Geochemistry Data Analysis

This Geochemistry Data Analysis How-To Guide demonstrates the key steps required to analyze your data with a variety of Geochemistry analysis tools.

Geosoft provides sample data for you to use when working through these How-To Guides. These data files can be found in your ".../Geosoft/resourcefiles/data/geochemistry" folder.

The procedures in this guide show you how to:

1. Perform Histogram Analysis
2. Correlation Analysis
3. Scatter Analysis
4. Probability Analysis
5. Triplot Analysis
6. Create Overlay Maps

Histogram Analysis

Histograms are a familiar method for displaying numerical information and have the added benefit of providing a visual representation of the data in which:

› Total data range for a particular element
› Modes can be easily recognised
› The range of greatest abundance of values can be estimated rapidly
› The general form of the density distribution of data is apparent
› The data can be coloured using statistical calculations of the selected lines in the database

They are also useful for distinguishing between background and anomalous values (i.e. quality control), or for recognizing a bimodal data distribution (i.e. interpretation). In many cases, the logarithmic transform of raw data is important because it provides a normal form to the density distribution; in which case, the data is said to be log-normal.

The Geochemistry system provides an interactive histogram analysis tool that displays the selected channel, channel statistics, histogram width, current cursor position and corresponding data value and percentile values. The tool is a dynamic dialog box that updates data values whenever you make a change to a corresponding value in the database.

In addition to providing a quality control tool for analyzing your data, the histogram tool enables you to create classified symbol plots with symbol legends for your maps.

Once the histogram tool has been created, it is stored as an Auxiliary Tool in the Project Explorer (on the Tools tab). The Auxiliary Tools can be hidden/displayed as necessary (right-click on the tool in the Project Explorer and select 'Hide' or 'Show' from the pop-up menu). The Auxiliary Tools are saved in the project when you close Oasis montaj and will be available automatically, with the same settings, the next time the project is opened.
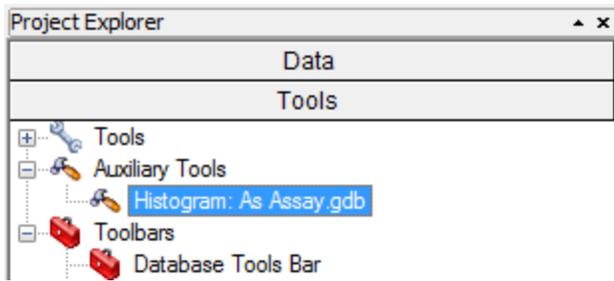
⚠️ *The Histogram tool can be docked at the top/bottom or sides of the current project window and resized, up to the full size of the screen.*
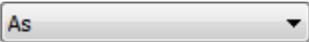
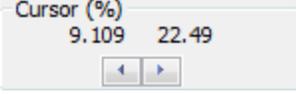## Accessing the Histogram Analysis Tool

1. Open and select the database you want to use.

2. Select the channel for which you want to display histogram results.

3. On the *GeochemAnalysis* menu, click the **Histogram analysis** menu item.
   The *Histogram* tool appears.
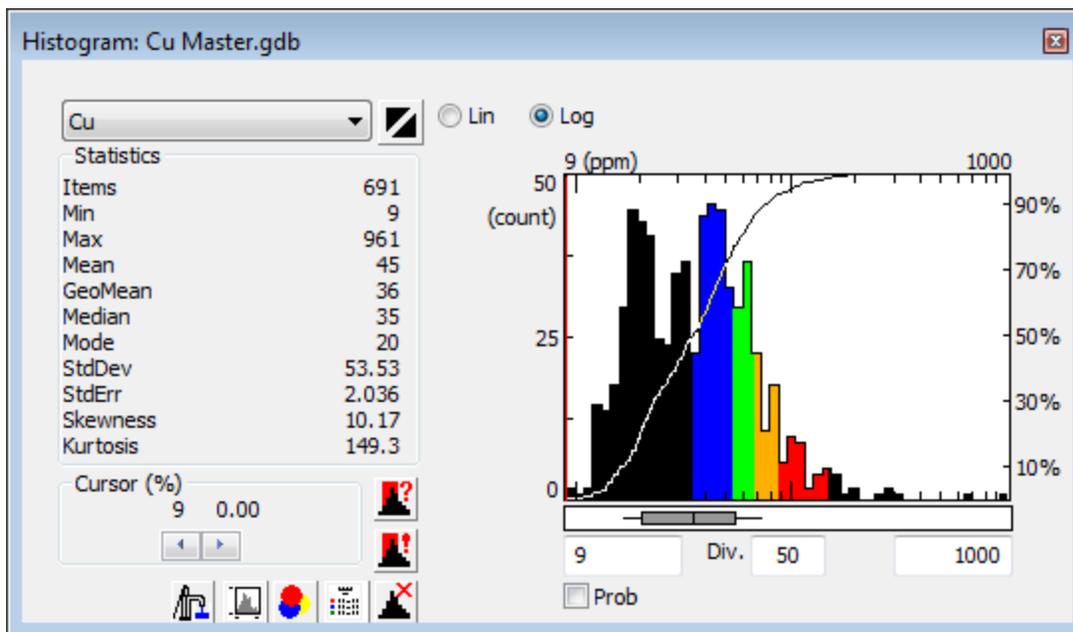
Using Basic Histogram Capabilities

