

Analysis Tools in Geochemistry for ArcGIS

The database that is used to store all of the geographic information in Geochemistry for ArcGIS is Esri's file Geodatabase (fGDB). This is a collection of tables and feature classes, which includes survey locations, assay results and a merged combination of the two that when imported will be maintained in a file Geodatabase.

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

This How-To Guide walks you through several key steps necessary to analyse your data:

- Display and Save Assay Statistics
- Plot Attributes and Statistics
- Perform a Histogram Analysis
- Store Graphs with Datasets
- Use Dynamic Data Links
- Use the Scatter Plot Tool
- Use the Ternary Plot Tool
- Multi-Element Correlation Report

Display and Save Assay Statistics

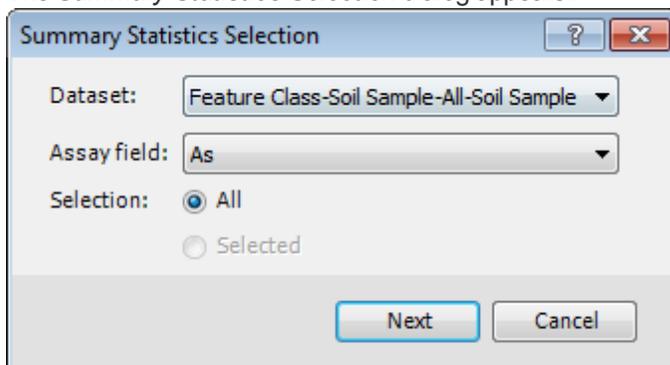
The Geochemistry for ArcGIS Statistical Reporting tools calculate basic and advanced statistical parameters for a single assay element. Basic (Summary) Statistics include: Assay Element, Total Number of Samples, Number of Nulls, Minimum, Maximum, Range, Mean and Standard Deviation. The Advanced Statistics include: Geometric Mean, Median, Mode, Sum of squares, Variance, Skewness, & Kurtosis.

Display Statistics

Use the *Summary Statistics* option to select and view statistic calculations of your Assay data.

To Display Summary Assay Statistics

1. On the *Geosoft Geochemistry* toolbar, from the *Analysis* menu, select **Summary Statistics**. The *Summary Statistics Selection* dialog appears.

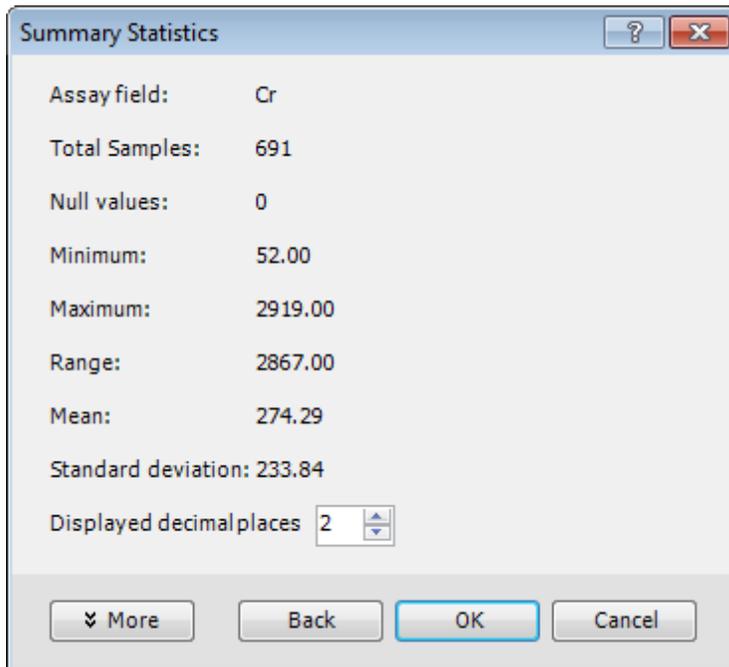


2. Using the *Dataset* dropdown list, select the desired dataset for statistic calculation.
3. From the *Assay Field* dropdown list select the Assay field in which to calculate statistics.
4. Choose **All** or **Selected** depending on the data source.

 *If you select a table from the Geochemistry Data Source panel, then you are selecting "All" the data and the "Selected" option is not available. If you open a table and perform a selection of data then the "Selected" option becomes active and is selected by default.*

5. Select the **Next** button to view the Summary Statistics dialog.

 *In the example below, we are viewing statistics for the Cr field.*



Key fields include the number of *Total Samples* and the number of *Null values*. The following table describes the summary statistical values that are reported.

Assay field	Name of the Assay
Total Samples	Number of “non-dummy” items in the assay field
Null values	Number of blank items. Null values are ignored in the calculation.
Minimum	Minimum value.
Maximum	Maximum value.
Range	Range of values.
Mean	Arithmetic mean or average value. This is equal to the sum of all values divided by the number of items.
Standard Deviation	Standard deviation in the data. This is equal to the square root of the variance in the data, and is an estimator for the “width” of the data.
Displayed decimal places	Use the scroll arrows to select the number of displayed decimal places for the statistical values.

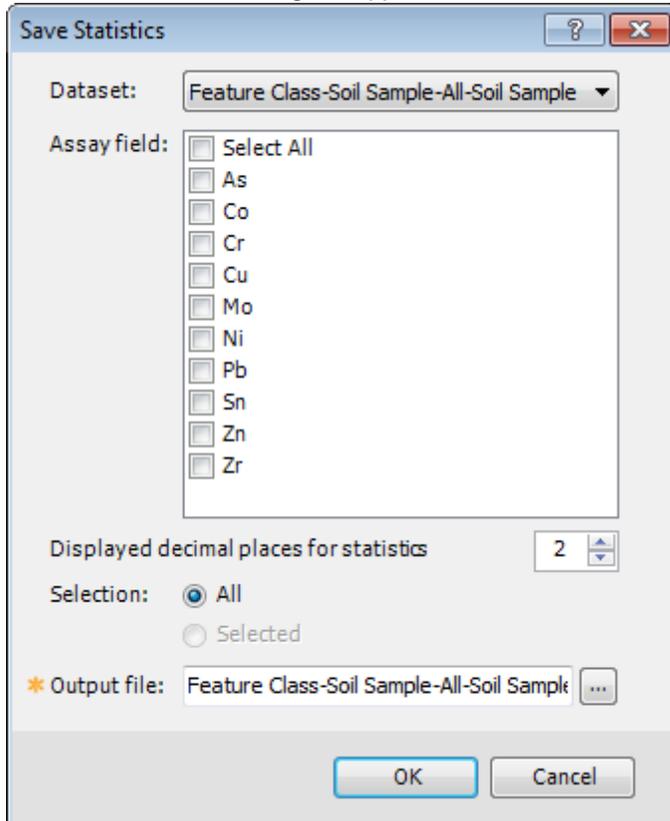
6. To view the extended statistics for the assay field, select the **More** button.
7. To return to the *Summary Statistics Selection* dialog select the **Back** button.
You can now view the statistics of another assay field or finish by clicking the **Cancel** button.

Save Statistics

Use the *Save Statistics* option to save statistic calculations of your Assay data to a CSV file.

To Save Assay Statistics

1. On the *Geosoft Geochemistry* toolbar, from the *Analysis* menu, select **Save Statistics**.
The *Save Statistics* dialog will appear.



