



TECHNICAL BULLETIN #19
MMI ORIENTATION IN TEMPERATE TO TROPICAL
(NON-BOREAL) ENVIRONMENTS

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The following information is intended as a guide for MMI orientation surveys. A separate guide is available for surveys in Boreal Climates and active desert environments. Further detailed information to assist is available by contacting SGS personnel or from www.sgs.com/geochem.

AREA SELECTION

- Usually a line of samples, however can include multiple lines to allow 2-D geochemical map evaluation
- Preferably over a known target or commodity source
- Imperative that sampling extends onto background environments
- Sample sites should be undisturbed and preferably away from any major contamination - mine dumps, creek beds, contaminated drainage, drilling lines, pads, roads
- Can extend from known to unknown target sources

HOW TO SAMPLE

- Choose sample interval – typically 25-50m but depends on target style, (contact SGS if unsure).
- Discard the top 10cm surface soil layer to eliminate loose organic matter, debris, and any possible contamination. Samples are then collected 10 to 25cm below this level at a consistent depth.
- Do not vary depth of sample once the first 10cm is discarded. Do not target a specific layer/feature of a soil profile when sampling.
- Moist samples are collected in a similar manner and should not be dried in ovens or pulverised in crushers or mills.
- Organic material in the form of fine roots and hairs, decomposing leaf material and other fine organic debris will not adversely affect MMI analyses.
- A 30-cm diameter plastic garden sieve or kitchen colander with minus 5-mm apertures, a plastic collection dish and a dust pan brush are ideal for sample collection.
- Steel implements must be paint free.
- A 150-gram sample is collected and stored in a plastic (90 x 150-mm) snap seal bag, do not use calico or brown paper.
- Record standard sample site data.
- Send to a licensed MMI laboratory.

ELEMENT SELECTION

- Choose an element suite appropriate for the expected commodity and its setting. e.g. Au, Ag, Ni, Co, Cr, Pd, Ce for gold and nickel targets in the Yilgarn Craton.
- MMI-M - A multi element suite selected from the leach list is recommended initially for orientations. This approach has provided very useful information in not only pin-pointing target element responses but also providing information on structure, alteration and mineralization halos and lithological setting.
 - e.g. Porphyry Systems: Cu, Mo, Zn, Cd, Au, Ag, Pb, Co, As, Y, Ce, Nd, Rb, La, Se, W, Fe, Mg
 - Kimberlite Targets: Cr, Ni, Pd, Mg, Co, Nb, Y, La, Ce, Nd
 - IOGC Targets: Cu, Au, Ag, U, Th, Co, Ce, La, Mg, Fe
- Specific commodity element packages can also be used:
 - e.g. MMI-A: Cu, Pb, Zn, Cd
 - MMI-B: Au, Ag, Ni, Co, Pd
 - MMI-L: Au, Ag, Ni, Co, Pd – Specifically for low level gold (LDL 0.05ppb Au) in saline and high water absorbing soil samples.

INTERPRETATION

- Element responses along discrete lines can be assessed as either raw element levels (ppb) or as response ratios (RR).
- Response Ratios allow a number of element responses to be reviewed and compared as stacked bar charts.
- To calculate response ratios for an element:
 - a) Values less than the detection limit need to be included by means of substituting a value half of the elements' detection limit
 - b) Determine the lowest 25% of the data for all the samples analysed in the survey area
 - c) The BACKGROUND value is the average value of the lowest quartile (25%) of the element data
 - d) Response ratios are calculated by dividing each sample value by the background value, numbers are then rounded to give integers ≥ 1
- Multi-element anomalies are common with MMI analyses and can be significant because of either their coincidence or spatial relationship to other adjacent element responses.
- The sharpness of the technique often provides information on metal and alteration zoning and geology.
 - a) VMS metal zonation shown by discrete spatial responses in Cu/Zn, Ag/Pb and Au/Ag
 - b) Porphyry Cu/Mo/Zn core, Ag, Pb As Co, outer halo, Au, Ag distal zones
 - c) Propylitic zones Y/Ce/Se responses
 - d) Biotite zones Mg/Fe/La responses
- It is important to establish relevant thresholds either as ppb or response ratios for the survey.
 - a) Response ratios in general need to be greater than 2-5 times background before being considered "anomalous" due to the greater contrast inherent in the MMI technique
 - b) Samples with response ratios greater than 5 may be considered significant depending upon the regolith/landform characteristics of the area and the sample spacing used for the survey
 - c) Typically for Au, response ratio levels should be above 20 times background and Zn above 50 times
- Great value can often be obtained from the elements' spatial relationships in an MMI survey where a better understanding of the mineralised system at depth can improve exploration drilling efficiency.

NOTE

1. The information above should be used as a general guide only. More site specific information on the element associations within the orientation target can be used to expand the element suite if appropriate.
2. Important detailed information for **application of the technology, sampling protocols, analysis, interpretation and technical and research results** can be obtained on our website, or by contacting us.