SAMPLING GRIDS FOR MMI^{TM}

INTRODUCTION

Perhaps the first and most important step in undertaking a soil geochemistry program is to design an appropriate grid for sampling. Strictly speaking, sampling does not need to be undertaken on a regular grid, and in certain cases (e.g. in aeolian dune country, or when drill spoil or contamination is present) the need to obtain good sample overrides other considerations. In general, however, samples are often taken on a regular grid, and this bulletin is simplified by referring to regular or orthogonal grids. Figure 1 below shows an example in which two samples from a 2km x100m grid intersected a highly anomalous (Pb) carbonate horizon.

It is worth noting that anomalies have been intersected on only one line – immediate infill is required to determine the shape and dimension of the anomaly. It may transpire that it was a fortuitously placed line, but it may also be that the horizon may be of some length – the line has been placed with due regard to strike. Irrespective of this, the above example illustrates the capability of low density, (regional) MMI^{TM} to detect mineralization envelopes, providing the grid pattern is intelligently designed and appropriately placed.

FOOTPRINTS

The grid density, and its layout is determined first and foremost by the type of deposit being sought. Good exploration proceeds by both by having a concept for the style of mineralization being sought, as well as an objective and efficient data collection system to assess the ground relative to the concept (this will involve, at various stages of exploration, evaluation and re-definition of the concept).

The surface "footprint" of a deposit is governed by the overall tonnage and the shape, or disposition of the mineralization envelope relative to the ground surface. In Table 1, the footprints for various types and styles of mineralization have been calculated.

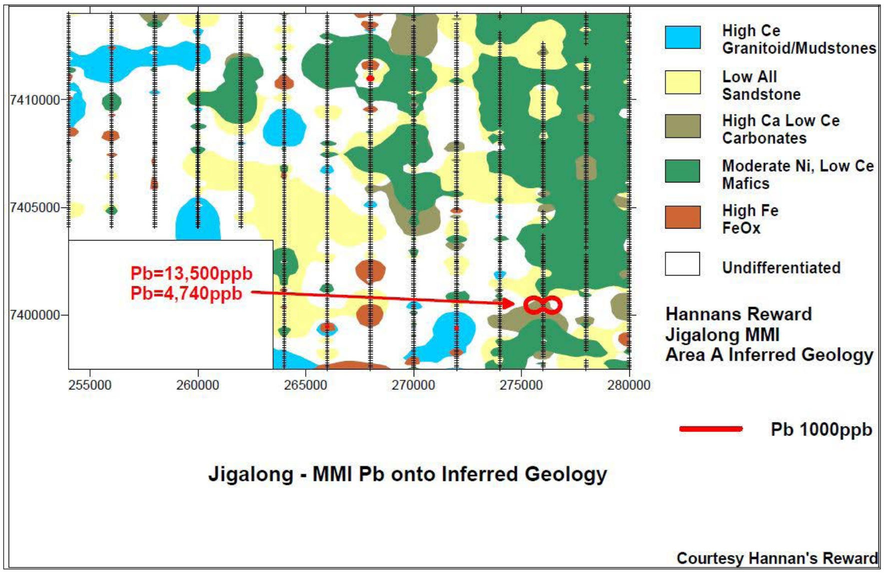
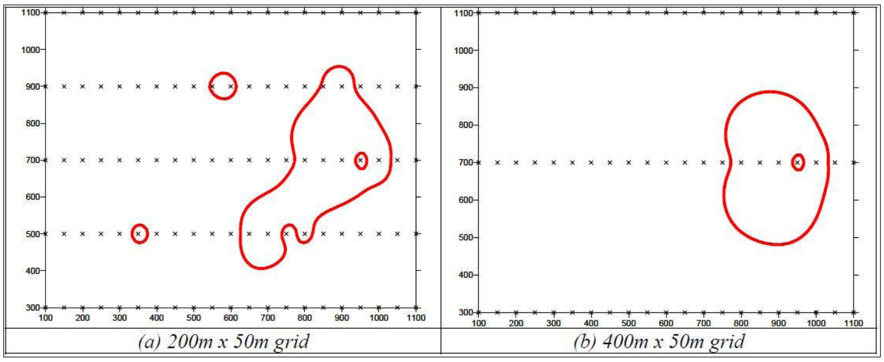


