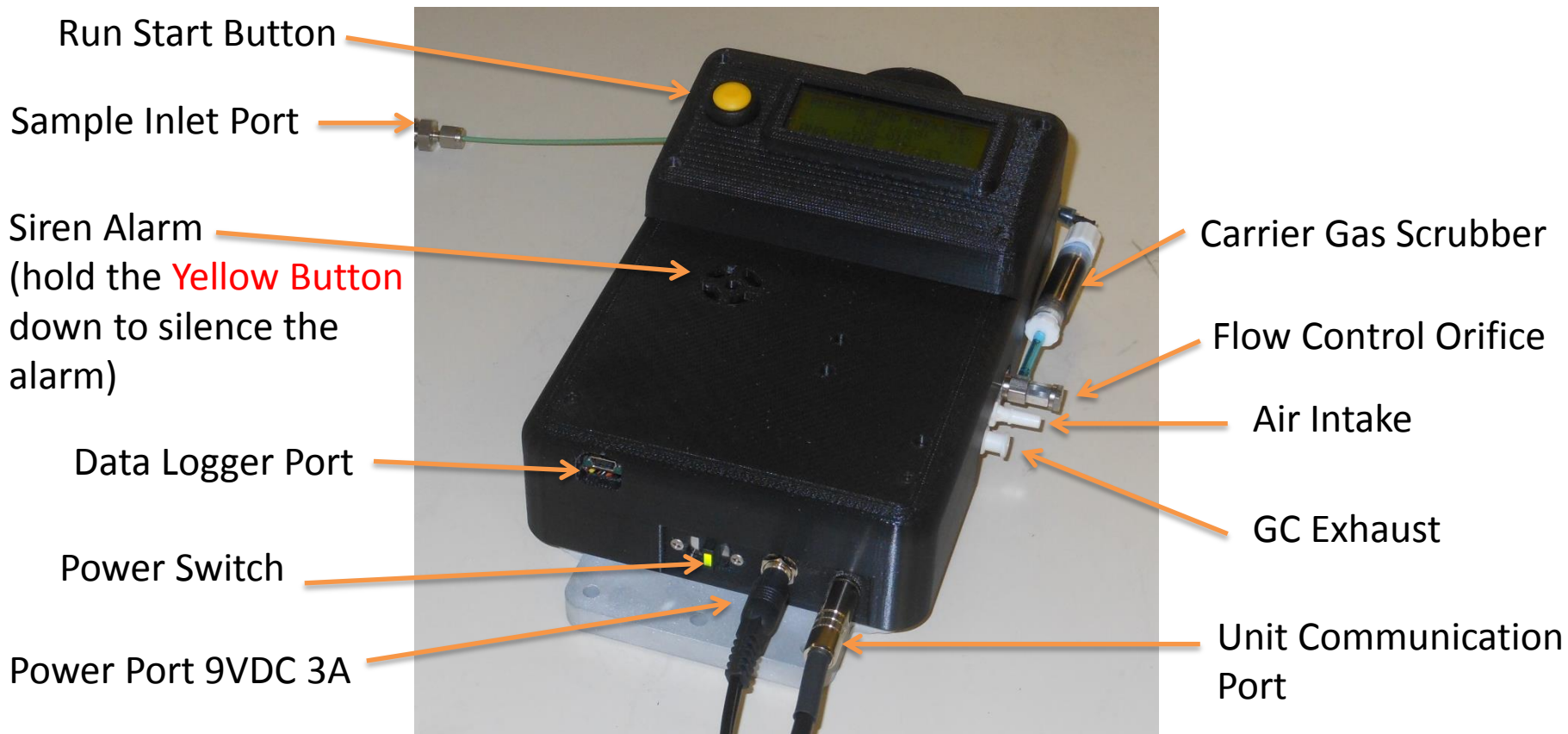


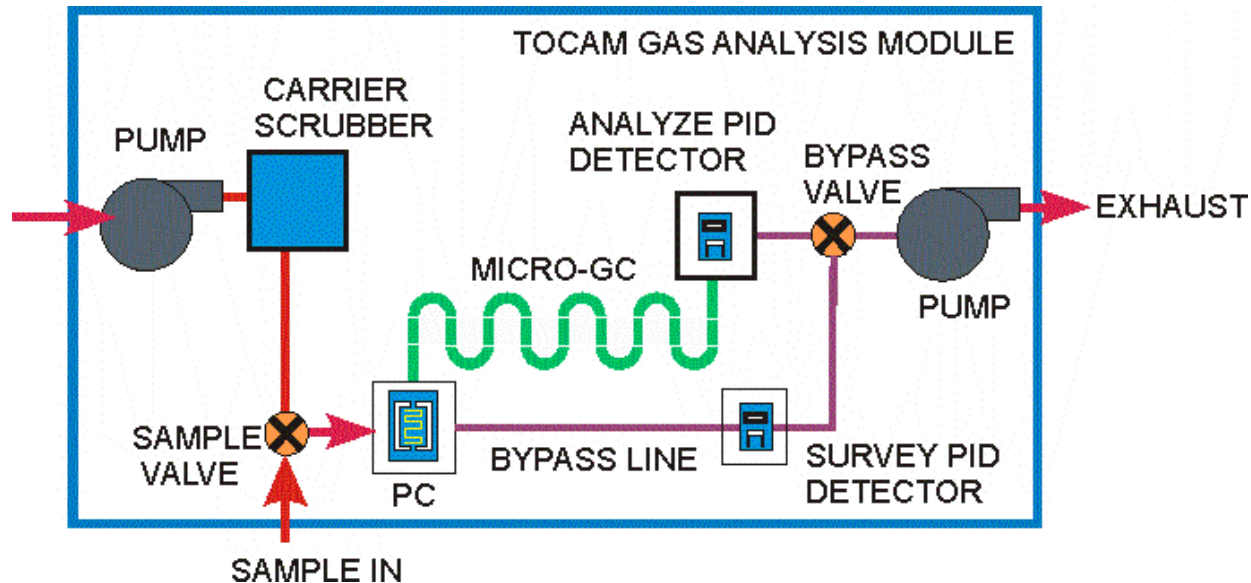
Operation of the Toxic Organic Chemical Air Monitor (TOCAM[®]) with the Ellvin[®] Chromatography Software



Basic Parts of the Toxic Organic Chemical Air Monitor (TOCAM[®])



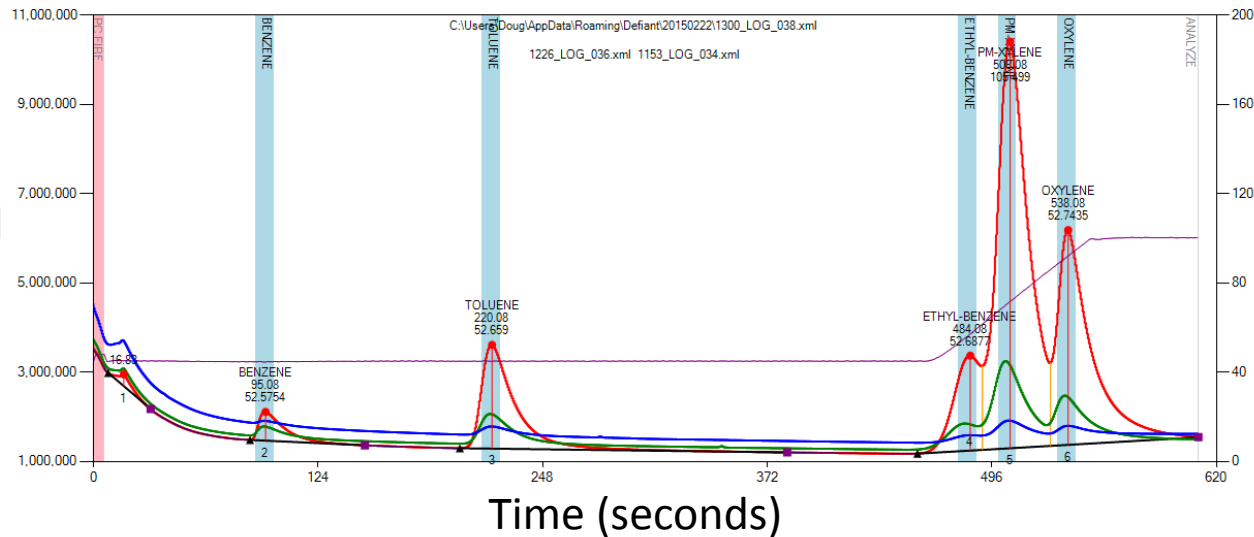
Basic Operation of the Toxic Organic Chemical Air Monitor (TOCAM®)