The following table summarizes how to perform basic activities with the Histogram tool.

To change or select the channel As ▼	Type a new channel name in the entry field near the top left of the tool or using the drop-down menu, select a name from the list.
To log transform the data (retains raw data statistics) ○ Lin ⦿ Log	Select the **Log** button near the top centre of the tool. Selected option will be highlighted.
To display the histogram as a cumulative %. ☑ Prob	Select the **Prob** (Probability) button near the bottom left of the tool. Check mark should appear. This option re-scales the cumulative % curve as if the data were normally distributed. The vertical scale is based on units of standard deviation. For data which is normally distributed the cumulative % curve will plot as a straight line (constant slope).
Positioning the cursor by clicking	Click inside the *Histogram* window. The system places a vertical point where you clicked.
Positioning the cursor with left and right buttons ◄ ►	Press the left arrow or right arrow buttons. The system moves the vertical cursor one division in the histogram to the left or right.
Changing min/max values 1 ... 70	Type new values in the entry fields below the Histogram window.
Changing the number of divisions Div. 50	Type a new value in the corresponding entry field below the histogram window.
Working out percentile values Cursor (%) 9.109 22.49 ◄ ►	Position the cursor by clicking or moving the left and right arrow buttons. The system displays the corresponding percentile values in the Cursor Position area near the bottom left of the tool.
Updating values after making changes in data (Pump tool) 🛢	If you make changes in the database (for example, by changing value or replacing them with dummies), you must update the Histogram window by clicking the Data Pump tool button near the bottom left corner of the tool.
Plotting the Histogram on the current map 📊	Select an open map, and click the **Plot the Histogram on the current map** button near the bottom left of the tool. The system asks you where on the map you wish to place the histogram. Type values or use the **Locate** button to place the histogram interactively.
Plot classified colour symbols on	Select an open map and click the **Plot classified colour symbols**

the current map	on the current map button. Specify the attributes for the selected symbols and click OK to draw the symbols on the map.
Plot symbol legend on the current map	Select an open map and press the symbol legend button. Enter the legend information and press Locate to position the legend. Click OK to draw the legend on the map.
Box-whisker plot	Provides a quick visual indication of the histogram for log normal on a skewed distribution. The box indicates the percentile range and the whisker lines represent the next 10 percent on either side Note: the default percentile range is 20 - 80. The percentile range may be changed to 25 - 75 in the *ChemImport|Preferences* dialog.
Make original size button	You can now resize the histogram tool by dragging any side of the tool to a larger size. Clicking the Make original size button returns the histogram to the original size.
Define masking limits button	You can now define mask limits. Click the Define Masking Limits button. The cursor appears as a cross. Click the left mouse button at the lower extreme of your mask limit, and then left click at the upper extreme. The mask area will be highlighted.
Apply current limits to mask channel	After defining your masking limits, click the Apply current limits to mask channel button. The *Set Mask based on data range* dialog is display. Specify your parameters and click OK to apply the limits to the selected mask channel.
Reset mask channel	The Reset mask channel button enables you to reset the mask channel and set all values in the Mask channel to 1.

