PROCESSING AND PRESENTING MMI™ GEOCHEMICAL DATA

BACKGROUND

Effective interpretation of analytical MMI™ data typically involve presentations that include graphs and bar charts for sections and geochemical plans and images to overlay geological, geophysical and topographic maps.

With the development of MMI-M leach capable of determining 50 plus elements, the significance of multi-element associations has been dramatically emphasised in exploration for a number of commodities (Au, Ag, Ni, PGE, base metals, U and diamonds) and mineral settings (discrete veins, stockworks, VMS systems and intrusives including porphyries). This is not to say that a large analytical suite is necessary for effective application of MMI™ geochemistry, rather an expanded element group can be used as an aid to exploration, especially drill targeting. Information for application of the technology to specific commodities and settings, sampling protocols, analysis, interpretation and technical and research results can be found by contacting your local SGS representative and visiting the MMI™website: **WWW.SGS.COM/MINING/MMI**

DATA RETRIEVAL FROM LABORATORY

MMI™ data can be returned from the licensed laboratory in a number of different formats and methods, including fax, letter and electronic formats such as Excel, csv, sif, pdf. The original laboratory results should always be retained in a secure place and/or format. This ensures a backup is available in the event of mishap.

Supreme care should always be taken when combining sample number and spatial coordinate information with the laboratory results – poor alignment of sample results and coordinate information could have disastrous and potentially costly results for any further work such as follow up sampling or drilling. Integrity of individual element results can be equally as important. For example, when inserting data or columns into an excel spreadsheet, it is possible to corrupt the alignment between the column header (i.e. element name) with its associated data, resulting in data attributed to an incorrect element.

TREATMENT OF DATA WITH VALUES LESS THAN DETECTION LIMIT

Depending upon the software and methods to be used for data presentation, for those samples with values at the detection limit, a value half of the detection limit should be applied.

QUALITY CONTROL - DUPLICATES

Laboratories routinely report duplicate analyses, whereby a sample is selected (generally at set intervals within the sample sequence) and re-digested and analysed as part of their quality control regime. It is also recommended that companies include samples for duplicate analysis to comply with its quality assurance/control program.

Duplicate sample values measure for repeatability. A useful method to quantify this is to determine a sample's mean percentage difference. This is calculated by taking the absolute value of the difference between the two values and expressing it as a percentage of the arithmetic mean of the two values. This should be performed for each element. A mean percentage difference less than 30% should be considered as acceptable. Where the values have reported within a factor of 10 of the detection limit for that element, common sense should prevail when observing the mean percentage difference for that element and duplicate sample pair.

Where duplicate analyses indicate a trend in poor reproducibility for a particular element, care should be taken with interpretation of the data for that element. A request for assistance from the laboratory is advised.

Where duplicate analyses highlight a problem sample, a number of causes and remedies can be reviewed:

- Check with the sampling team/field notes to ensure strict sampling protocols were adhered to, especially consistency and accuracy of sample depth and contamination prevention issues (for further information, see TB22 – MMI™ Sampling in Tropical and Temperate Climate Zones.
- Request assistance from the licensed laboratory – a further analysis of the sample in question may reveal more information as to the cause of any discrepancy.

QUALITY CONTROL – CHECK MATERIAL

The laboratories routinely report results from analysis of SRM. Values for analysis of SRM should generally fall within a Coefficient of Variation (CV) of 15% of the expected value for each element. The CV for SRM results can be calculated by dividing the standard deviation with the arithmetic mean and expressing as a percentage. i.e.

$$CV = \frac{\text{standard deviation}}{\text{mean}} \times 100\%$$

PRESENTATION OF DATA

Presentation of univariate (single element) data can depend on the layout of the sampling points. In a 'typical' sampling grid comprising 100+ data points in a grid over a survey area, presentation of data can be performed by applying the Kriging Interpolation algorithm (to the raw data), present in a number of contouring software packages including Surfer, MapInfo and others. Contour plots of Kriged data can be colour coded to demonstrate anomalous areas, as per Figure 1.

It can also be useful to geographically/ geologically align the geochemistry with any associated information, including drill data, geophysical data, or surface geology maps.

Where the MMI™ survey is in discrete sections or lines that cannot be connected to produce representative contour images such as the images above, simple bar charts for each element with analytical value on the y axis and adjacent sample points on the x axis may suffice. These will still allow a visual identification of the anomalous data and geochemical patterns.

PRESENTATION OF MULTI-ELEMENT DATA

Some software packages (e.g. Geosoft) allow for multiple contoured element images to be combined and 'stacked' on top of each other in layers, with a degree of transparency between layers. This allows for visual determination of coincident elemental responses, thereby providing another level of information that univariate data presentation cannot provide.