1. Sample air is drawn over the Preconcentrator (PC) and Survey PID
2. PC heats periodically to send concentrated chemical plume over the Survey PID
3. A jump in Survey PID signal indicates presence of a chemical above allowable threshold
4. When threshold level is exceeded, the PC is loaded for full analysis
5. Valves and Pumps are switched to push chemical plume through micro-gas chromatography (GC) column and over Analysis PID

Basic Gas Chromatography Concept

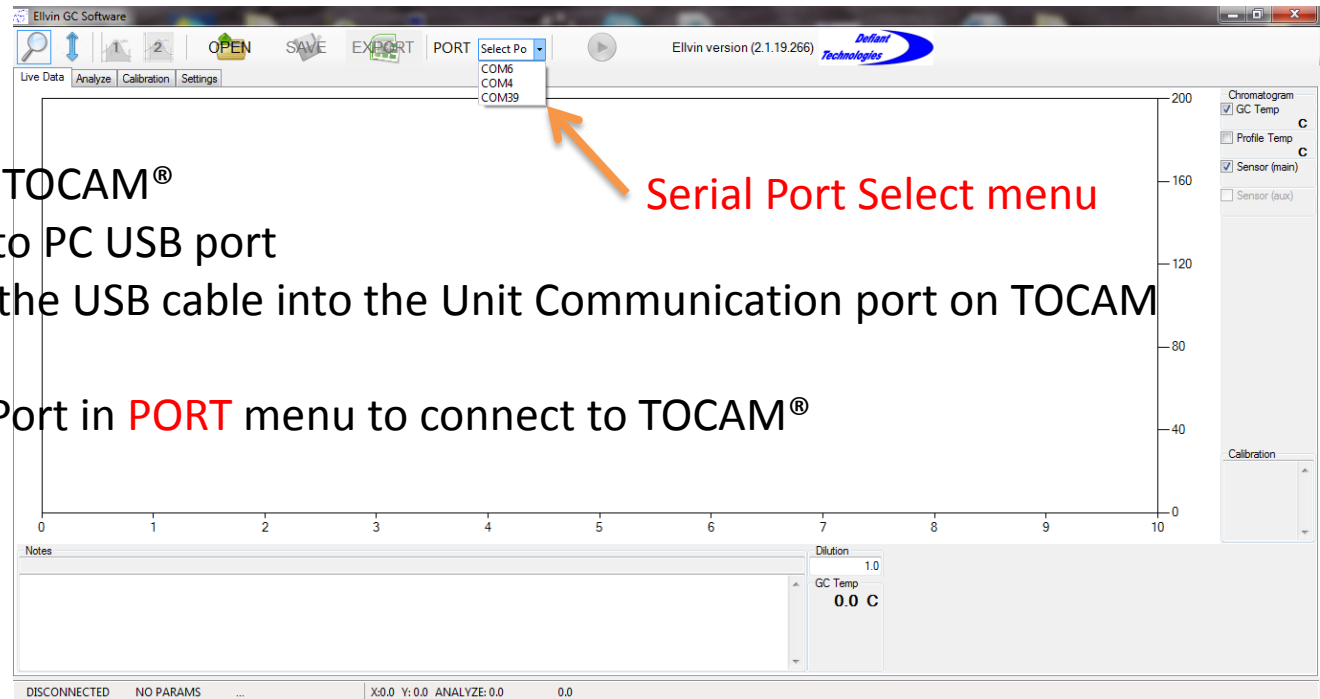
1. A concentrated mix of chemical is injected into a long tube (that is, the micro-GC)
2. Chemicals in the mix separate as they interact with a coating on the walls of the micro-GC column
3. A detector (that is the Analyze PID) senses analytes as they emerge (or elute) from the GC one at a time
4. Chemical identity is based on the time it takes an analyte to move through the micro-GC (i.e., the Retention Time)
5. Chemical concentration is a function of the signal level from the detector
6. A calibration is created for the GC system by running known chemical challenges on the instrument



Installing Ellvin Software and Connecting to TOCAM[®]

1. Load Ellvin CD
2. Run Setup
3. Go into the **USBtoSerialSerialDrivers** folder on CD
4. Run **CDM 2.04.06.exe** to install the drivers for the USB to Serial Cable
5. Start Ellvin program

6. Plug power cable into TOCAM[®]
7. Plug clear USB plug into PC USB port
8. Plug the other end of the USB cable into the Unit Communication port on TOCAM
9. Slide TOCAM[®] on
10. Select the new Serial Port in **PORT** menu to connect to TOCAM[®]



Ellvin Software Settings Tab

- GC Temperature profile is setup here (see figure to right)
- This is how long a sample is collected for an analysis
- Time PC is heated to clean before run
- Time for settling before and after sample collect
- How long the PC is heated
- SET** sends changes to TOCAM
- How long material is collected during the rapid screening
- How many rapid screening cycles are repeated before a full analysis is performed
- What is the height limit on a screening pulse that will initiate an instant analysis

The screenshot displays the 'Settings' tab in the Ellvin GC Software. It features a table of parameters and a temperature profile graph. The graph shows a temperature profile with the following parameters: Ta = 360, Tb = 60, Ct = 40, Ht = 100, and Tc = 120. The table lists various parameters and their values:

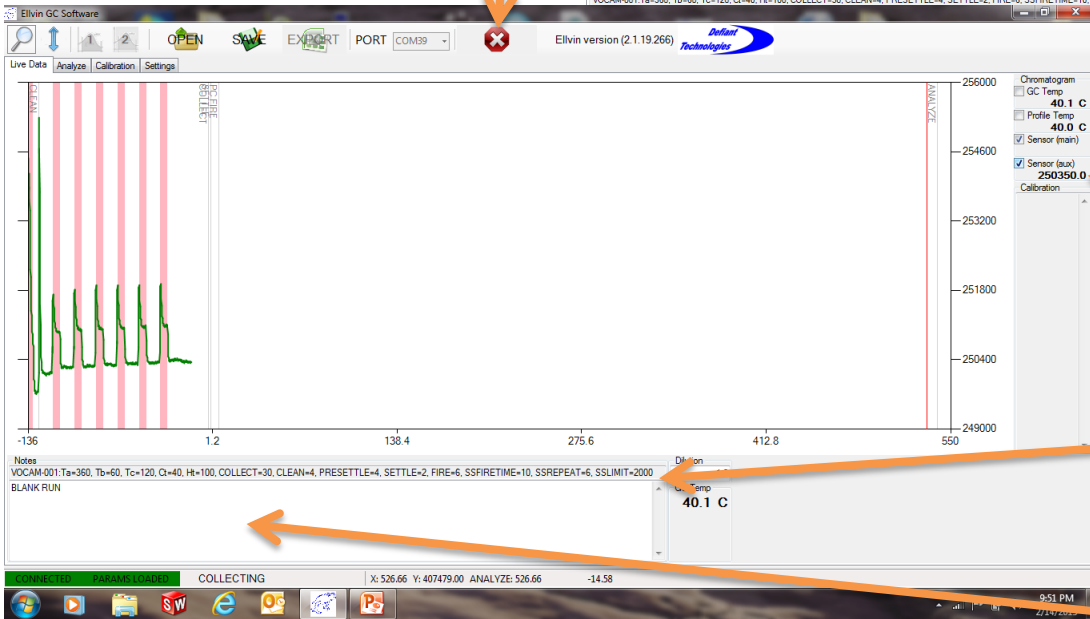
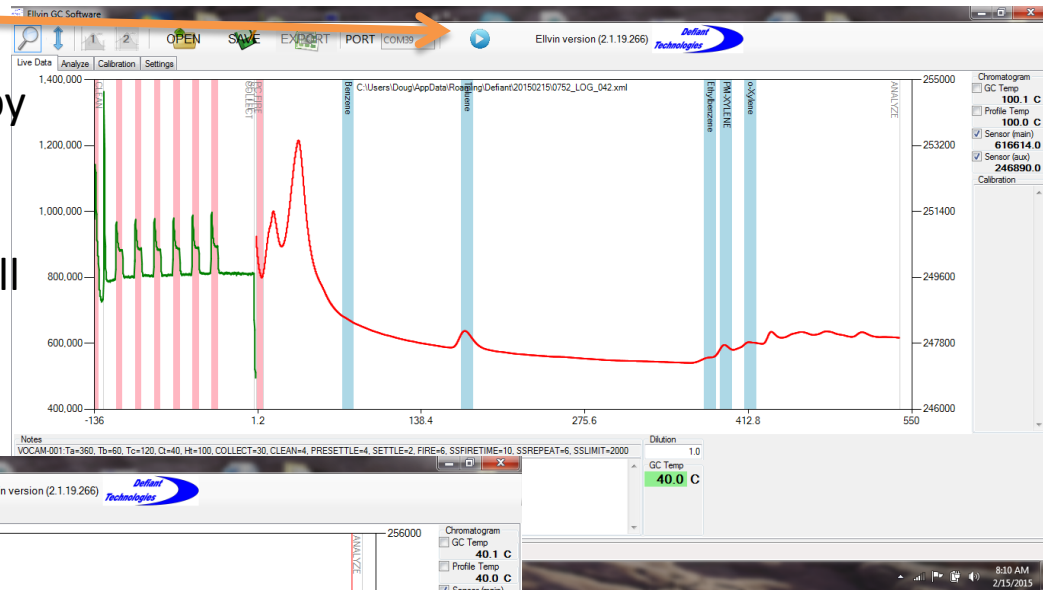
Parameter	Range	Value
Ta	[2 - 900]	360
Tb	[2 - 900]	60
Tc	[2 - 900]	120
Ct	[30 - 99]	40
Ht	[30 - 150]	100
COLLECT	[10 - 900]	30
CLEAN	[2 - 20]	4
PRESETTLE	[2 - 20]	4
SETTLE	[2 - 20]	2
FIRE	[2 - 20]	6
SSEIDETIME	[2 - 99]	10
SSREPEAT	[0 - 250]	6
SSLIMIT	[2 - 900000]	2500