Correlations

The Geochemistry system enables you to calculate a *Multi-Element Pearson Correlation* between data channels, and then plots the results in a correlation table on a map.
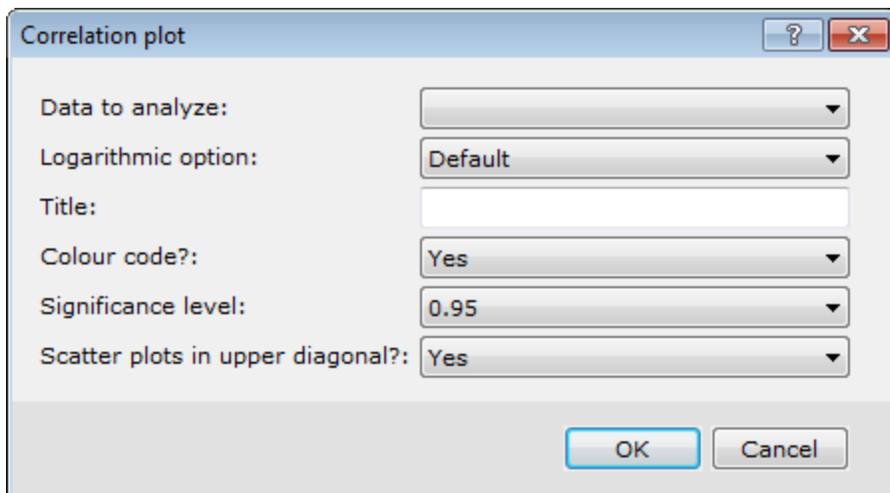
The correlation matrix will appear as the selected group on the map. While the group is selected, you can move the mouse to a specific correlation of interest. If you then press the right mouse button, the groups "Maker" will appear as "Scatter tool" at the bottom of the pop-up menu. Select this option to display the scatter tool for this data pair. Any number of scatter tools can be open at the same time, and all will be linked to each other and any open map of the survey area.

⚠️ *For more detailed information on the Multi-Element Pearson Correlation click the Help button on the Correlation plot dialog.*

Displaying the Correlation

A *Multi-Element Pearson Correlation* will be calculated and the results will be plotted in a table on a map.

1. On the *GeochemAnalysis* menu, select **Correlations**.
   The *Correlation plot* dialog appears.

2. Select the data to analysis from the *Data to analyze* dropdown list.

3. You can also specify the *Logarithmic option*, *Title*, *Colour Code*, *Significance Level*, and *Scatter plots in upper diagonal* options.

4. Click **OK**. The Correlation plot will be displayed.

Pearson Correlation Plot

Project:
Scientist:
Project date:
Report date: 2012/05/28

	Cr	Co	Ni	Cu	Zn	As	Zr	Mo	Sn	Pb
Cr										
Co	0.50									
Ni	0.78	0.67								
Cu	0.07	0.20	0.27							
Zn	0.07	0.01	0.13	0.57						
As	0.01	0.06	-0.00	-0.13	-0.18					
Zr	-0.10	-0.26	-0.34	-0.22	-0.04	-0.32				
Mo	-0.12	-0.29	-0.31	-0.27	-0.22	-0.38	0.90			
Sn	-0.14	-0.22	-0.24	0.09	0.06	-0.02	0.13	0.14		
Pb	-0.01	-0.08	-0.03	0.64	0.69	-0.16	0.03	-0.08	0.23	

Colour Coding
(significance 0.95)

- very strong
- strong
- moderate
- weak
- very weak
- null

Sample Size 701

⚠️ *The correlation matrix will be the selected (active) group on the map. The cursor will reflect which map selection mode you are in by appearing like the **Select a group** button on the mapping toolbar ⌇⌇⌇.*

While the group is selected, you can move the cursor to a specific correlation of interest. Click the right mouse button, a pop-up list will appear. Select the *Scatter tool* from the pop-up list. The specific correlation elements will be displayed in the Scatter tool. Any number of scatter tools can be open at the same time.

Scatter Analysis

The *Scatter Analysis Tool* plots one channel against another channel. Using the Scatter tool you can select a predefined template and/or overlay file, select the channels to be displayed, the masked channel to use, the scaling method for the data and the symbol and symbol attributes to use for plotting. The *Scatter Analysis Tool* enables you to interactively interrogate the data contained within your database and plot to a map.

The *Scatter Analysis Tool* implements dynamic linking between itself and the current database, and through it with any other Scatter or Triplot tool open in the project

A 'mask' channel can be used for selecting a subset of data values from the database. When a mask channel is selected, it will be used and updated by the dialog as selections are plotted. A data value is highlighted in red if its corresponding mask value is not a "dummy" value.