To facilitate multi-element interpretation of MMI™ analytical data, it is recommended that the data is normalized. For each element, a background for the data is calculated, using the lowest quartile of the data. Then a peak to background ratio (response ratio) is calculated for each element for each sample. Response ratios provide a number of benefits for interpretation:

• Reduce the effects of dissolution variables during extraction, for example time and temperature;

• Allow the splicing of different data

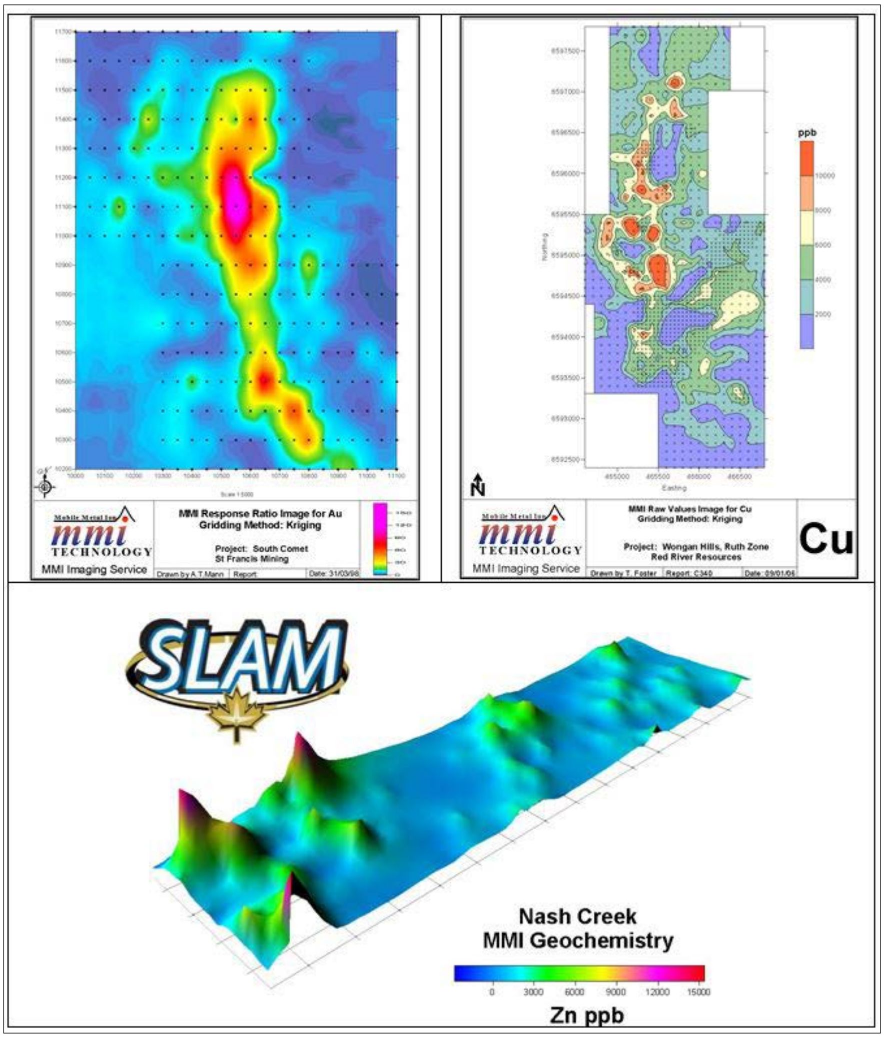

Figure 1: Contour Plots of Kriged Data

batches or data from varying regolith situations;

• Reduce the effects of sampling in different regolith units; and

• Facilitate multi-element data presentations for interpretation.

Before presenting MMI™ data in any graphical form, individual element response ratios are calculated for each sample. The concept of response ratios is simple: it involves determining a background value for each element in a survey area and ratioing all the data to that background. In more detail:

Determining the Background

• Select an element, for example Au, and determine the lowest 25% of the data for all the samples analysed in the survey area.

• Any values less than the detection limit need to be included and a value half of the detection limit should be substituted as an estimate value (based on scientific reports). For example, if Au has a detection limit of 0.01 ppb, any sample that analysed below this should be given a substituted value of 0.005 ppb.

• After determining the lowest quartile (25%) of the data, the average of these values is then calculated. This is the BACKGROUND value for that element within the specific dataset of a survey area.

Calculating MMI™ Response Ratios

• Response ratios are calculated by dividing each sample value by the predetermined background value for that element. The numbers are then rounded to give whole numbers greater than or equal to one (1).