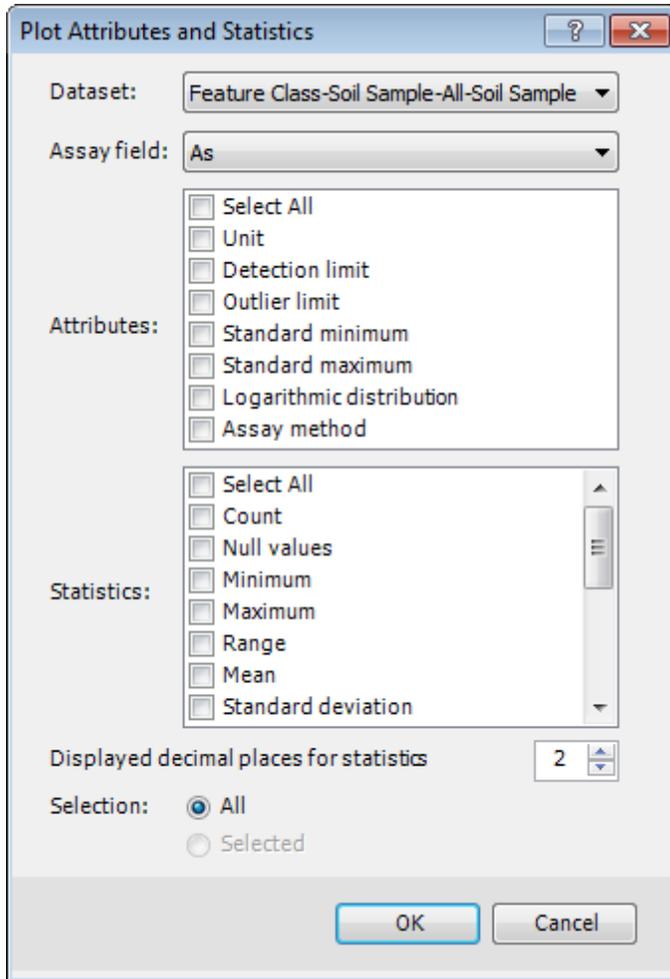
2. From the *Dataset* dropdown list, select the dataset for statistic calculation.
3. For the *Assay field* select the fields to include in the statistics calculation, or 'Select All' to include all fields.
4. Using the arrows, select the number of *decimal places* to display.
5. For the *Selection*, choose either **All** or **Selected**.
6. Browse to **Output file** location and specify a name. This defaults to your project folder.
7. Select the **OK** button and the statistics will be saved.
This file can be opened in Excel (or any text editor) for viewing or printing.

Plot Attributes and Statistics

Use the *Plot Attributes and Statistics* option to plot your data attributes and statistics on a legend in a map.

To Plot Attributes and Statistics

1. On the *Geosoft Geochemistry* toolbar, from the *Analysis* menu, select **Plot Attributes and Statistics**.
The *Plot Attributes and Statistics* dialog appears.



2. From the *Dataset* dropdown list, select the dataset to display.
3. Select the *Assay field* to display as a box plot from the dropdown list.
4. Select the individual *Attributes* to include.
5. Select the individual *Statistics* to include.
6. Using the arrows, select the number of *decimal places* to display.
7. For the *Selection*, choose either **All** or **Selected**.
8. Click **OK** and an *Attributes and Statistics* legend will be added to the map in the layout view of ArcMap.

As**Attributes**

Unit	ppm
------	-----

Statistics

Minimum	0.00
Maximum	63.00
Mean	15.07
Standard deviation	9.26



When in Layout view other elements such as, titles, text, north arrows, pictures can be added to the document by accessing the Insert menu from the main toolbar in ArcMap and choosing any of the options.

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:

- They use the colour-based percentile breaks as defined in the Visualisation tools
- Total data range is shown for a particular assay field
- 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

Histograms 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.

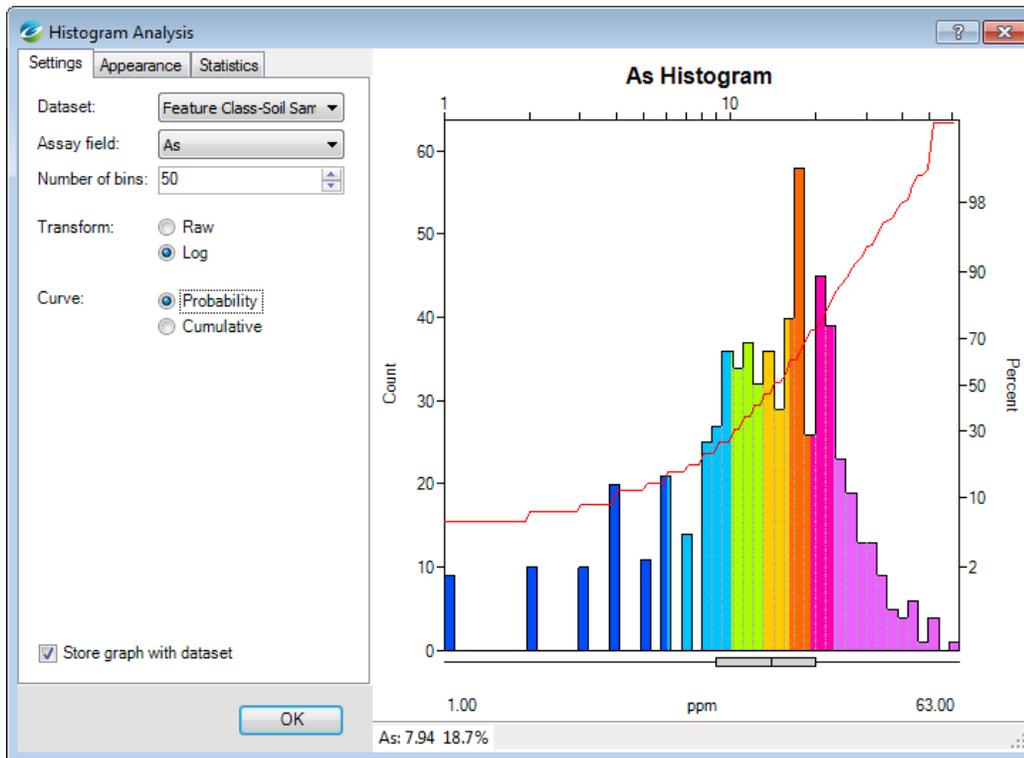
Histogram Analysis Tool

The Geochemistry for ArcGIS system provides an interactive Histogram analysis tool that displays the selected assay field, statistics, histogram width, current cursor position and corresponding data value and colour-based percentile values. The tool is a dynamic dialog that interactively updates data values when changes are made to corresponding values in the Feature Class.

The *Histogram Tool* implements dynamic-linking between itself, feature classes, map features, and other Analysis tools currently open in the project.

To Use the Histogram Analysis Tool

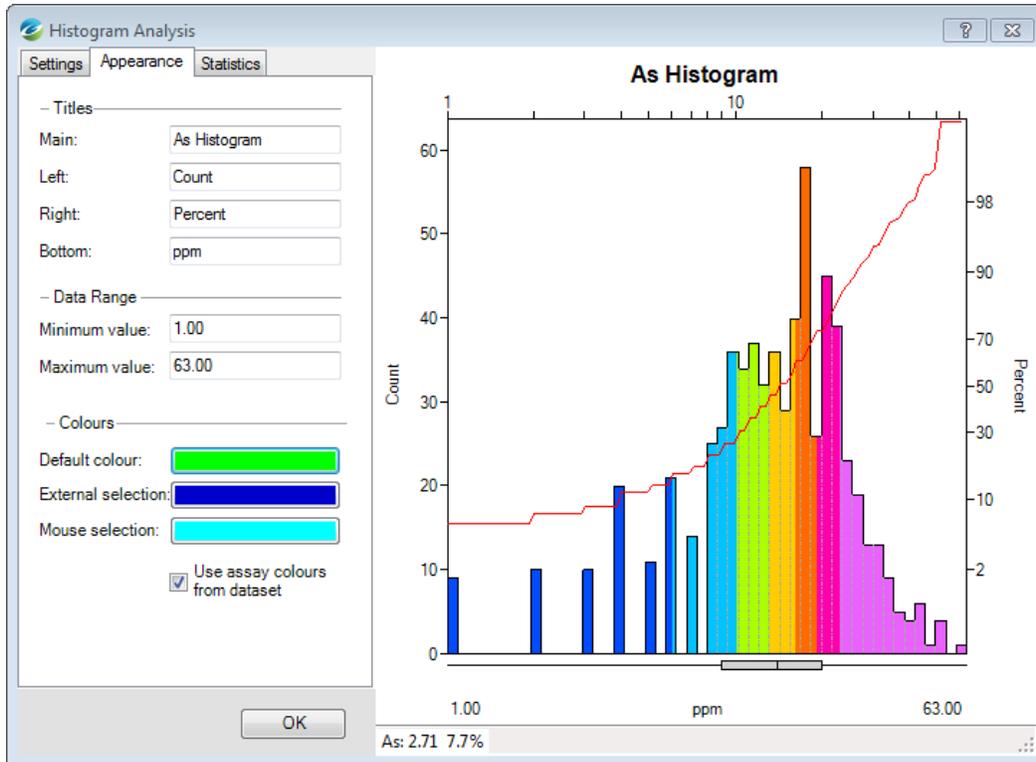
1. On the *Geosoft Geochemistry* toolbar, from the *Analysis* menu, select **Histogram Analysis**.
The *Histogram Analysis* tool will be displayed.