The graph shows a temperature profile with the following parameters: Ta = 360, Tb = 60, Ct = 40, Ht = 100, and Tc = 120. The graph shows a temperature profile with the following parameters: Ta = 360, Tb = 60, Ct = 40, Ht = 100, and Tc = 120.

Description of GC Temperature profile

Running a Test from the Live Data Tab

1. Press the **Play Button** to begin a run
2. A run can also be initiated by pressing the **Yellow Button** on the TOCAM[®] box
3. Pressing the **Stop Button** will end a run and initiate a short PC cleaning cycle.



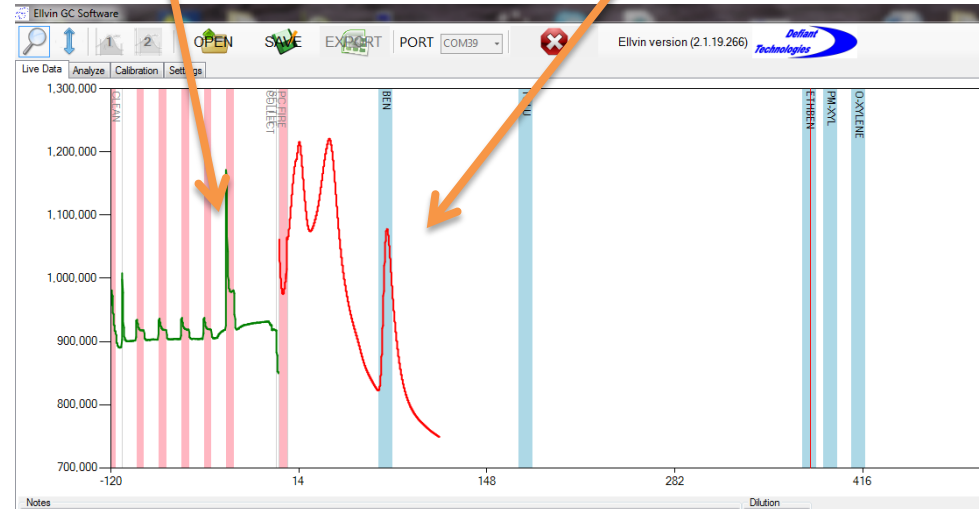
4. These tabs allow you to toggle between displaying the GC temperature and data from the Survey PID.
5. The operating parameters are listed here and stored in an annotations file.
6. Add notes here to indicate test conditions for later reference

Features of the Live Data Tab

1. If the survey run sees a chemical hit, it will immediately begin collecting for an analysis run
2. The peak level to initiate an instant analysis is entered in the **Settings** Tab as the **SSLIMIT**

Chemical Hit

Analysis Underway



The screenshot shows the 'Settings' tab in the Elvin GC Software. The left pane contains a list of settings with their current values and ranges:

Parameter	Value	Range
tC	120	[4 - 900]
Ct	40	[30 - 99]
Ht	100	[30 - 150]
COLLECT	30	[10 - 900]
CLEAN	20	[2 - 20]
PRESETTLE	4	[2 - 20]
SETTLE	2	[2 - 20]
FIRE	6	[2 - 20]
SSFIRETIME	10	[2 - 84]
SSREPEAT	6	[0 - 250]
SSLIMIT	2000	[2 - 500000]

The right pane shows a diagram of a peak with the following parameters:

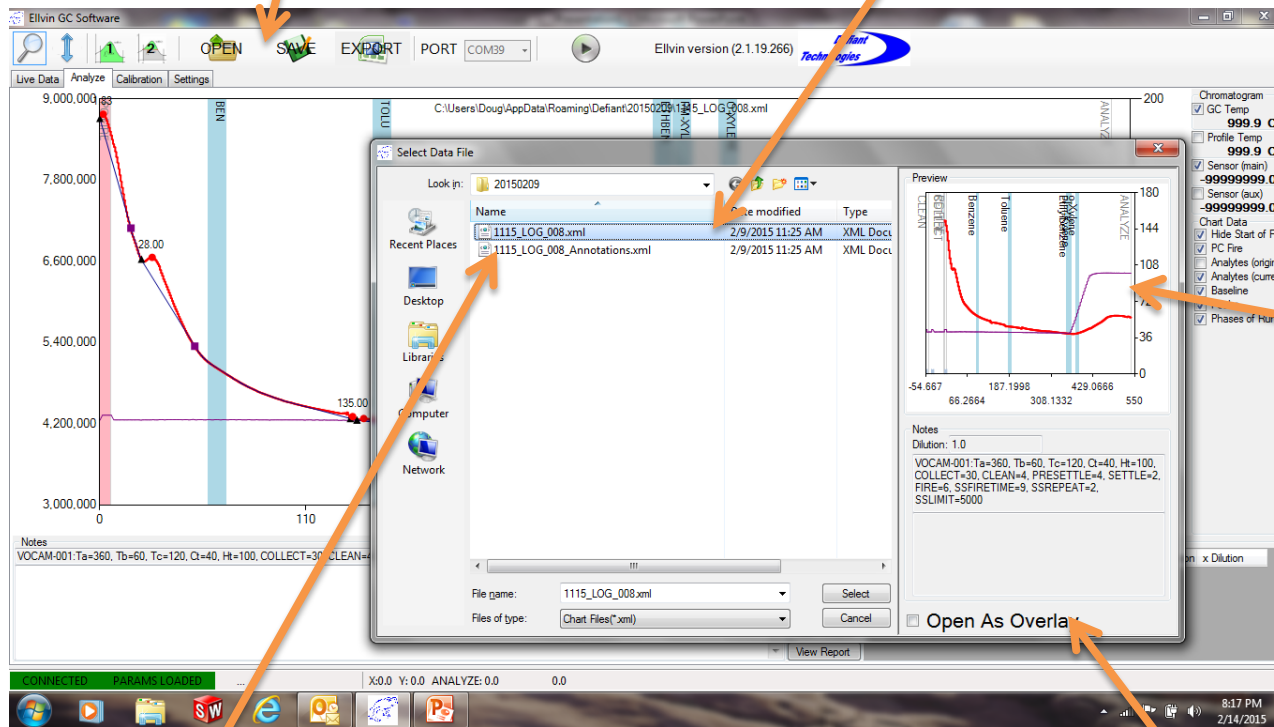
- Temperature (°C): 360
- Ta = 360
- Tb = 60
- Tc = 120
- Ct = 40
- Ht = 100

The diagram also shows a list of peak heights (SS.HEIGHT) and a 'Behavior for Integration Tool' section with two radio button options: 'Partition the selected peaks and calculate the area of each one' (selected) and 'Calculate the area selected and the time of its center of mass'.