Figure 1: Regional Spaced Sampling Grid, Jigalong, Western Australia



(a) 200m x 50m grid

(b) 400m x 50m grid

Figure 2: MMI^{TM} Contour Outlines for 10,000 ppb Zn, Delineated by Two Hypothetical Grids

Using an S.G. of 2 as an approximate density factor, it is a simple matter to convert the expected tonnage to a volume of crust which is mineralized. The shape or disposition of the mineralization envelope (depth) can then be used to obtain a likely surface area, and in turn linear dimensions for the footprint. Since MMI^{TM} is a high-resolution technique, it is appropriate to assume that samples within this footprint (and not a dispersion train from it) will be required for detection. The penultimate column of Table 1 shows the grid spacing required to detect various deposit styles (i.e. to guarantee at least one sample within the anomaly). The final column in Table 1 indicates the grid which would be required to plot accurately the outline of an anomaly, given that four or more points within an anomalous zone are required by most plotting routines to derived shape and dimension.

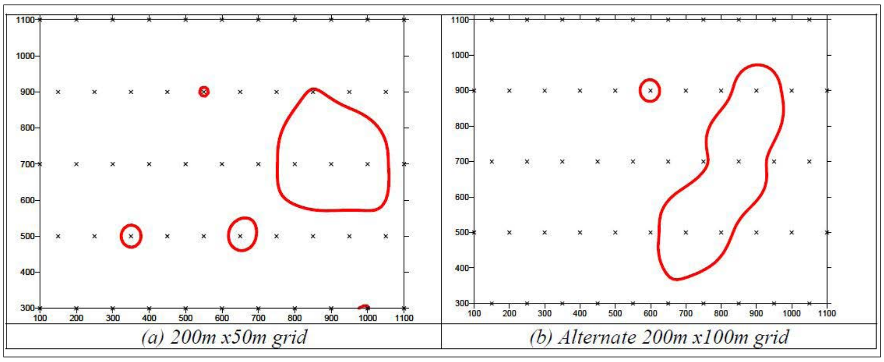
Low density grids of 400m x 400m are suitable for detection of large tonnage deposits such as porphyry systems. Zonation may also be useful in detecting outer lying parts of such systems. Pb and Zn are elements which are often found distal to the Au/Cu core of epithermal systems and porphyries. Low density grids are also capable of detecting shallow tabular bodies of much lower tonnage, such as carnotite in calcrete uranium deposits. For stratiform deposits such as Pb/Zn, an asymmetric grid (200x100m is chosen in the Table) may be appropriate to ensure at least one sample falls within the footprint.

The lower rows of Table 1 show the grid densities and disposition required to intersect smaller tonnage deposits. For large million ounce gold deposits, a grid of 400m x 50m might be appropriate for initial discovery, whilst for smaller, single vein type Au deposits a grid spacing of 100m x 20m might be required. Many komatiite type NiS deposits would similarly require very close spaced grids across strike to enable detection. The same is not true for detection of lateritic-type Ni deposits, where the tabular nature would suggest 100m x100m spacings to be appropriate.

GRID SPACINGS TO DELINEATE ANOMALIES

To delineate an anomaly requires a larger number of samples than is required to detect it. In the right-hand side column of Table 1, the number of samples required to be within an anomaly outline for that outline to be delineated is listed. The number which appears is a minimum – the greater the number of samples within the anomaly the more accurately it will be delineated. There is a compromise related to cost. A hypothetical multi-component anomaly (based on real analytical data) will be used to examine this in greater detail. In Figure 2 the 10000ppb contour for Zn over this epithermal/porphyry is shown for two different hypothetical grids.

At a sampling density of 200m x 50m (Figure 2(a)), 9 sample points appear within the main anomaly. As indicated the kriging algorithm can provide good definition of the anomaly. Decreasing the