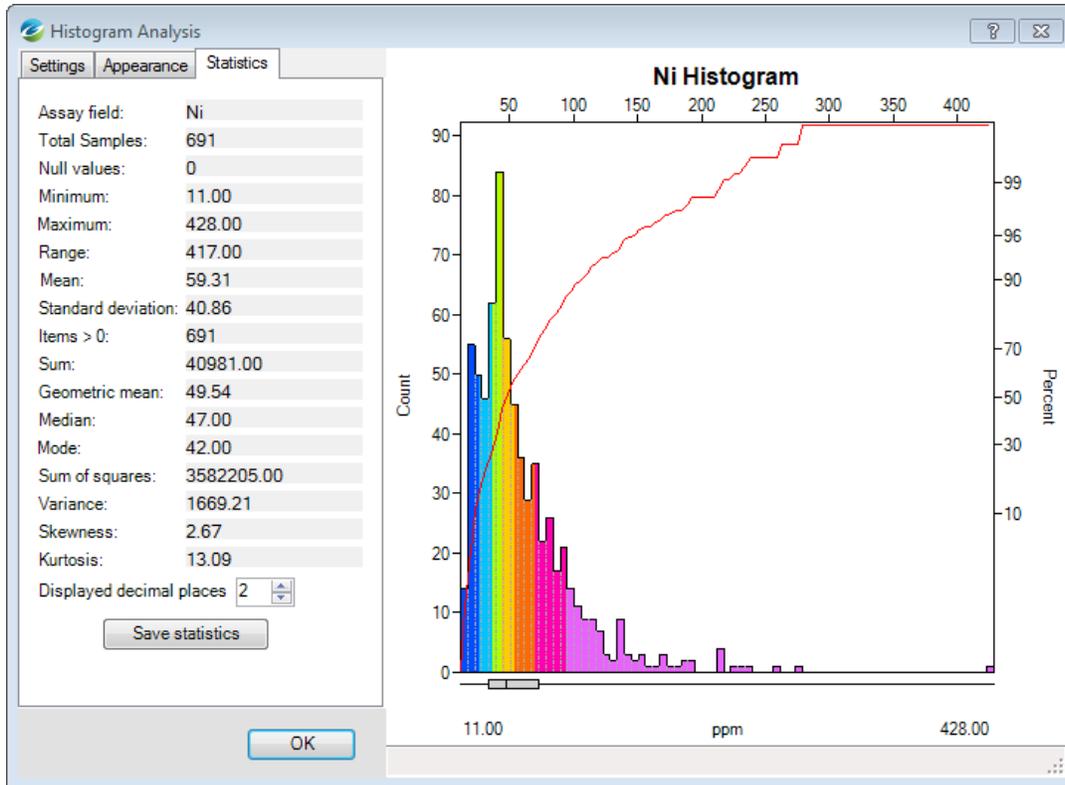
2. On the **Settings** tab, using the *Dataset* dropdown list, select the dataset to display in the histogram plot.
3. Using the *Assay field* dropdown list select the assay field to display in the histogram plot.
4. Change the *Number of bins*, if required. The range is 1 to 1024.
5. Using the radio buttons, select the *Transform* as **Raw** or **Log**.
6. Select the *Curve* as **Probability** or **Cumulative** using the radio buttons. Both forms of the curve track the cumulative percentage of the data, increasing from zero at the left to 100% at the far right, but the two options change the Y-axis percentage scale.

 *After each change is made the display window should dynamically update. For more detailed information on the Histogram Analysis parameters, click the Help button.*

7. If desired, select the **Store graph with dataset** checkbox in the lower left hand corner. This will store the graph in the Geochemistry Data Source tab for future reference.



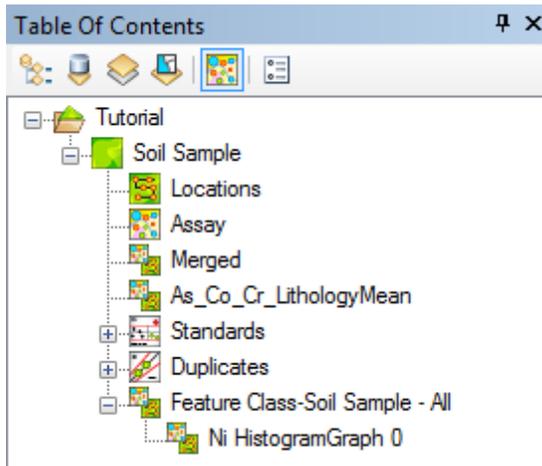
8. Select the **Appearance** tab. In the *Titles* section, specify the titles for the histogram plot or accept the defaults.
9. Set the default *Data Range* minimum or maximum values or accept the defaults.
10. Select a colour bar and the *Color* tool will be displayed. Use this tool to select the default colours and click **OK** to apply the colour and close the *Color* tool dialog. Repeat for each colour bar.
11. Select the *Use assay colours from dataset* check box to use the colours as defined in the *Visualisation* tools.



12. Select the **Statistics** tab to view the statistics for the currently selected *Assay field*.
13. Select **Save statistics** to save the statistics to the default folder.

 *Your current project folder is the default folder.*

14. To display the histogram in layout view for printing or comparing with other output analyses, right-click on the graph and from the pop-up menu select **Plot Graph to Layout**.
15. Select **OK** to close the Histogram Analysis tool.
16. A new HistogramGraph 0 sub-folder will be added under Feature Class in the Table of Contents tab in Geochemistry Data Source mode.



17. Select (highlight) the new HistogramGraph 0 tool in Geochemistry Data Source mode. Right-click and from the pop-up menu select **Open**.
The saved Histogram Analysis tool will be displayed.