You can also categorize the Scatter Analysis data with the colour based on a Classification channel.

The Scatter Analysis Template (and/or Overlay file) is used to store specific configurations of the Scatter tool. Each Template consists of three files:

1. The Template file, which is a text file that contains information on the channels, scales, titles, etc., as well as the name of the associated overlay file.

2. The Overlay file, which is a text file that contains either (i) line/text commands to draw an overlay or (ii) the name of a map file to use as the overlay. In this case, it refers to a map file.

3. The Map file, which is a Geosoft map containing the overlay map items.

These files are stored in the "*../Oasis montaj/resourcefiles/etc*" directory. New or modified Templates and Overlays are stored in the "*../Oasis montaj/users/etc*" directory.

Once the Scatter tool has been created, it is stored as an Auxiliary Tool in the Project Explorer (on the Tools tab). The Auxiliary Tools can be hidden/displayed as necessary (right-click on the tool in the Project Explorer and select 'Hide' or 'Show' from the pop-up menu). The Auxiliary Tools are saved in the project when you close Oasis montaj and will be available automatically, with the same settings, the next time the project is opened.

➤ The *Scatter* tool can be docked at the top/bottom or sides of the current project window and resized, up to the full size of the screen.
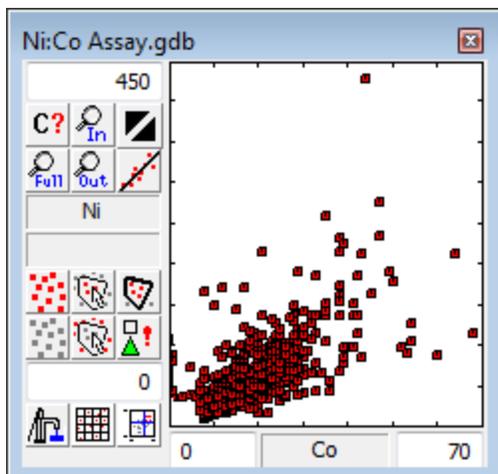
Accessing the Scatter Analysis Tool

1. Open and select the database you want to use.

2. On the *GeochemAnalysis* menu, select **Scatter Analysis**.
   The *Select scatter plot channels and symbols* dialog is displayed in the foreground and the *Scatter Analysis Tool* is displayed near the top left of the screen.
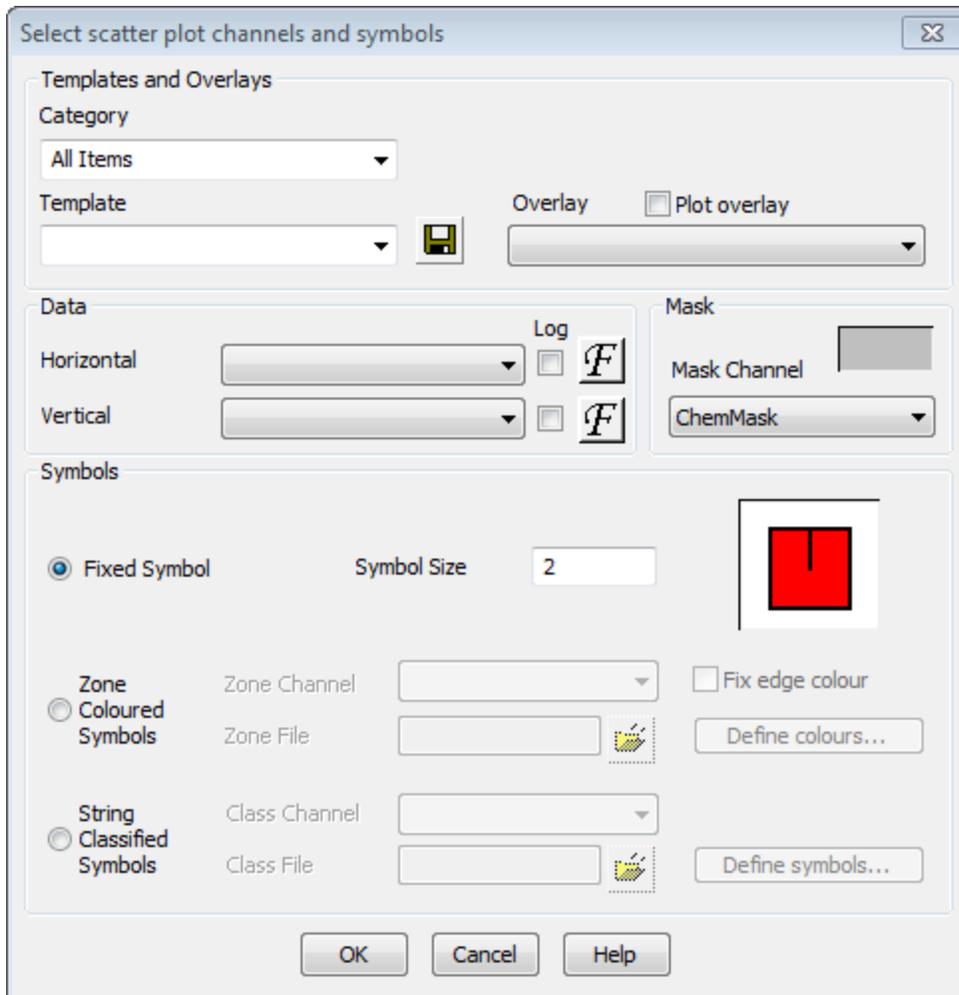
3. Using the dropdown list, select the *Template* and/or *Overlay* file to use.