3. The height of the survey peaks appears here in the Settings Tab

Analyzing Data in the Analyze Tab

1. Select **OPEN** and an Explorer Window opens to locate a stored data file
2. Each run is stored in a folder with the Current Date Stamp

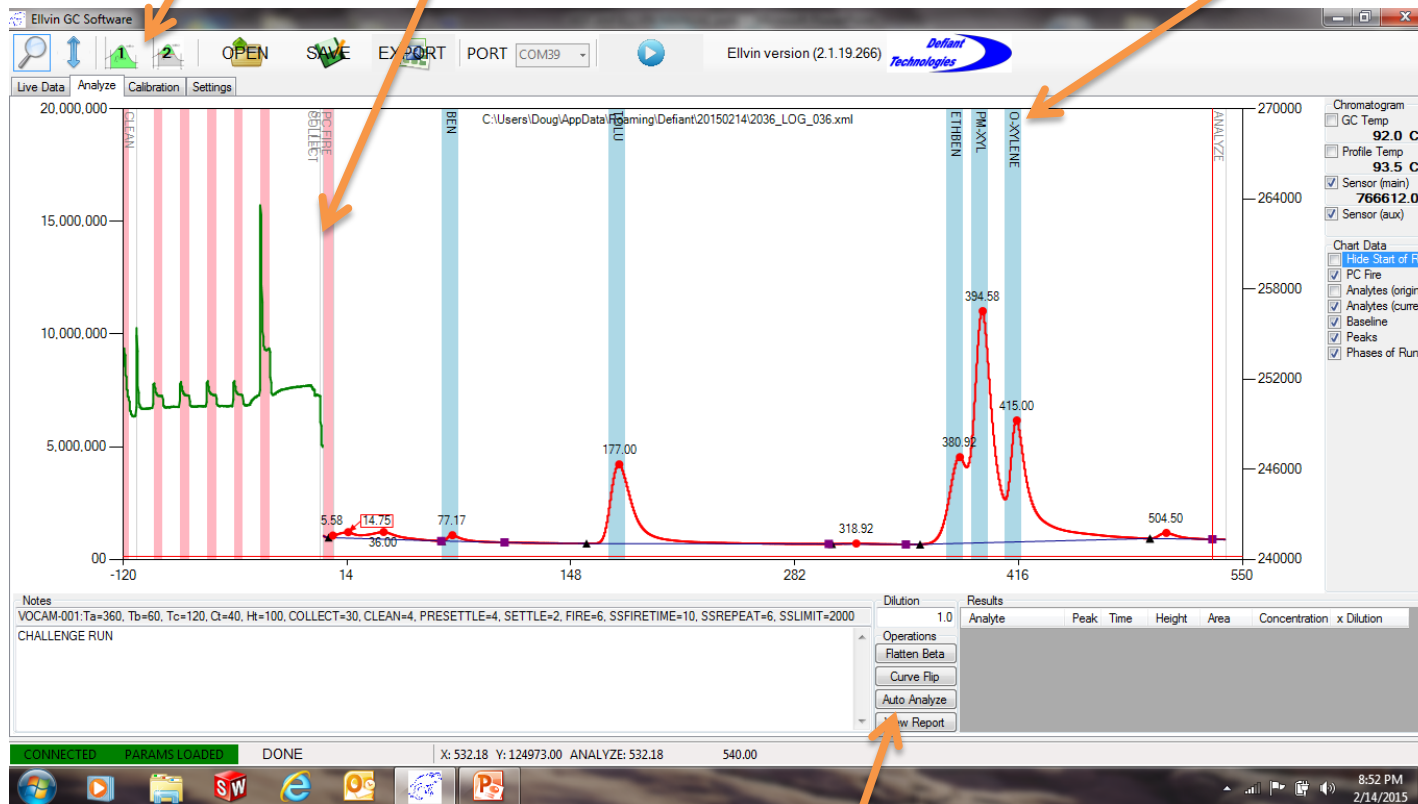


Thumbnail of data

3. Open the first file - Annotations files contains your notes
4. Open as Overlay allows up to 8 files to be displayed simultaneously.

Analyzing Data in the Analyze Tab (continued 1)

1. Tools to integrate analysis peaks. Tool 2 snaps to data line
2. Blue lines indicate retention time windows from calibration
3. Pink lines shows when PC fires



4. Auto Analyze will automatically find peaks and integrate area

Settings Tab (Creating a Calibration File)

1. Create a new calibration file here
2. Open an existing calibration file here

The screenshot shows the Elvin GC Software interface. A 'Save As' dialog box is open, displaying a list of files in the 'Defiant' folder. The file name is 'VOCAM021515' and the save type is 'Analyte Files (*.ana)'. The list of files includes:

Name	Date modified
VOCAM.ana	2/14/2015 8:36 PM
frog 6 btex h2o.ana	12/1/2014 4:30 PM
FROG 16 AIR 0814.ana	11/12/2014 6:59 PM
BLANK.ana	10/28/2014 5:51 PM
FROG007 BTEXAIR.ana	10/19/2014 6:05 PM
tcepce 092314.ana	10/19/2014 6:04 PM
FROG 16 H2O 0814.ana	8/29/2014 10:21 AM
FROG007 BTEX.ana	8/8/2014 8:49 AM
FROG 29 BTEX.ana	6/26/2014 2:29 PM
FROG0026btex.ana	6/18/2014 1:14 PM

Below the dialog box, a list of calibration data is shown, with a red line indicating a peak at 100 seconds:

```
SS.HEIGHT 2250.  
SS.HEIGHT 930.  
SS.HEIGHT 994.  
SS.HEIGHT 1047.  
SS.HEIGHT 1811.  
SS.HEIGHT 6222.  
SS.HEIGHT 1096.  
SS.HEIGHT 1088.  
SS.HEIGHT 1247.  
SS.HEIGHT 4729.  
SS.HEIGHT 952.  
SS.HEIGHT 1003.  
SS.HEIGHT 1032.  
SS.HEIGHT 1010.  
SS.HEIGHT 8740.
```

Buttons for 'Frog Doctor...', 'Reset Log File Numbers', 'SET', 'SAVE AS DEFAULT', 'LOAD DEFAULTS', and 'CLEAR' are visible. The status bar at the bottom shows 'CONNECTED', 'PARAMS LOADED', 'DONE', and coordinates 'X: 526.66 Y: 407479.00 ANALYZE: 526.66 540.00'. The taskbar shows the date 'April 15, 2015' and time '9:03 PM 2/14/2015'.