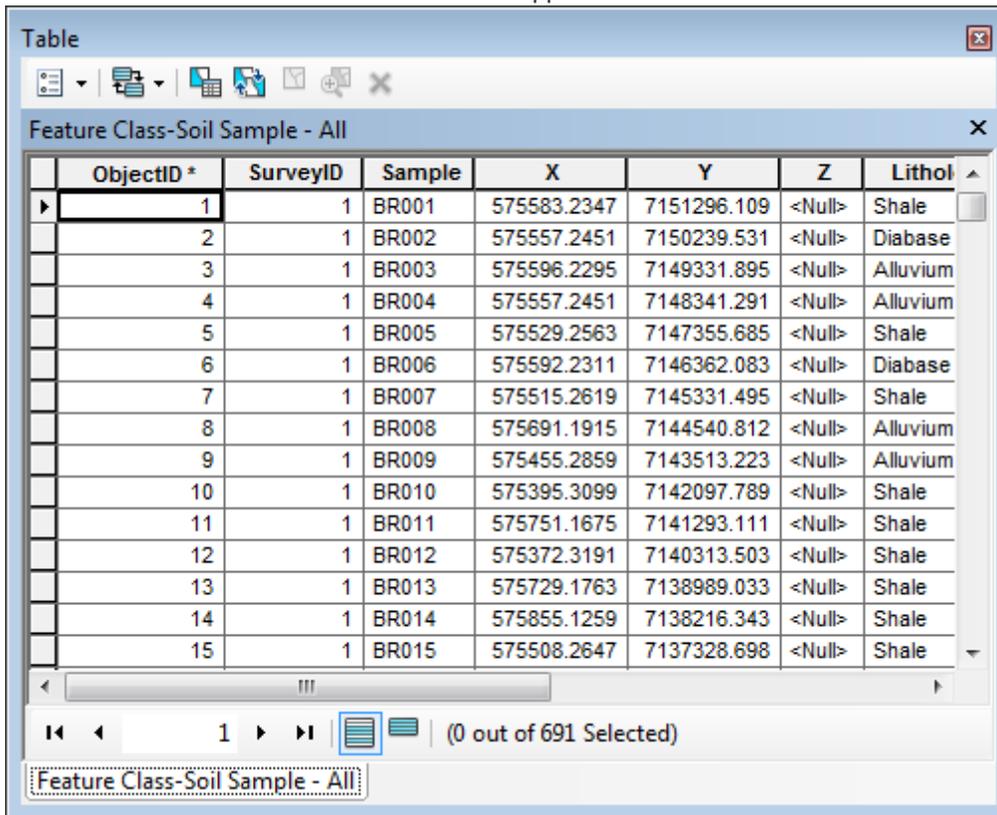
Use Dynamic Data Linking

Dynamic data links are virtual georeferenced connections between feature classes, Analysis tools (graphs), and map features. Links are graphical connections that connect what you see on a Graph to the same data in other displayed Graph windows and to the original feature class table and map features. These links work in multi-directions so you can select any window and see the equivalent data in the other windows you are using.

To Demonstrate Dynamic Data Linking

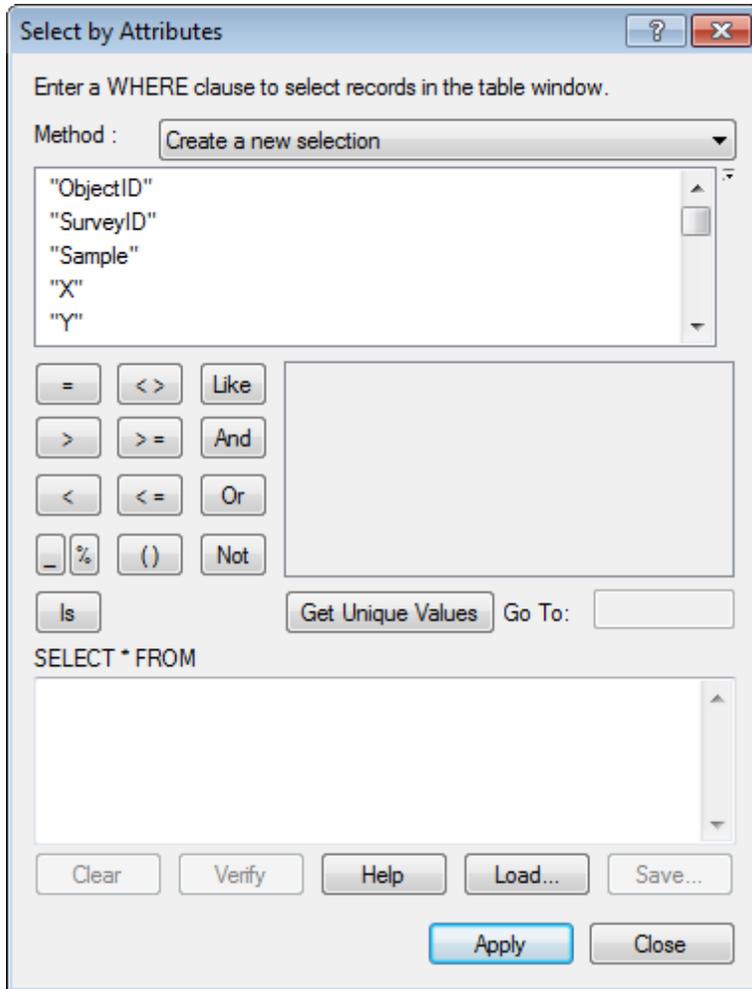
1. In Geochemistry Data Source mode, right-click on the Feature Class and from the pop-up menu, select **Open Attribute Table**.

The attributes *Table* of the Feature Class will appear.



ObjectID*	SurveyID	Sample	X	Y	Z	Lithol
1	1	BR001	575583.2347	7151296.109	<Null>	Shale
2	1	BR002	575557.2451	7150239.531	<Null>	Diabase
3	1	BR003	575596.2295	7149331.895	<Null>	Alluvium
4	1	BR004	575557.2451	7148341.291	<Null>	Alluvium
5	1	BR005	575529.2563	7147355.685	<Null>	Shale
6	1	BR006	575592.2311	7146362.083	<Null>	Diabase
7	1	BR007	575515.2619	7145331.495	<Null>	Shale
8	1	BR008	575691.1915	7144540.812	<Null>	Alluvium
9	1	BR009	575455.2859	7143513.223	<Null>	Alluvium
10	1	BR010	575395.3099	7142097.789	<Null>	Shale
11	1	BR011	575751.1675	7141293.111	<Null>	Shale
12	1	BR012	575372.3191	7140313.503	<Null>	Shale
13	1	BR013	575729.1763	7138989.033	<Null>	Shale
14	1	BR014	575855.1259	7138216.343	<Null>	Shale
15	1	BR015	575508.2647	7137328.698	<Null>	Shale

2. Select **Table Options** and from the dropdown menu, select **Select by Attributes**. The *Select by Attributes* dialog will appear.



3. You can now type in the bottom input box anything that will satisfy a SQL expression query to the feature class.
 - ⚠ *Double-clicking a selection in the top input box will add it to the bottom input box.*
4. Select the **Verify** button to verify that the expression is valid. The *Verifying expression* message box will appear.
5. If the expression is correct, select **OK** to continue.
6. Select the **Apply** button. The changes are highlighted in the open Feature Class table.