   You can also select the *Horizontal* and *Vertical* data channels, *Mask* channel and the *Symbol* parameters to use.

4. When you are satisfied with your selections, click **OK** and the Scatter plot will be displayed in your current project

⚠️ *You can use the buttons provided on the Scatter Plot tool to change the channels displayed, mask the data, or modify any of the other parameters.*

Using Basic Scatter Analysis Capabilities

Most options in the *Scatter Analysis Tool* are initiated with buttons.

	Plot Ranges The plot ranges may be edited directly by clicking in the edit fields. The plot will be updated with the new value when another control is clicked, or after the **<Enter>** key is pressed.
	⚠️ *Automatic scaling is performed which creates "nice" bounds and tick intervals, so the ranges and values displayed may not be exactly what was selected with the zoom box. Moreover, for logarithmic plotting, the ranges are rounded to the nearest one-tenth of a decade, so the zoom and shrink functions may not behave exactly as expected. Specifically, at least one-tenth of a decade is always displayed when log scaling is used, and the zoom button will not increase beyond this scale.*
C?	**Select channels** Click this button to display the *Select scatter plot channels and symbols* dialog. This dialog enables you to select a *Template* and/or *Overlay* file, the *Data* channels to plot and the *Symbols* to use. Alternatively, clicking inside the channel name boxes (e.g. NA2O_K2O and SIO2) using the left mouse button will also display the same dialog box (i.e. *Select scatter plot channels and symbols* dialog).
🔍In	**Zoom In** Clicking this button enables you to zoom into a user defined area on the scatter plot. Click and hold down the left mouse button while dragging the cursor over the area you want to zoom into. Once you have created a box of the correct size and location, release the left mouse button and your zoom box edges will become the new plot boundaries.
🔍Full	**View all data** Click this button to redraw the scatter plot based on the minimum and maximum values in the data, so that all the data will be displayed.
🔍Out	**Zoom Out** Click this button to redraw the scatter plot at half the current scale, subject to the maximum and minimum values in the data.
◪	**Make original size** Click this button to return the scatter plot to its original size.
	⚠️ *To increase/decrease the size of the Scatter Plot tool, move the cursor to an outside edge of the Scatter tool and the cursor will change to a double arrow (↔), click and hold down the left mouse button while dragging the side or corner of the dialog to the desired size.*
✎	**Plot linear regression line** Click this button to display the *Linear Regression Slope* and *Intercept* for the current data value in the Scatter Tool.
▦	**Select All Points** Click this button to select all the data points.
▦	**Unselect all items** Click this button to unselect all the data points.
▦	**Select items inside an overlay polygon** Click this button to select the items that are inside an overlay polygon area, while unselecting all items outside the polygon.
	⚠️ *Press the <Ctrl> key and select this button in order to add the items in the selected polygon to the currently selected items.*

	Unselect all items inside an overlay polygon Click this button to unselect all of the items that are inside an overlay polygon area, while selecting all items outside the polygon. ⚠️ *Press the* ***<Ctrl>*** *key and select this button in order to remove the items in the selected polygon from the existing selected items.*
	Mask using Polygon Tool Click this button to select a subset of values using the polygon drawing tool. Points within the boundary of the polygon are selected.
	Plot Selected Points on the Map Click this button and the *Symbol Attribute* dialog will be displayed. Use this dialog to specify the symbol plotting parameters. Click the **OK** button to plot the selected data values on the currently selected map. If there is no current map, the user is asked to open one.
	Refresh the Data Click the button (**Pump**) to refresh the data. The data is read fresh from the database whenever one of the channel selections is changed.
	Create a multi-scatter plot Click the button to create a multi-scatter plot on the current map.
	Plot the scatter plot to a map Click the button to plot the scatter plot on the currently selected map. To use this option, the map you are plotting to must have a basemap drawn on it.