3. Analyte files end with a **.ana** extension

Creating a New Calibration File in the Calibration Tab

1. Enter Analyte Name and a short Alias Name (Alias will appear on TOCAM[®] Display)
2. Press ADD to add name to list

3. Sample runs used to create system calibration are displayed here

Peak	Time	Height	Area	Width	Concentration	FileName
1	42	81610	1011545	0	400	C:\Users\Pat\AppData\Roaming\Defiant\20141222\0909_LOG_570.xml
2	42.08	104325	1360316	0	800	C:\Users\Pat\AppData\Roaming\Defiant\20141222\0919_LOG_571.xml
3	42.42	185231	2609447	0	2000	C:\Users\Pat\AppData\Roaming\Defiant\20141222\0930_LOG_572.xml

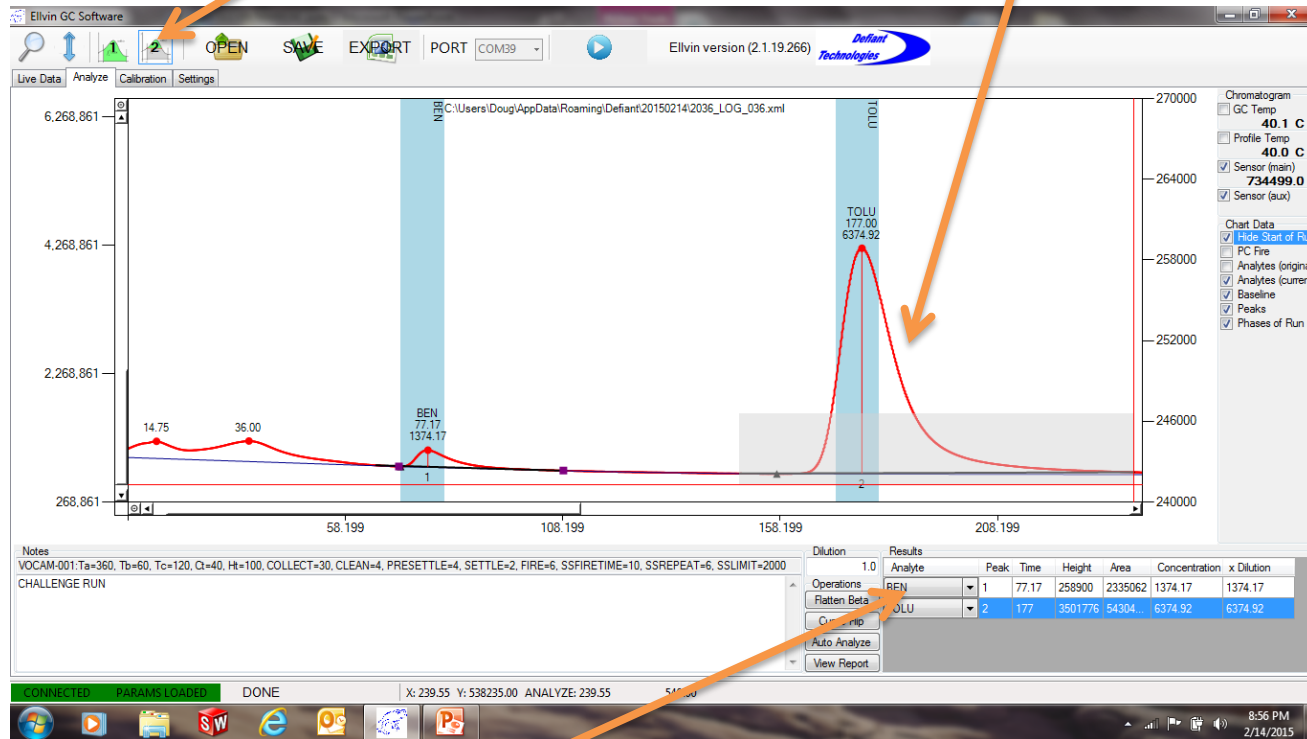
4. Data is added to the table when peaks are integrated in the **Analyze** Tab

5. As peaks are added, a calibration curve is developed

Creating a Calibration (continued)

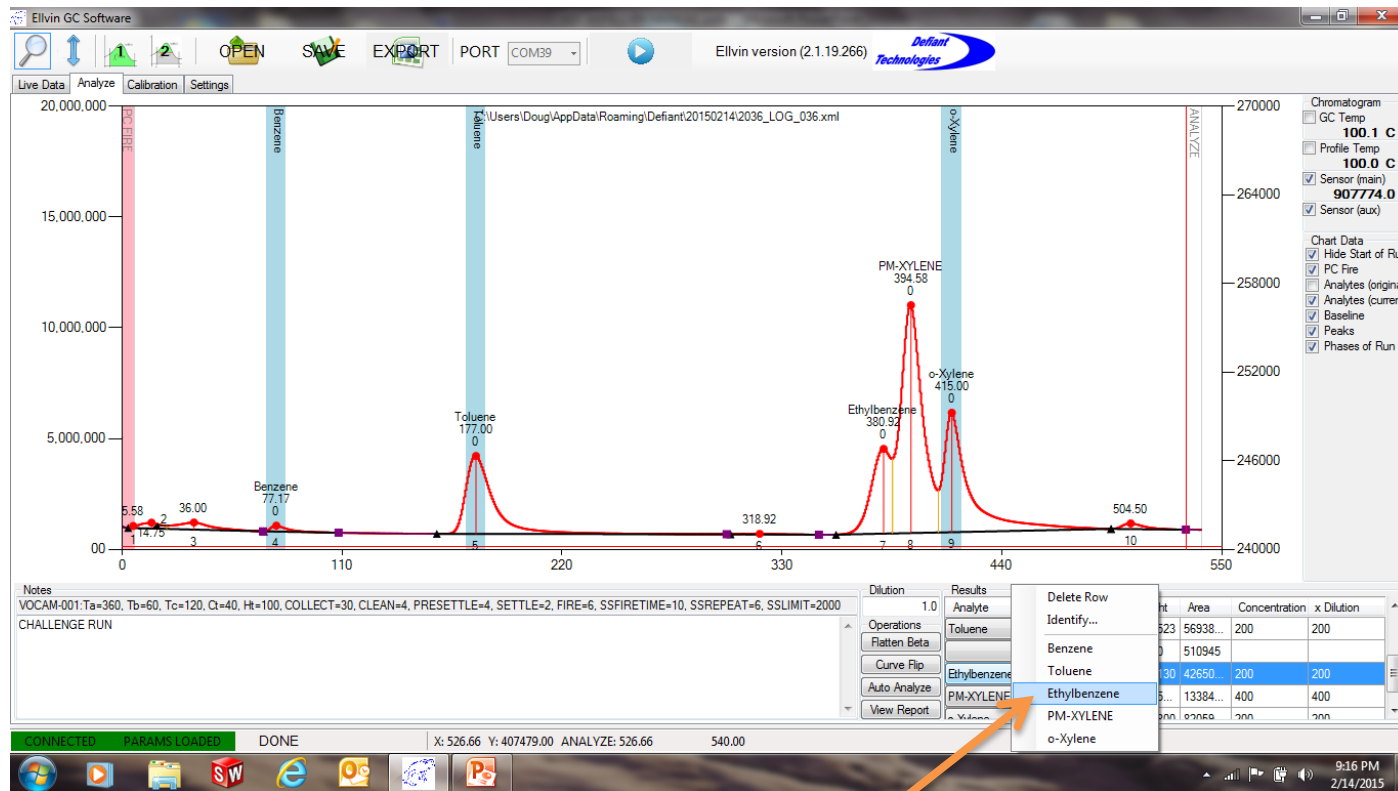
Analyzing Data in the Analyze Tab

1. Select Integration **Tool 2** then hold left mouse down and drag across peak



2. Integrated peaks appear here
3. Analyte name will not appear at first (associating name with retention time on next page)

Creating a Calibration (continued 3) Analyzing Data in the Analyze Tab



1. Left click to select row (row turns blue)
2. Right click to open list of calibration analytes
3. Left click on analyte name for peak data to go into the calibration table in **Calibration Tab**
4. This procedure associates an analyte name with the retention time

Calibration Data in the Calibrate Tab (continued 4)

The screenshot shows the 'Calibration' tab in the Ellvin GC Software. The 'Analyte Name' is 'o-Xylene' and the 'Analyte Alias' is 'O-XY'. The 'Data' table is as follows:

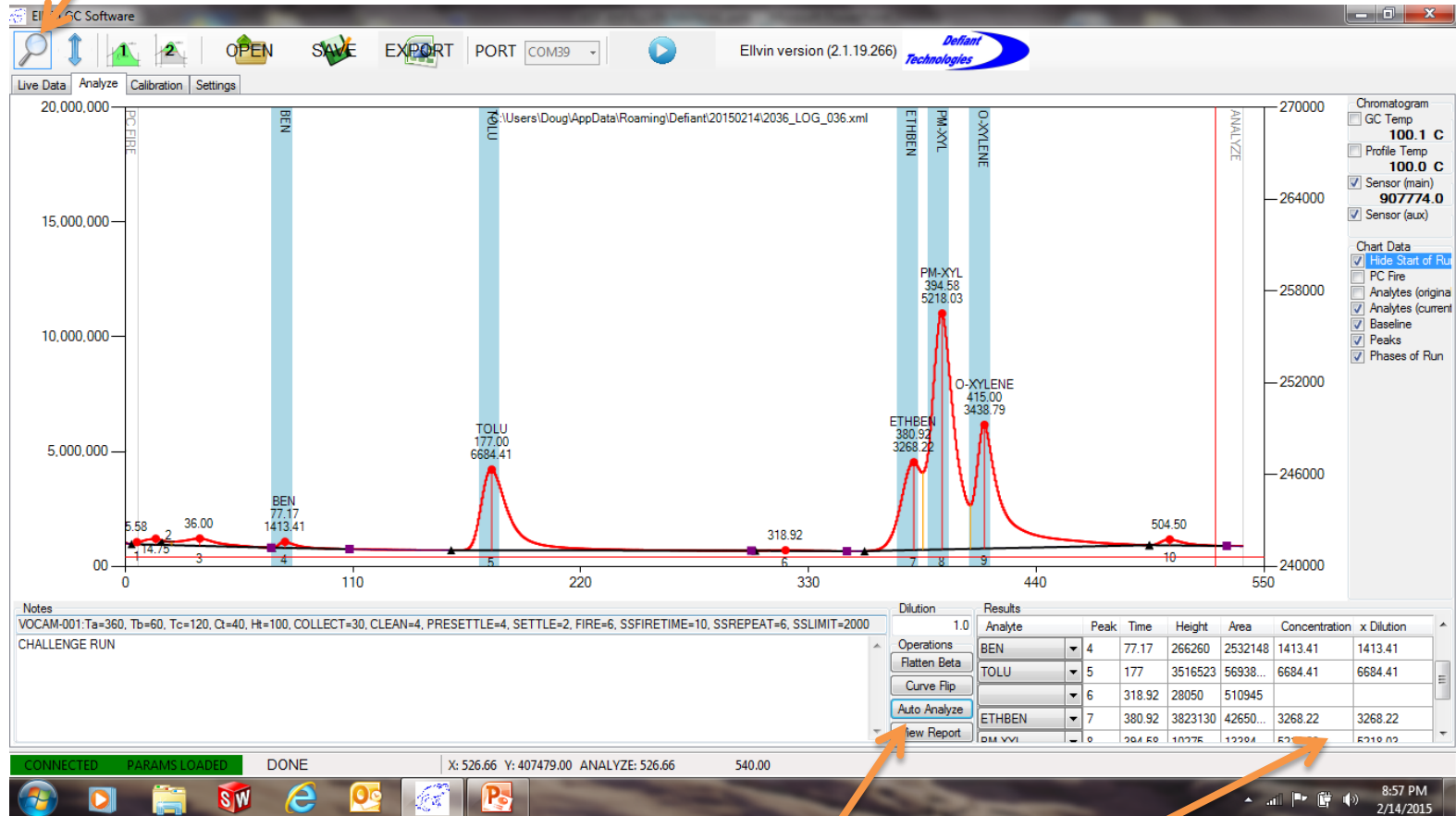
Peak	Time	Height	Area	Width	Concentration	FileName
1	415	5387800	82059850	0	200	C:\Users\Doug\AppData\Roaming\Defiant\20150214\2036_LOG_036...

The 'Analyte Window' is set to 10.00 seconds. The 'Retention Time' is 415 seconds. The 'Solve Using' method is 'Area' with a 'Linear' fit. The calibration equation is $y = Ax^2 + Bx + C$ with $QUAD R^2 = 0.0$ and $LINE R^2 = 1.00000$. The graph shows 'Concentration (ppb)' on the y-axis (0 to 250) and 'Peak Area' on the x-axis (0 to 1,000,000,000). A single data point is plotted at approximately (820,598,500, 200) with a linear fit line passing through it.

1. Data selected in the Analyze table will transfer to here.
2. Add the concentration data of the test sample here.
3. The calibration curve will begin to build with even a single point.

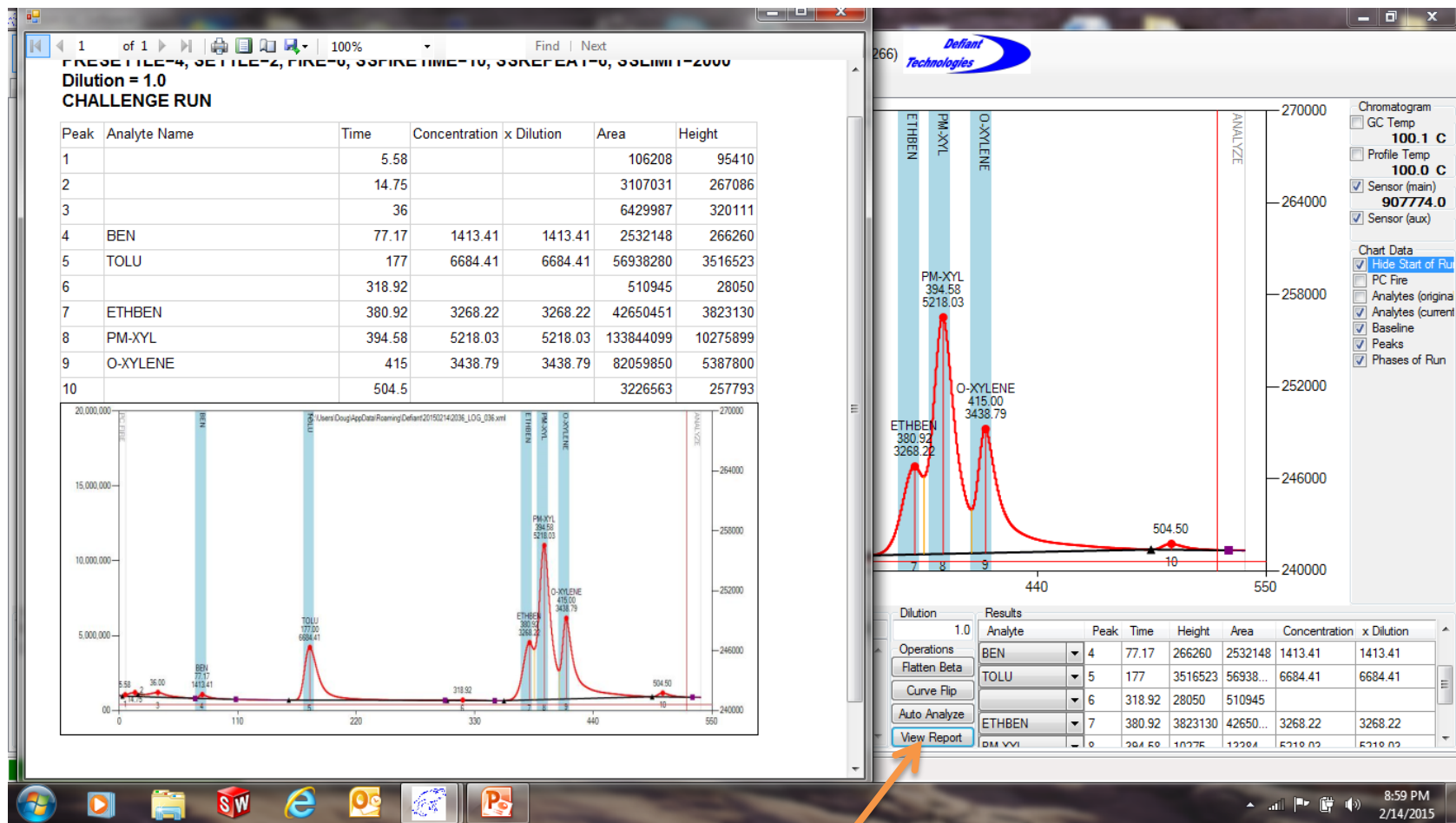
Analyzing Data in the Analyze Tab (continued)