Table

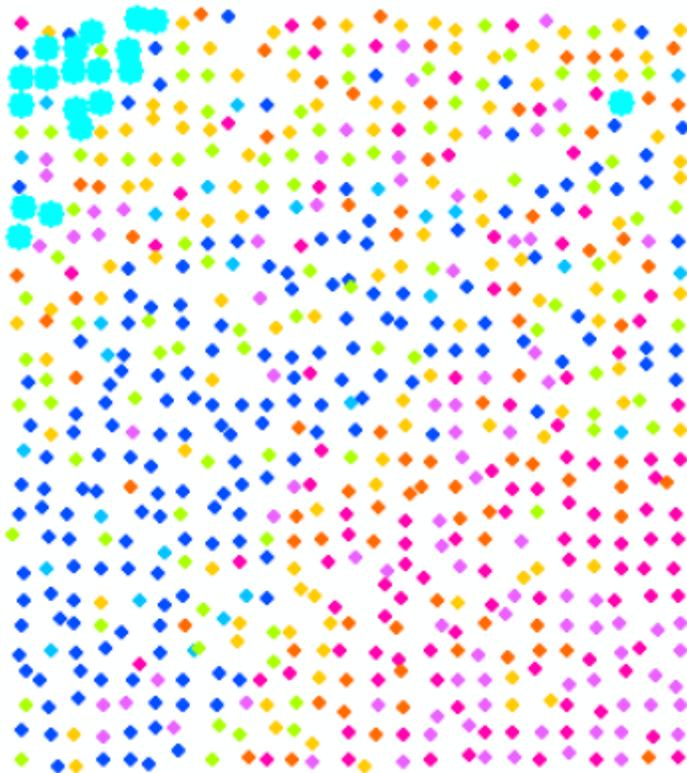
Feature Class-Soil Sample - All

ObjectID *	SurveyID	Sample	X	Y	Z	Lithology	Shape *	stand
1	1	BR001	575583.2347	7151296.109	<Null>	Shale	Point	
2	1	BR002	575557.2451	7150239.531	<Null>	Diabase	Point	
3	1	BR003	575596.2295	7149331.895	<Null>	Alluvium	Point	
4	1	BR004	575557.2451	7148341.291	<Null>	Alluvium	Point	
5	1	BR005	575529.2563	7147355.685	<Null>	Shale	Point	
6	1	BR006	575592.2311	7146362.083	<Null>	Diabase	Point	
7	1	BR007	575515.2619	7145331.495	<Null>	Shale	Point	
8	1	BR008	575691.1915	7144540.812	<Null>	Alluvium	Point	
9	1	BR009	575455.2859	7143513.223	<Null>	Alluvium	Point	
10	1	BR010	575395.3099	7142097.789	<Null>	Shale	Point	
11	1	BR011	575751.1675	7141293.111	<Null>	Shale	Point	
12	1	BR012	575372.3191	7140313.503	<Null>	Shale	Point	
13	1	BR013	575729.1763	7138989.033	<Null>	Shale	Point	
14	1	BR014	575855.1259	7138216.343	<Null>	Shale	Point	
15	1	BR015	575508.2647	7137328.698	<Null>	Shale	Point	
16	1	BR016	575906.1055	7136630.977	<Null>	Shale	Point	
17	1	BR017	575660.2039	7135665.363	<Null>	Shale	Point	

(19 out of 691 Selected)

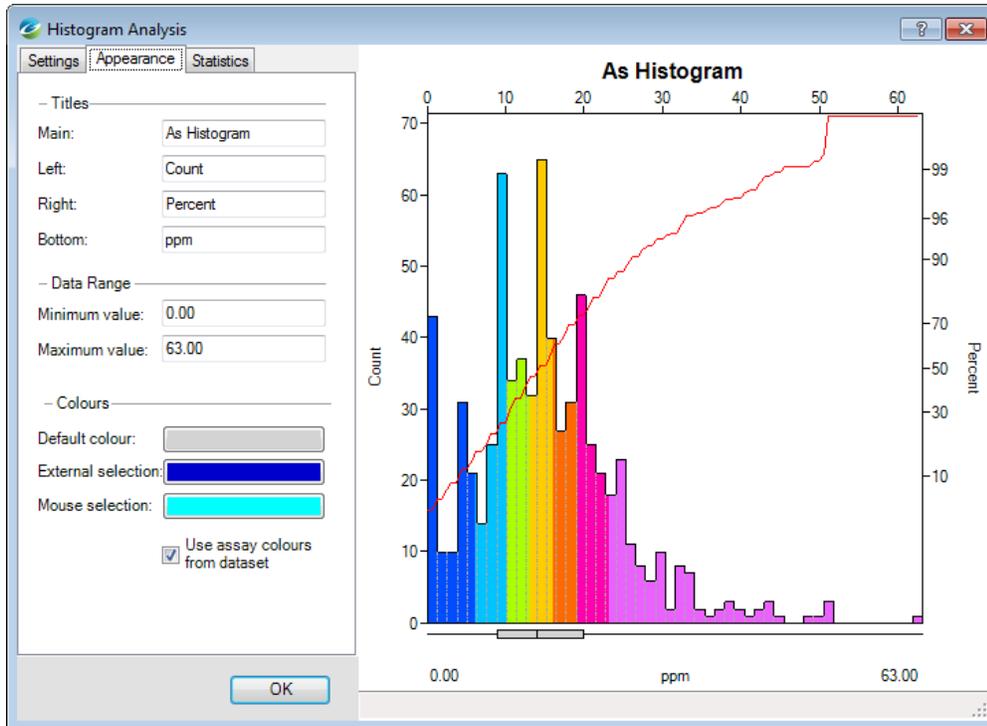
Feature Class-Soil Sample - All

7. Changes also appear in the open map.



8. Leave the Feature Class table open and select **Close** on the *Select by Attributes* dialog.
9. On the *Geosoft Geochemistry* toolbar, select *Analysis* and then select **Histogram Analysis**. The Histogram Analysis tool will be displayed.

 *In the example below the fields which had been externally selected are highlighted in blue.*



 *Any of the other Analysis tools will also display the selected and dynamically linked data points.*

 *You can select data that falls within a certain bin, or groups of bins in the Histogram Analysis tool and observe that the selections are updated in the Histogram tool, the map features and in the feature class table.*

10. Select **Close** to close the reports and table.

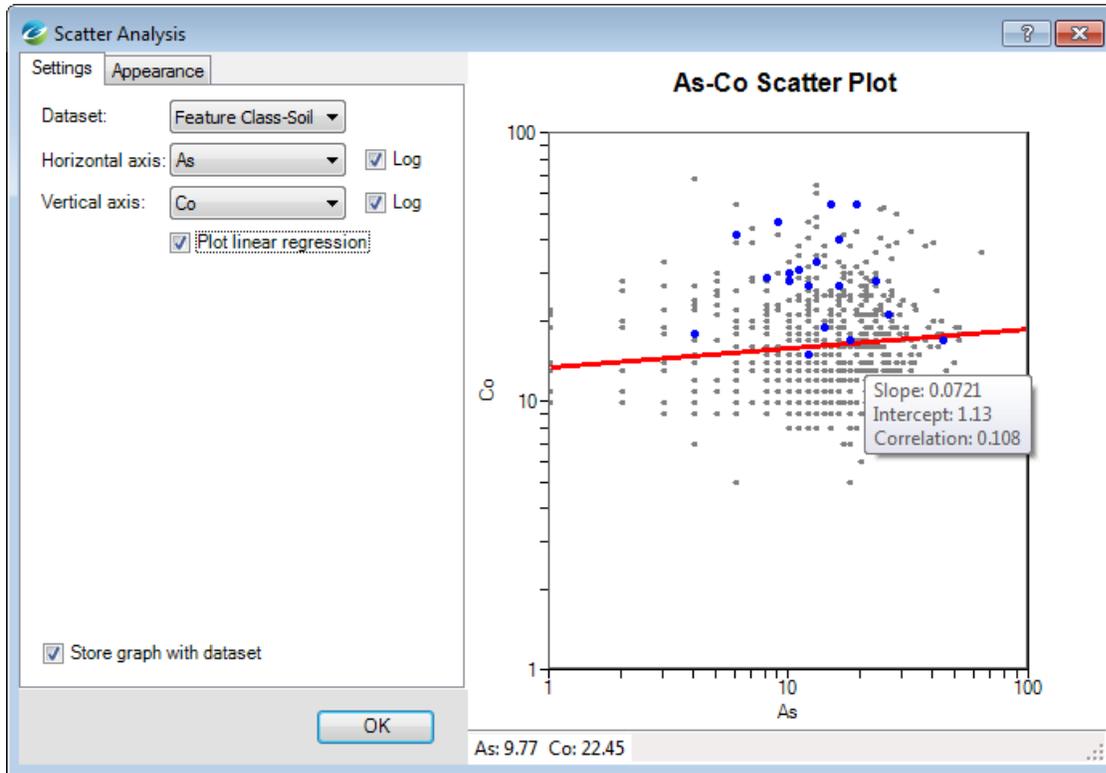
Scatter Analysis Tool

The *Scatter Analysis* tool plots one assay field against another assay field. Using the Scatter Analysis tool you can select the assay fields to be displayed, 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 feature class table and plot to a map.