The Scatter Plot tool implements dynamic linking between itself and the current database, and through it with any other Scatter or TRI Plot tool open in the project The Scatter Plot tool can also be resized up to the full size of the screen.

Probability Analysis

Probability Plots are a familiar method for determining normal distribution of geochemistry data and have the added benefit of providing a visual representation of the data in which:

› Total data range for a particular element
› Modes can be easily recognised
› Distribution of data can be estimated rapidly
› The general form of the distribution of data is apparent
› The data can be coloured using statistical calculations of the selected lines in the database

They are also useful for distinguishing between background and anomalous values (i.e. quality control), or for recognizing a bimodal data distribution (i.e. interpretation). In many cases, the logarithmic transform of raw data is important because it provides a normal form to the density distribution; in which case, the data is said to be log-normal.

The Geochemistry system provides an interactive probability analysis tool that displays the selected channel, channel statistics, sigma range, current cursor position and corresponding data value and percentile values. The tool is a dynamic dialog box that updates data values whenever you make a change to a corresponding value in the database.

In addition to providing a quality control tool for analyzing your data, the probability tool enables you to create classified symbol plots with symbol legends for your maps.

Once the Probability tool has been created, it is stored as an Auxiliary Tool in the Project Explorer (on the Tools tab). The Auxiliary Tools can be hidden/displayed as necessary (right-click on the tool in the Project Explorer and select 'Hide' or 'Show' from the pop-up menu). The Auxiliary Tools are saved in the project when you close Oasis montaj and will be available automatically, with the same settings, the next time the project is opened.
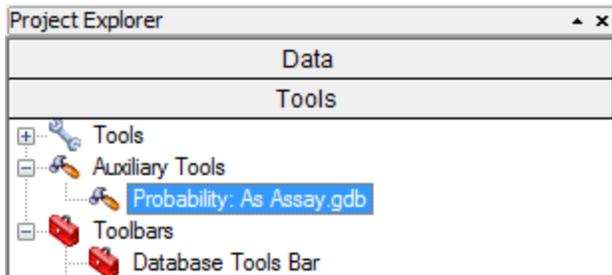
⚠️ *The Probability tool can be docked at the top/bottom or sides of the current project window and resized, up to the full size of the screen.*

Triplot Analysis

The *Triplot Analysis Tool* is similar to the Scatter Plot Tool, but plots a ternary plot using three channels. The values for any point are summed, and then normalized to give fractions from 0 to 100 percent. Each corner of the triangle represents 100 percent for one of the channels, and at any point in the plot the sum of all three components sums to 100.

The Triplot tool implements dynamic linking between itself and the current database, and through it with any other Triplot or Scatter plot tool open in the project.

A 'mask' channel can be used for selecting a subset of data values from the database. When a mask channel is selected, it will be used and updated by the dialog as selections are plotted. A data value is highlighted in red if its corresponding mask value is not a "dummy" value.

You can also categorize the Triplot data with the colour based on a Classification channel.

The Triplot Template (and/or Overlay file) is used to store specific configurations of the Triplot tool. Each Template consists of three files:

1. The Template file, which is a text file that contains information on the channels, scales, titles, etc., as well as the name of the associated overlay file.

2. The Overlay file, which is a text file that contains either (i) line/text commands to draw an overlay or (ii) the name of a map file to use as the overlay. In this case, it refers to a map file.

3. The Map file, which is a Geosoft map containing the overlay map items.

These files are stored in the *../Oasis montaj/resourcefiles/etc* directory. New or modified Templates and Overlays are stored in the *../Oasis montaj/users/etc* directory.

Once the Triplot tool has been created, it is stored as an Auxiliary Tool in the Project Explorer (on the Tools tab). The Auxiliary Tools can be hidden/displayed as necessary (right-click on the tool in the Project Explorer and select 'Hide' or 'Show' from the pop-up menu). The Auxiliary Tools are saved in the project when you close Oasis montaj and will be available automatically, with the same settings, the next time the project is opened.