1. Use zoom to focus on part of the analyze data
2. Double-click on magnifier to zoom out to full screen



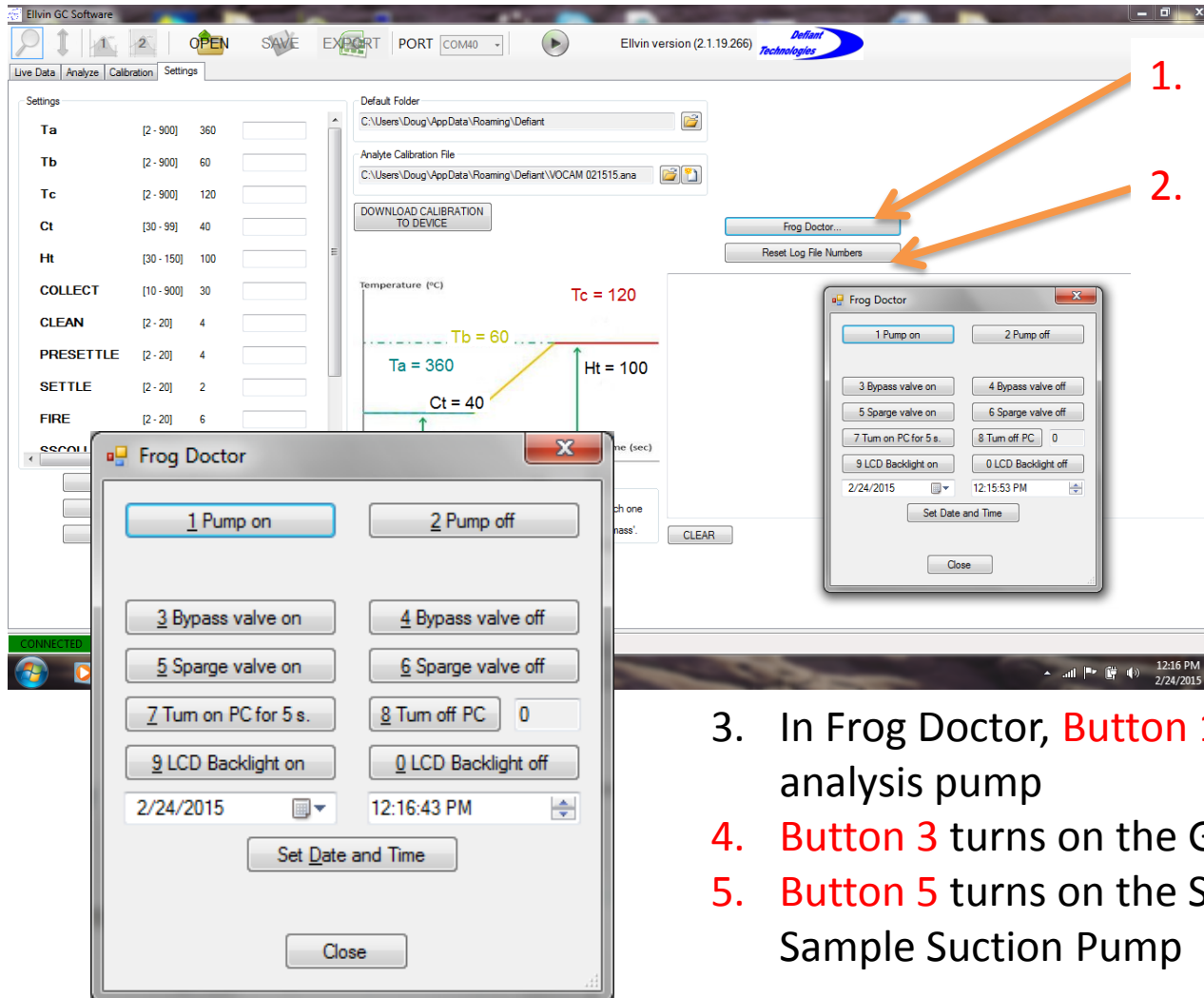
3. Once a calibration file is created, pressing **Auto Analyze** will identify peaks and calculate concentrations

More Features in Analyze Tab



1. After integrating data, press **View Report** to create a summary data sheet
2. Summary sheet can be saved as a PDF or Excel file

Frog Doctor Diagnostics in Settings Window



1. Frog Doctor opens a diagnostic program
2. Reset Log puts the log file number back to 001

3. In Frog Doctor, Button 1 turns on the analysis pump
4. Button 3 turns on the GC bypass valve
5. Button 5 turns on the Sample Valve and Sample Suction Pump