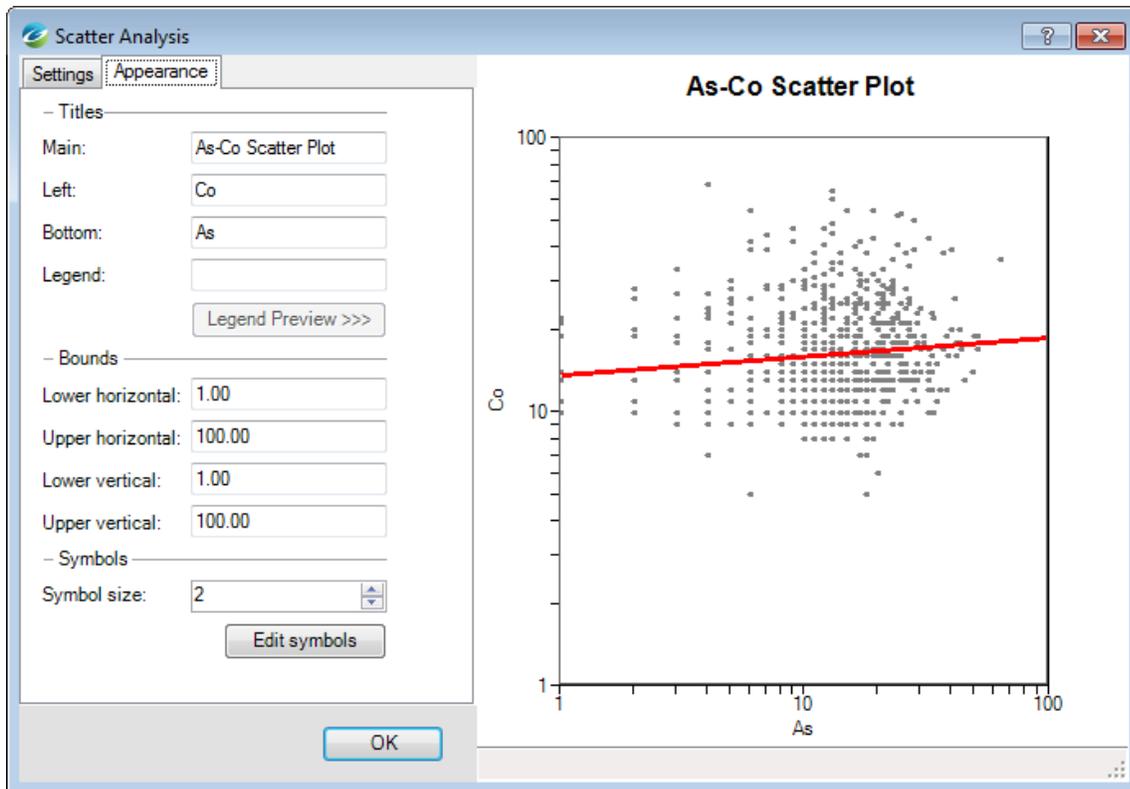
The *Scatter Analysis* tool, like all of the Analysis tools, implements dynamic linking between itself and the project feature classes, Analysis tools (graphs), and map features.

To Use the Scatter Analysis Tool

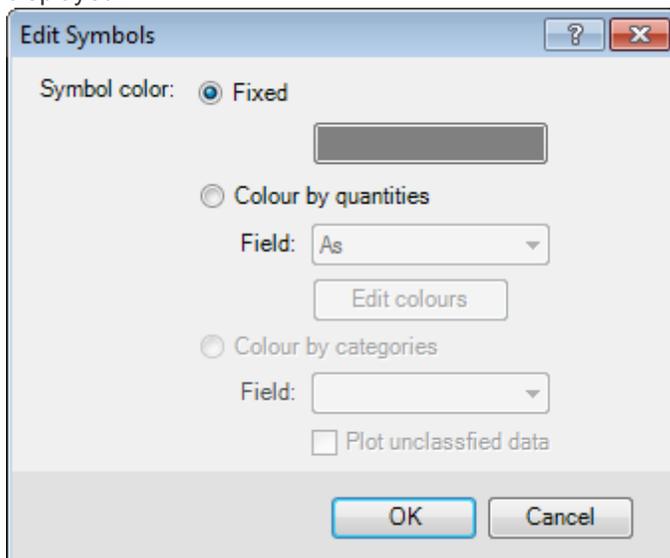
1. On the *Geosoft Geochemistry* toolbar, select *Analysis* and then select **Scatter Analysis**. The *Scatter Analysis* tool will appear.



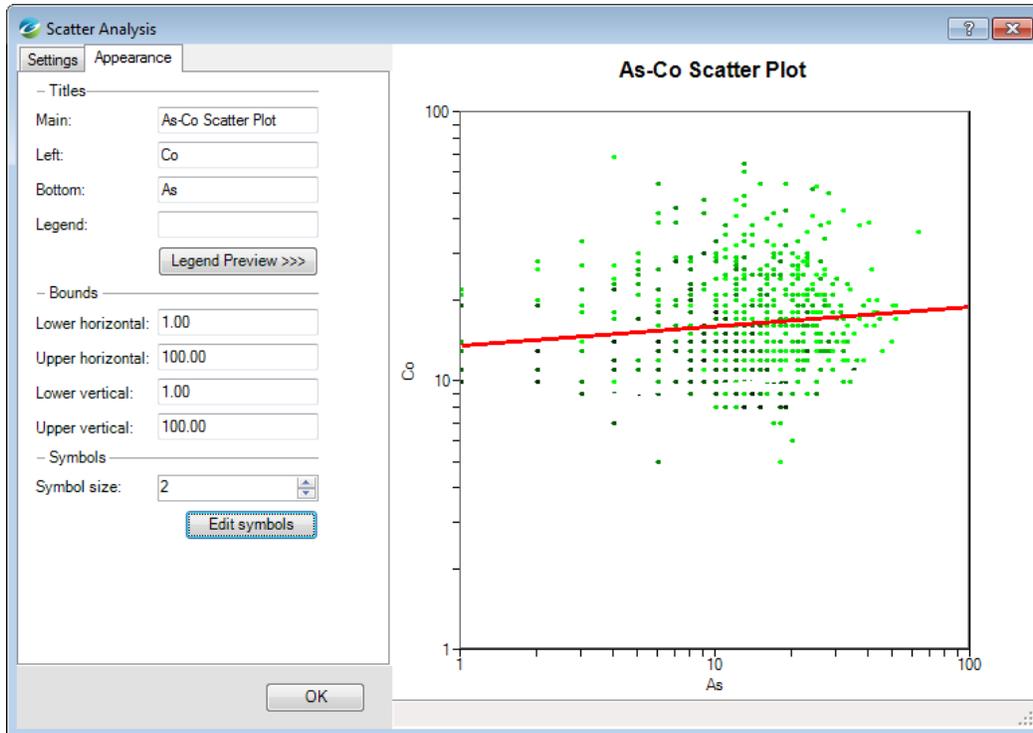
2. On the **Settings** tab, from the *Dataset* dropdown list, select the dataset to display in a Scatter Plot.
3. From the *Horizontal axis* dropdown list, select the assay field to display on the Horizontal axis.
4. From the *Vertical axis* dropdown list, select the assay field to display on the Vertical axis.
 - ⚠ *The scatter plot will automatically update as you change each axis.*
5. To plot the linear regression of the data select the *Plot linear regression* checkbox.
6. Click on the **Linear Regression** line in the Scatter Plot graph area to display the Slope, Intercept, and Correlation values.
7. Select the **Store graph with dataset** checkbox to save the Scatter Analysis graph with the Feature Class table in Geochemistry Data Source mode.
8. Select the **Appearance** tab.



9. Edit the Scatter Plot *Titles* as desired.
10. The symbols in the graph area can be edited by selecting the **Edit Symbols** button, the *Edit Symbols* dialog will be displayed.



11. To select a *Symbol color* you can select one of three radio buttons, **Fixed**, **Colour by quantities**, **Colour by categories**. For more information, click the **Help** button.
12. When complete, select **OK** to accept the changes and display the assay colour zones in the Scatter Analysis window.



13. Other options available in the Scatter Analysis tool include adding a Legend to the Scatter Plot. Click the **Legend Preview** button to preview the legend in the Scatter Plot window.