• A sample with a response ratio of 2, or less, is considered low and is a background sample. Samples with response ratios

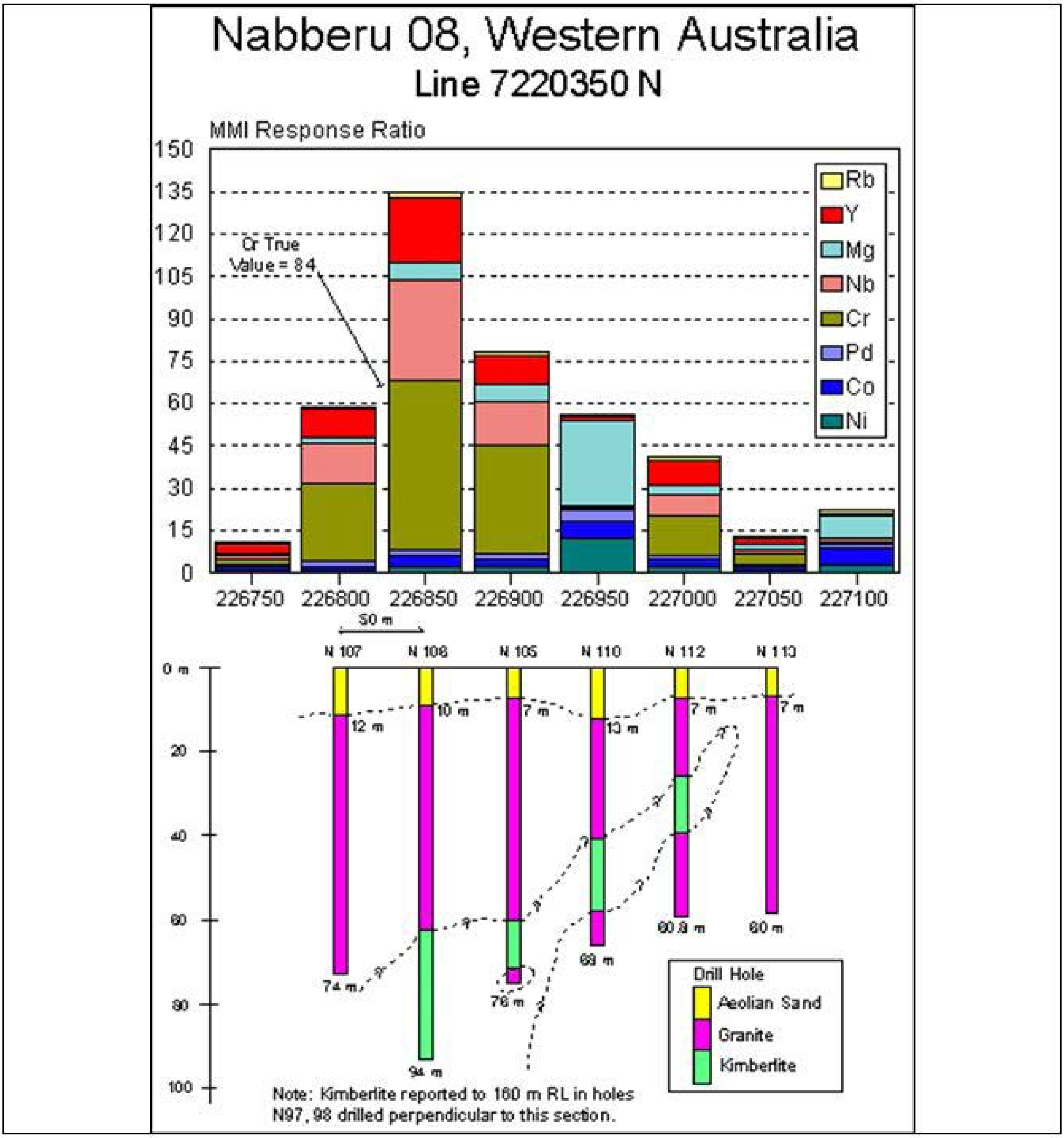

Figure 2: MMI™ Response Ratios

greater than 5 could be considered significant depending upon the regolith/ landform characteristics of the area and the sample spacing used for the survey. Note however, that due to the greater contrast inherent in the MMI™ technique, response ratios in general need to be greater than 2-5 times background before being considered "anomalous.

Additional advantages of using response ratios are:

1. The effective application of MMI™ Response ratios relies upon correct determination of the background for the survey area. It is important that the survey area covers sufficient ground and has not just been conducted over a mineralized sequence. Correct determination of the background and rationing of all the data to that value helps distinguish between those samples which are anomalous and those which are not. With MMI™ we are not looking at the absolute value of an element (for example Au) in a sample as it is a partial extraction technique. Instead, we are interested in the relative difference between background samples and those which are anomalous and which may overlie mineralization.

MMI-M LEACH

MMI-M, a single multi-element leach, incorporates more than 6 specific ligands to hold elements in the analyte solution, thereby resolving soil and solution pH issues recognised as problematic in other partial extraction geochemistry. With MMI-M, individual multi-element packages (using ANY of the 50 plus elements) can now be tailored for specific commodity targeting (e.g. diamond, PGE, uranium and porphyry exploration) as well as for geological and alteration mapping.