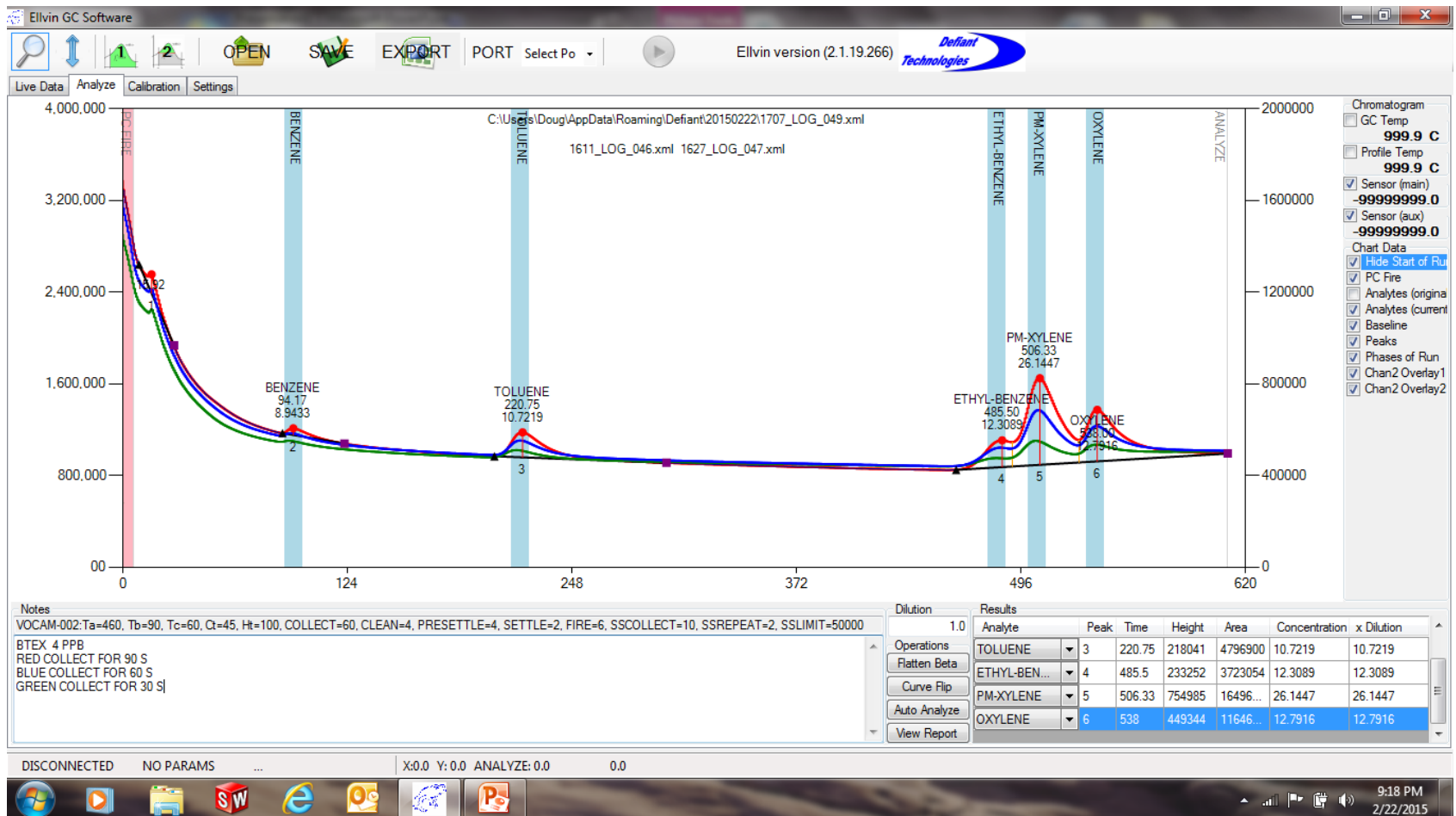
Common Concepts - Cleaning

These peaks will go away after with clean air runs



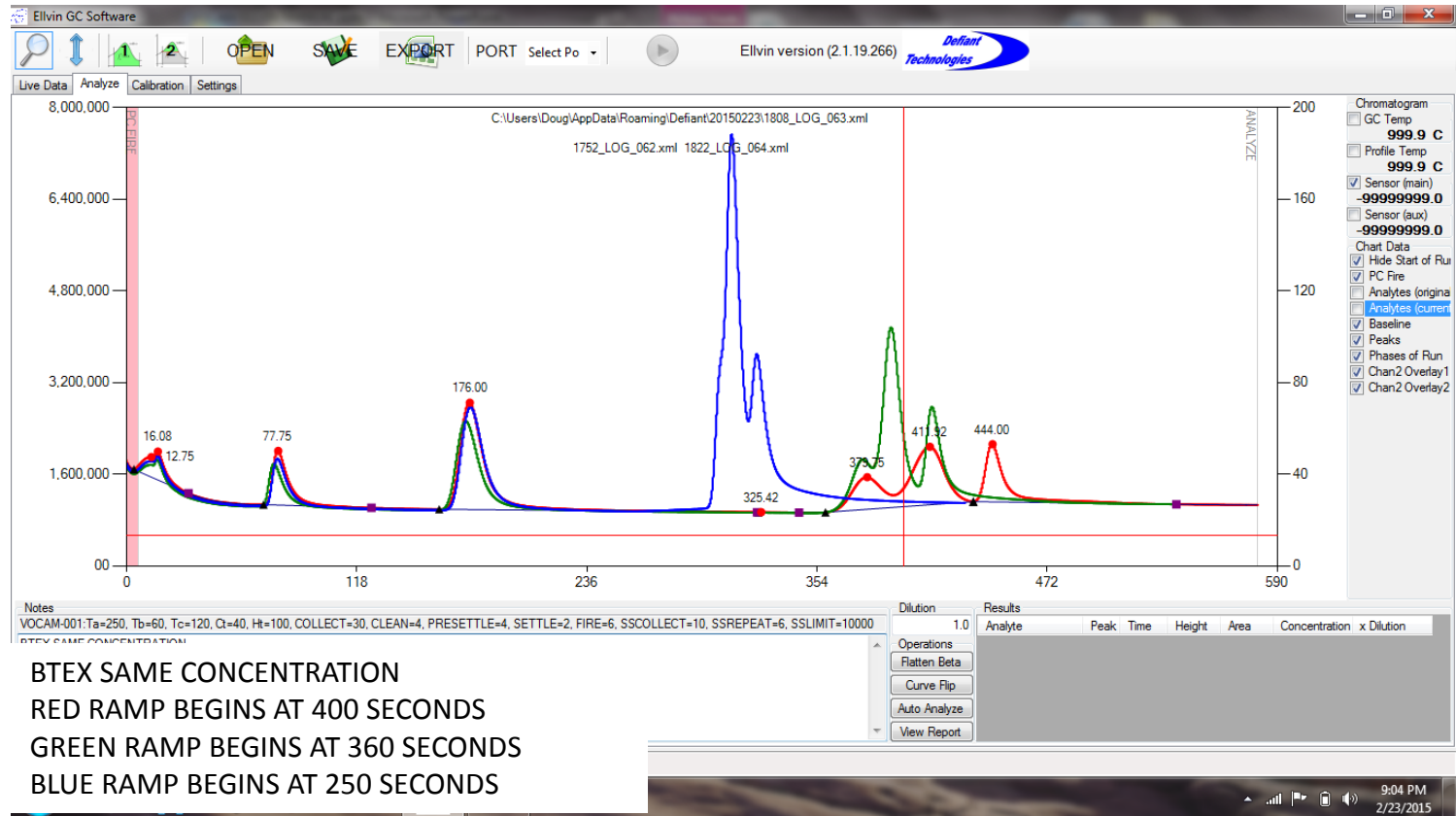
These peaks are common background peaks from solvents used in the PC production or surroundings

Common Concepts - Collect Time



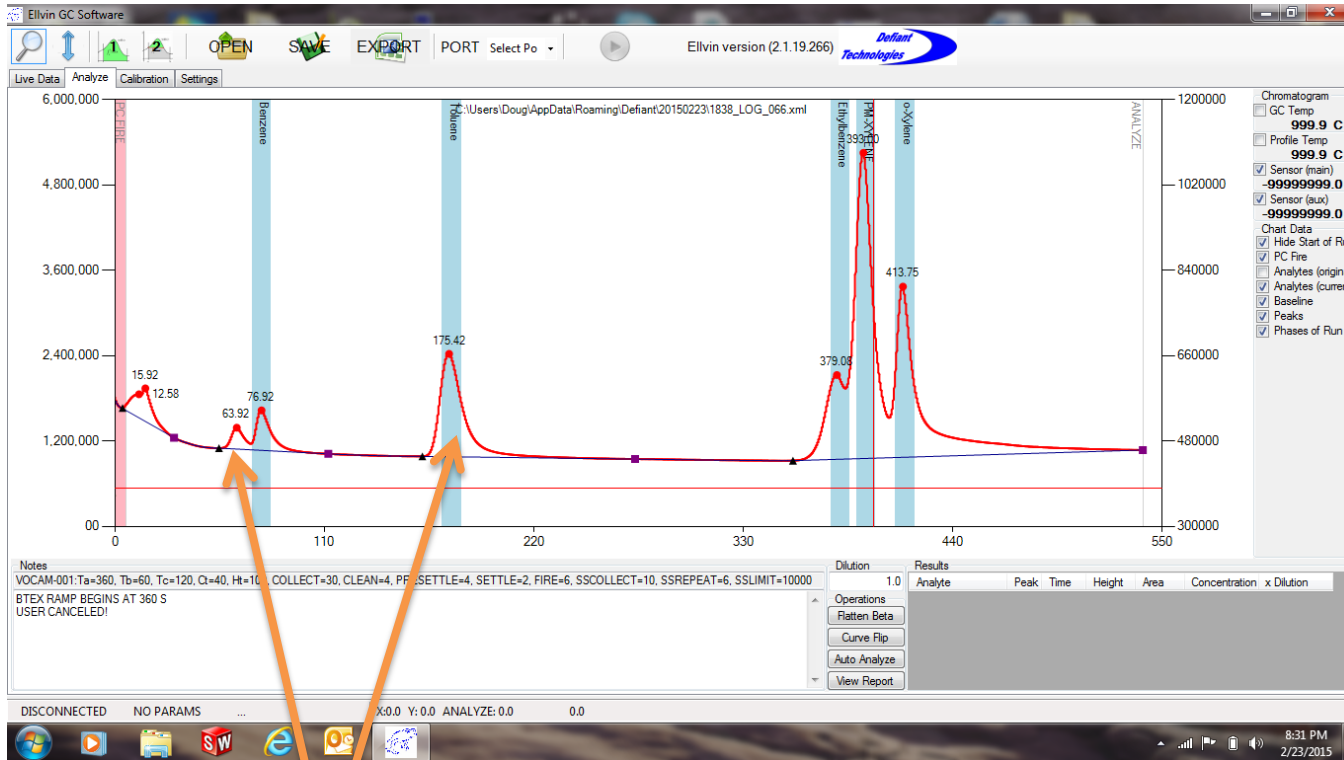
A longer Collect Time will create larger peaks (up to about 120 seconds)

Common Concepts - Temperature Ramping



By changing temperature profiles you can often improve separation. Shown are three runs at similar BTEX concentrations with different start times for a GC ramp. All three went from 40°C to 100°C in 60 seconds.

Common Concepts - Ghosting



Halting a run after the PC is fired will leave analyte suspended in the column. These analytes will emerge on the next run as separate peaks or merged with another peak

Common Concepts - Do's and Don'ts

- Do let the instrument run one cycle after a complete power shutdown to clean the PC and allow the GC temperature to equilibrate
- Do run a calibration check daily if possible
- Do run the GC at temperatures above ambient
- Do not suck liquid into the TOCAM®
- Do not use elastomeric tubing for the gas sample lines (they will absorb the chemicals and bleed them out slowly)
- Do use PTFE (good), PEEK (better), or Sulfinert® treated stainless (best) tubing for gas sample lines
- Do play with the instrument and learn how it works – we have yet to see one destroyed beyond repair

Finally: If you want TOCAM® to run multiple unattended runs, hold the **shift key down** when you click on the **PLAY BUTTON**.

You can also start multiple runs by holding down the **Yellow Button** when **power** to TOCAM® is switched on.