Cu

Mo (ppm)

- 0.00-5.00
- 5.00-10.00
- 10.00-15.00
- 15.00-21.00
- 21.00-29.00
- 29.00-43.00

14. Select **OK** to close the *Scatter Analysis* tool.

Notes about the Scatter Analysis Tool:

- Depending on the Symbol colours option selected on the *Appearance* tab, you can add a Legend to your Scatter and Ternary Plots. When you select either the **Colour by quantities** or **Colour by categories** option on the *Edit Symbols* dialog, the **Legend Preview** button will become enabled on the *Appearances* tab, enabling you to preview the plot legend.
- You can also add the Scatter Plot to the layout view by **right-clicking** anywhere on the Scatter graph area and from the pop-up menu selecting **Plot Graph to Layout**.
- You can also select items in the Scatter graph area by **clicking and dragging** a box over the area to be selected. Note that the selected data points are dynamically linked to other project data including other Analysis tools, feature class tables and map features.
- Another method for selecting the data points is to **right-click** anywhere on the Scatter Analysis graph area and from the pop-up menu, select **Create Polygon Selection**. Using your mouse, digitise a polygon around the points to select **right-click** again and select **Close Polygon** to close the polygon. The points encapsulated by the polygon will be highlighted

in the Scatter Analysis and other dynamically linked project data.

Ternary Analysis Tool

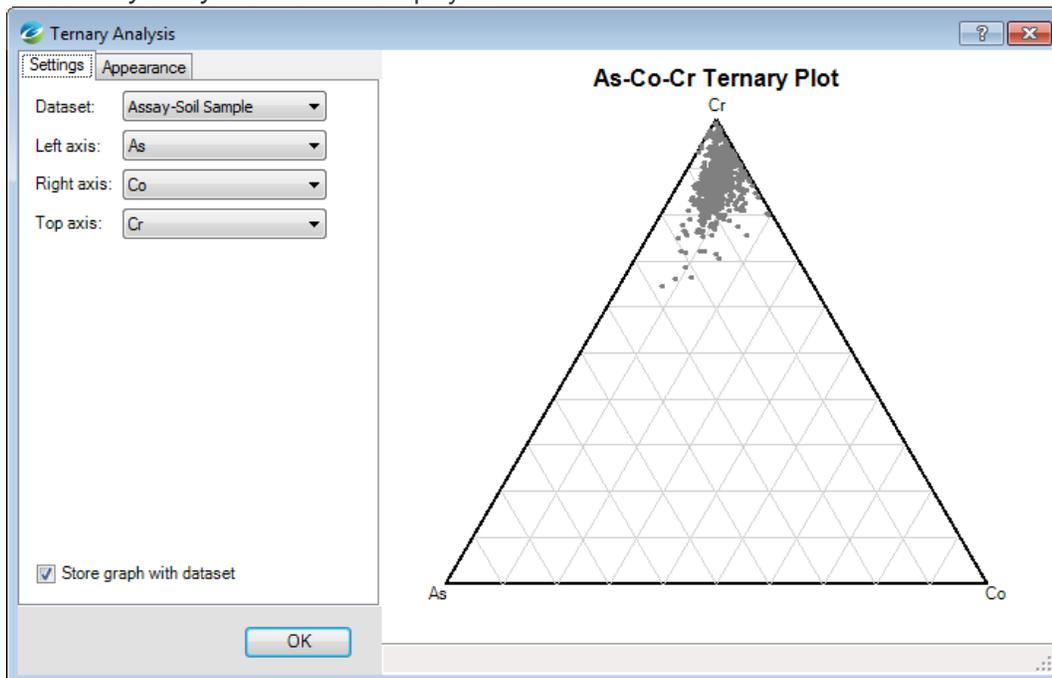
The *Ternary Analysis* tool is similar to the *Scatter Analysis* tool but uses three assay fields instead of two. The values for any point are summed, and then normalized to give fractions from 0 to 100 percent. Each corner of the triangle represents 100 percent for one of the assay fields, and at any point in the plot the sum of all three components sums to 100.

The *Ternary Analysis* tool, like all of the Analysis tools, implements dynamic linking between itself and the project feature class data and any other Analysis tool currently open in your project.

As with the *Scatter Analysis* tool, you can also categorize the Ternary data, by quantities or categories, based on a colour classification field. Also like the other Analysis tools the Ternary Analysis can be saved on the Geochemistry Data Source tab with the feature class used to create it.

To Use the Ternary Analysis Tool

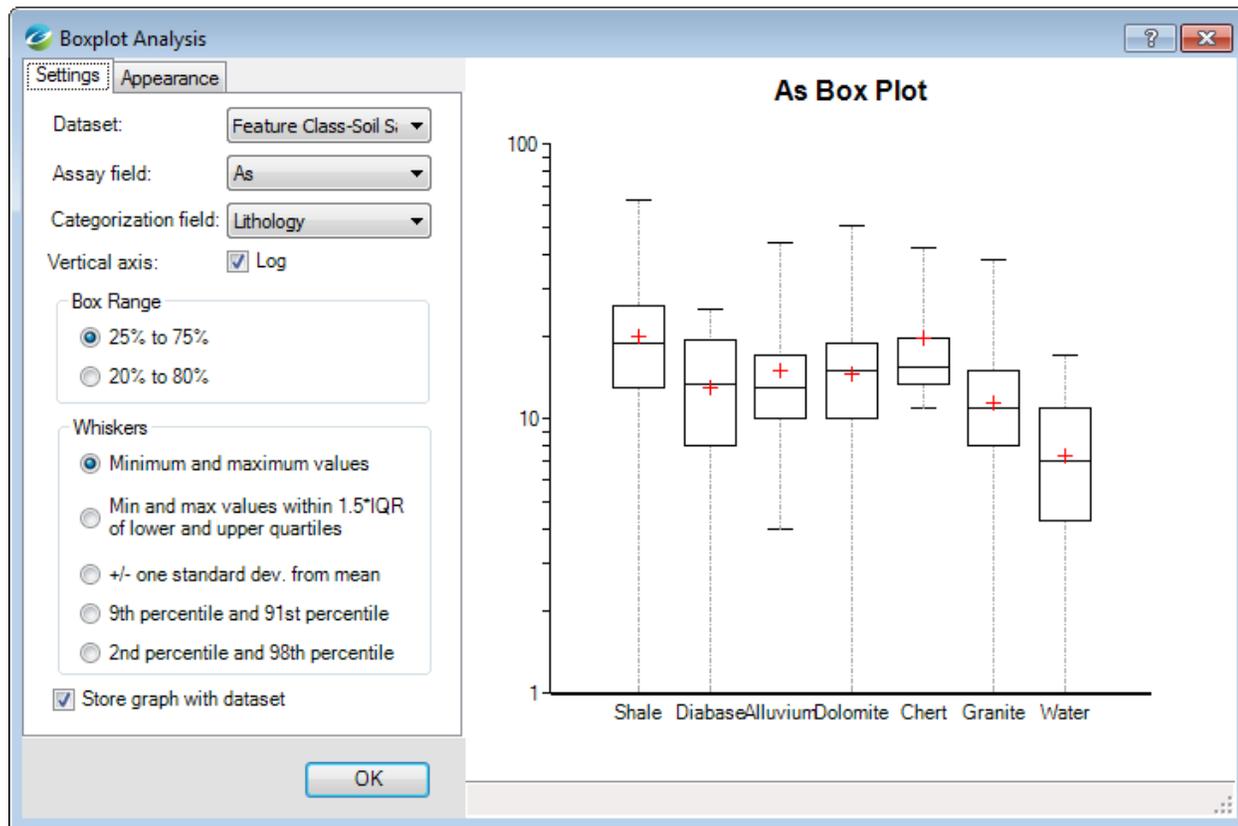
1. On the *Geosoft Geochemistry* toolbar, select *Analysis* and then select **Ternary Analysis**. The *Ternary Analysis* tool will be displayed.



