column k and Sca Click Elem Channel 2 3 4 5 5 5 7 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8	o Time o (TKCS) T n n ent Row to si ka mg ka fe ka ca ka ni ka mn ka Peaks	Edit Peak Edit Peak E Spect 2 1 5 2 3 4	secs secs secs tro Cry LPI TA LIF LPE PE Spectro position (fr peak posit	0 se	rs In-Peak 31480.0 38490.0 48077.0 38431.0 41175.0 24068.0 24068.0 ets" are the d les) and the ad a peak co ose to zero.T	Hi-Peak 82022.5 39634.0 48660.2 39737.3 41758.7 25065.3	80937.4 37358.3 47568.6 37165.4 40591.3 23070.6	-25.5 9.157 38.34 -31.4 32.09 -28.6	233 5 234 1 867 5 114 1 3777 5 648 9 redicted petro Offsets" ve	542.500 1144.00 583.199 1306.30 583.699 397.299 997.299	Nomin Beam -542.60 -1131.7 -508.40 -1265.6 -583.70 -997.40

Stage Map!



Picture Snap! Calibration Window

Picture Snap Calibrat	ion	×
Point #1 Calibration – < Pixel Coordinate Y Pixel Coordinate	6744	Close Close Two Points Three Points
Pick Pixel Coordi Picture X Stage Coordinate Y Stage Coordinate Read Current Sta	<b>-18895</b> 32997	To calibrate the picture select two diagonal coordinates (for rectanglar samples) or three points (for round samples subject to rotation) on the picture
Point #2 Calibration -		for which you can accurately locate the stage positions. Then click the Calibrate Picture button.
X Pixel Coordinate Y Pixel Coordinate Pick Pixel Coordi Picture	17808 2964 nate on	Calibrate Picture
X Stage Coordinate Y Stage Coordinate Read Current Stag Coordinate	-10894 33608 ge Move To	Do Not Display Calibration Points X and Y Pixel Coordinates are actually given in "Twip" units! (1440 twips per logical inch)
Point #3 Calibration – X Pixel Coordinate Y Pixel Coordinate Pick Pixel Coordi Picture X Stage Coordinate Y Stage Coordinate Read Current Stag Coordinate	-12968 26821	When using a three point calibration, the automatically includes a Z correction for stage sample tilt!