CONTACT INFORMATION

Email us at minerals@sgs.com
www.sgs.com/mining

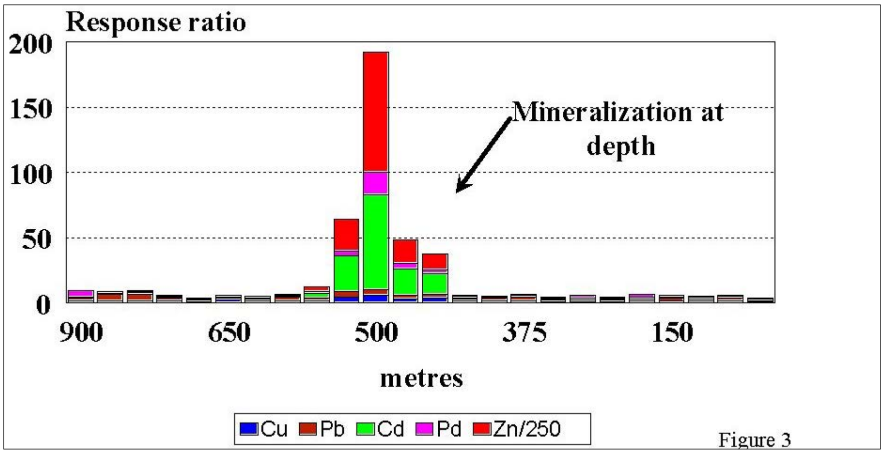

Figure 3: MMI™ Response Ratios for Base Metals

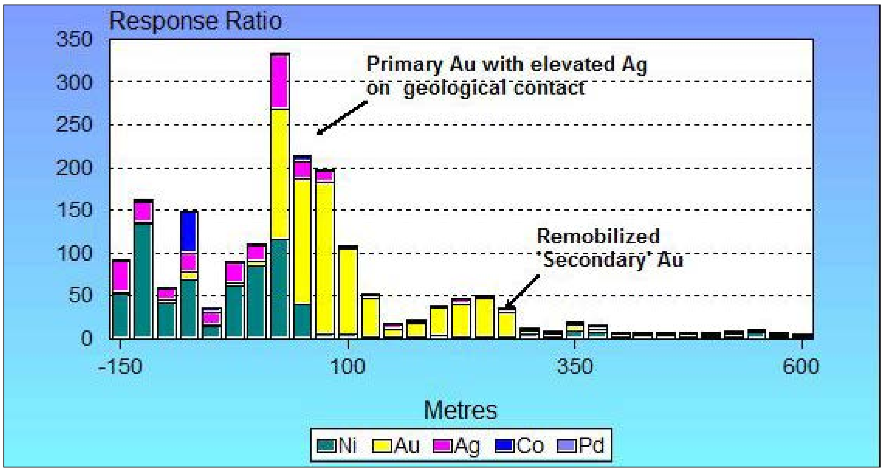

Figure 4: MMI™ Geochemistry - La Salle Concession Venezuela - Section 1900N

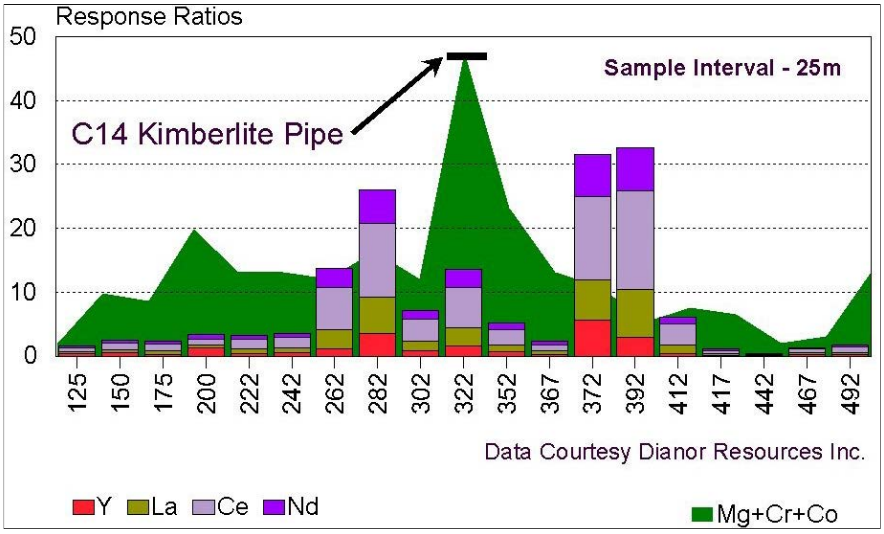

Figure 5: Apical Mg, Cr, Co Anomaly Over Pipe With Rare Earth Halo Around Margins