⚠️ *The Triplot Analysis tool can be docked at the top/bottom or sides of the current project window and resized, up to the full size of the screen.*

Accessing the TriPlot Tool

1. Select the database you want to use.

2. On the *ChemAnalyse* menu, select **Triplot analysis**.
   The *Select triplot channels and symbols* dialog apppears.
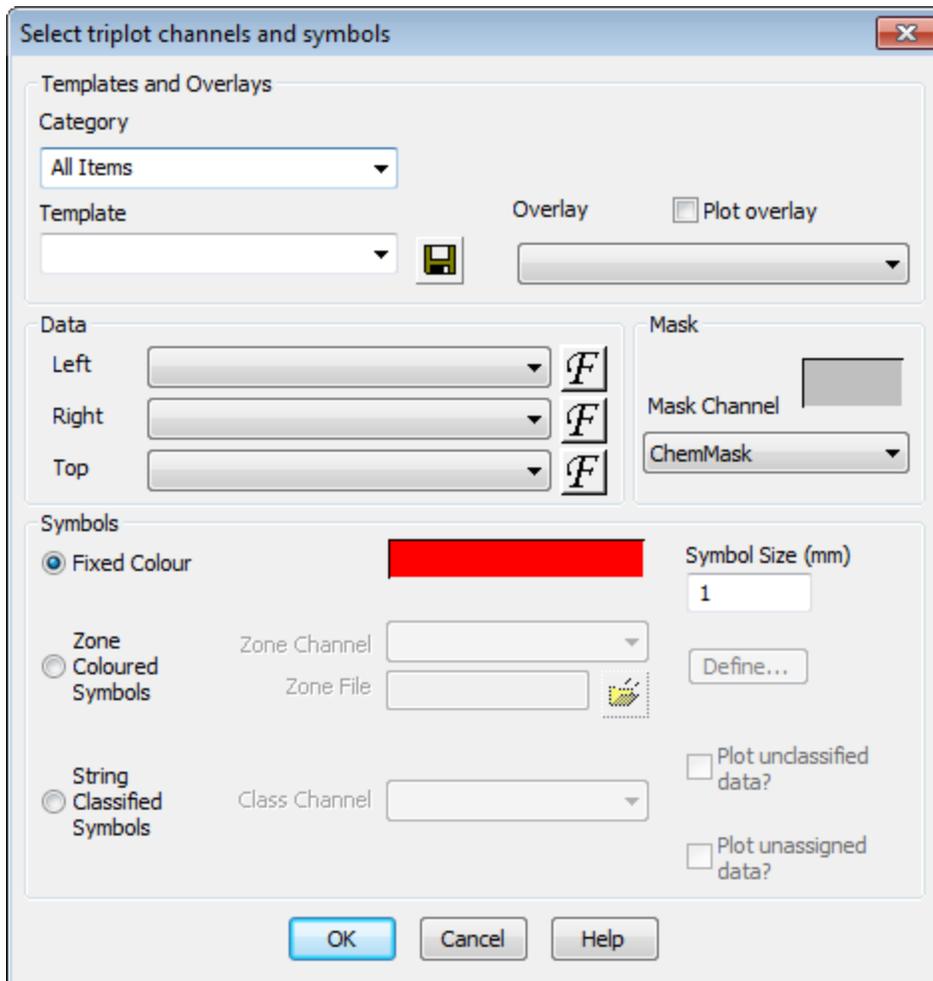
3. Using the dropdown list, select the *Template* and/or *Overlay* file to use. You can also select the *Left*, *Right* and *Top* data channels, *Mask* channel and the *Symbol* parameters to use.