2. On the **Settings** tab, from the *Dataset* dropdown list, select the dataset to display on the Ternary Plot.
 - ⚠ *Most of the features are the same as the Scatter Analysis tool except this tool has three axes.*
3. Change the *axis* options to observe the interactive updates.
4. Select the **Store graph with dataset** checkbox to save the Ternary Plot with the Feature Class table in Geochemistry Data Source mode.
5. On the **Appearance** tab, edit the *Titles* and *Symbols* as desired.
 - ⚠ *Refer to the **Scatter Analysis Tool** section for more information on Appearance options.*
6. Select **OK** to close the graph.

Boxplot Analysis

The *Boxplot Analysis* tool can display data using a logarithmic or linear distribution. We have also included a number of options for whisker display providing more flexibility for the display of outliers. The X axis labels can be plotted vertically on the Box plot graph, accommodating longer category names in the classification field.



 For more detailed information on the Box Plot parameters, click **Help** on the Box Plot Analysis dialog.

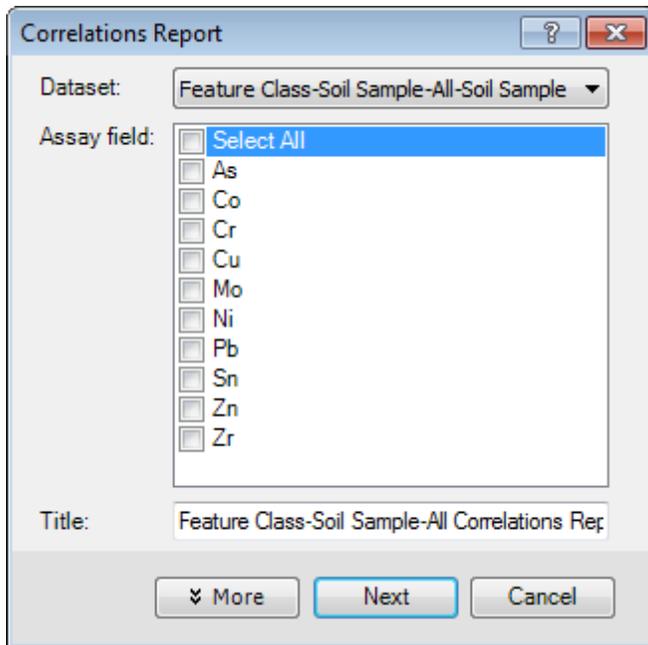
Multi-Element Correlations Report

The Geochemistry for ArcGIS software enables you to calculate a Multi-Element Pearson Correlation between selections of Assays fields, and then plot the results in a correlation table, which can be added to the Geochemistry Data Source mode list, or layout view.

 For more detailed information on the Multi-Element Correlations Report, click the **Help** button on the Correlations Report dialog.

To Use the Correlations Report Tool

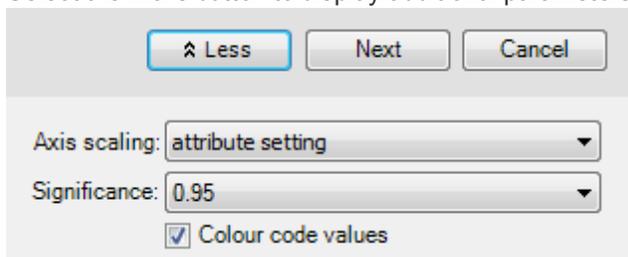
1. On the Geosoft Geochemistry toolbar, select *Analysis* and then select **Correlation Report**. The *Correlation Report* dialog will appear.



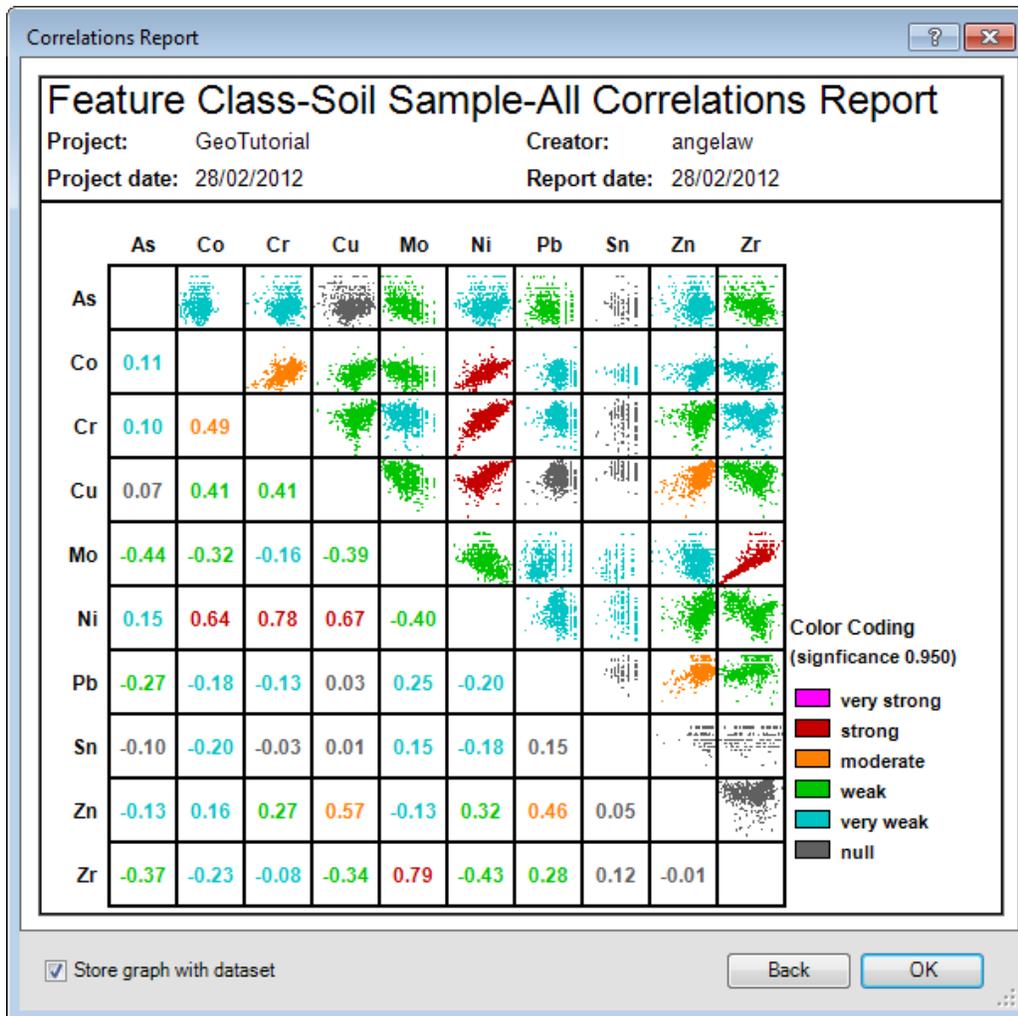
- From the *Dataset* dropdown list, select the data to use for the Correlations Report Plot.

 A correlation report can be run on feature classes, assay records, or merged datasets.

- In the *Assay Field* section individually select fields to include or select the 'Select All' checkbox.
- Specify a *Title* for the report or accept the default.
- Select the **More** button to display additional parameters.



- Use the *Axis scaling* dropdown list to determine the scaling. Select **linear** or **log** for the individual scatterplots. If you select **attribute setting**, the individual axes are scaled either linearly or logarithmically according to the individual assay field settings of the *Logarithmic distribution* checkbox in the *Edit Assay Field Attributes* dialog.
- Use the *Significance* dropdown list to select the level of the correlation strength.
- Use the *Colour codes values* checkbox to visualise which assay values have strong correlations and which ones have a weak correlation.
- Select the **Next** button.
The Correlations Report is displayed.



10. Select the *Store graph with dataset* option for quick viewing of the Correlations Report.
11. Select the **OK** to close the graph.

How-To Guide Publication Date: 01/12/2014

Copyright 2013 Geosoft Inc. All rights reserved.