4. When you are satisfied with your selections, click **OK** button and the *Triplot* tool will be displayed in your current project.
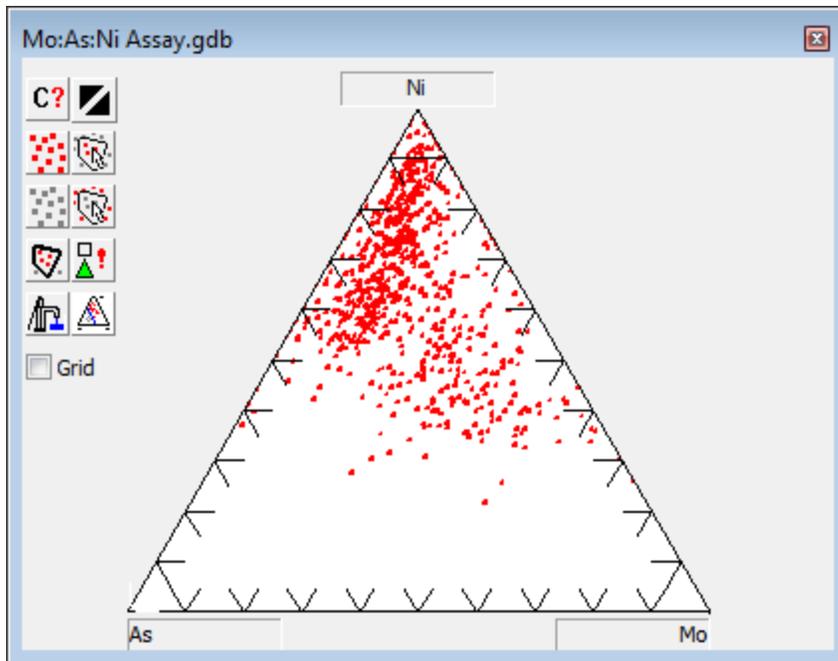
5. You can use the buttons provided on the Triplot tool to change the data channels, mask the data, or modify any of the other parameters. By default, the *Fixed Symbols* are displayed, or you can select *Zone Coloured Symbols* or *String Classified Symbols*.

⚠️ *The tool can be accessed from the Auxiliary Tools folder on the Data tab in the Oasis montaj Project Explorer window.*

Using Basic Triplot Capabilities

Most options in the *Triplot* tool are initiated with buttons.

C?	**Select channels** select this button to display the *Select triplot channels and symbols* dialog. This dialog enables you to select a *Template* and/or *Overlay* file, the *Data* channels to plot and the *Symbols* to use. Alternatively, clicking inside the channel name boxes (e.g. MGO , FEO or AL2O3) using the left mouse button will also display the same dialog box (i.e. *Select triplot channels and symbols* dialog).
◨	**Make original size** Select this button to return the Triplot to its original size. ⚠ *To increase/decrease the size of the Triplot tool, move the cursor to an outside edge of the Triplot tool and the cursor will change to a double arrow (↔), click and hold down the left mouse button while dragging the side or corner of the dialog to the desired size.*
⠿	**Select All Points** Select this button to select all the data points.
⠿	**Unselect all items** Select this button to unselect all the data points.
▨	**Select items inside an overlay polygon** Select this button to select the items that are inside an overlay polygon area, while unselecting all items outside the polygon. ⚠ *Press the <Ctrl> key and select this button in order to add the items in the selected polygon to the currently selected items.*
▨	**Unselect all items inside an overlay polygon** Select this button to unselect all of the items that are inside an overlay polygon area, while selecting all items outside the polygon. ⚠ *Press the <Ctrl> key and select this button in order to remove the items in the selected polygon from the existing selected items.*
🛡	**Mask using Polygon Tool** Select this button to select a subset of values using the polygon drawing tool. Points within the boundary of the polygon are selected.
🔺	**Plot Selected Points on the Map** Select this button and the *Symbol Attribute* dialog will be displayed. Use this dialog to specify the symbol plotting parameters. Click **OK** to plot the selected data values on the currently selected map. If there is no current map, the user is asked to create or open one.
⛽	**Refresh the Data** Select this button (the Pump) to refresh the data. The data is read fresh from the database whenever one of the channel selections is changed.
△	**Plot the triplot to a map** Select this button to plot the Triplot on the currently selected map. To use this option, the map you are plotting to must have a basemap drawn on it.
☐ Grid	**Grid** Check the Grid box to display grid lines on the Triplot tool.

Overlay Maps

The Geochemistry system enables you to create and display overlays for Scatter Plot (XY) and Triplot analysis. The corresponding menu options, New Overlay Group and Create Overlay, are found under the GeochemAnalysis menu.

The overlay options enable you to create a new overlay group on a current map. You can then add to the group polylines, polygons, text, and other elements. Then, using the Create overlay menu option, you can create an overlay map file that is added to the list of overlay files available in the Scatter Plot and Triplot tools.

⚠️ *For more information on creating new overlay groups and overlay files, refer to the **Online Help**.*

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