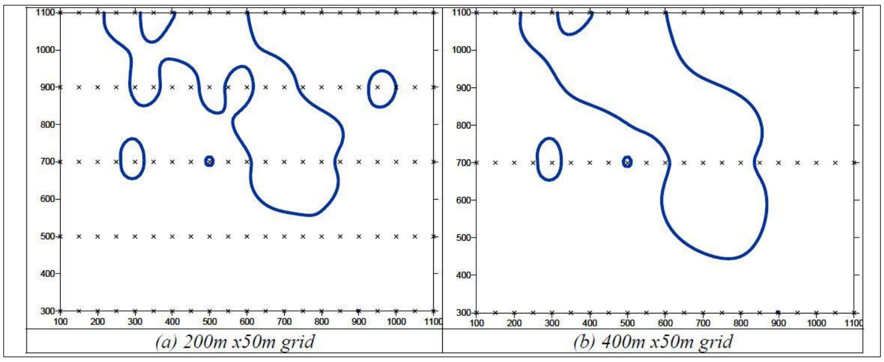


(a) 200m x50m grid (b) Alternate 200m x100m grid

Figure 3: MMI^{TM} Contour for 10,000 ppb Zn Delineated by Two 200m x100m Grids

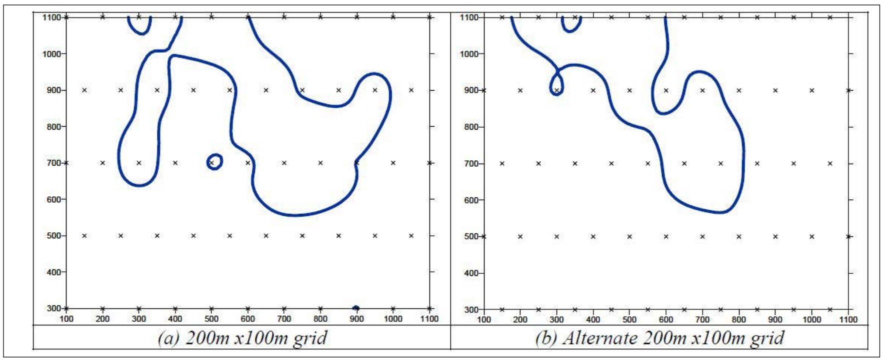
Table 1: Footprints for Various Deposit Styles and Appropriate Soil Sampling Grids

Tonnage	Type, Examples	Volume	Shape Disposition	Footprint	Grid to Detect	Grid To Delineate
430Mt	Cu,Au porphyry	216Mm^3	Cubic	600x600m	400x400m	200x200m
70Mt	Cu,Au Breccia (Ernest Henry)	35Mm^3	Elongate (1000m deep)	300x250m	200x200m	200x100m
32Mt	Stratiform Pb, Zn	16Mm^3	Stratiform 400x400x100	400x100m	200x100m	200x50m
16Mt	1 million oz Au	8Mm^3	Multi-Vein (400m deep)	400x50m	200x50m	100mx50m
8Mt	NiS	4Mm^3	Elongate (1000m deep)	200x20m	100x20m	50x10m
2Mt	Au High grade, low tonnage	1Mm^3	Vein (200m deep)	200x25m	100x20m	50x10m
0.5Mt	500,000t carnotite uranium	250,000m^3	Tabular (1m deep)	500 x500m	400x400m	200x200m



(a) 200m x50m grid (b) 400m x50m grid

Figure 4: MMI^{TM} Contours for 6000 ppb Pb, Delineated by Two Hypothetical Grids



(a) 200m x100m grid (b) Alternate 200m x100m grid

Figure 5: MMI^{TM} 6000 ppb Pb Contours Delineated by 200m x 100m Grids

sample density to 400x50m provides only 4 samples within the envelope and less definition as shown in Figure 2(b). It is of note that removal of the alternate set of sampling lines (i.e. to give 400m x 50m) provides even poorer definition of the anomaly (bifurcates it). In Figure 3(a) and (b) the effect of removing every second sample on E-W lines to make 200m x100m grids is shown.

The two 200m x 100m grids (Figure 3(a) and (b)) provide different results depending on which lines are removed. The set in Figure 3(a) gives poorer resolution than (b). Both have 4 samples within the envelope. A 400m x 100m grid, whilst just capable of detecting the anomaly would have great difficulty giving any suitable resolution.

The anomaly for Pb over this same porphyry system is larger, and elongated NW-SE, as shown in Figure 4(a).

In this case, removal of alternate E-W lines to give a 400m x 50m grid makes virtually no difference to the anomaly resolution, as shown by the comparison of Figure 4(b) with Figure 4 (a). In Figure 5(a) and 5(b) the effect of removing every second sample on E-W lines i.e. to make 200x100m grids is shown.

Again, because of the larger size and greater number of samples in the inherent anomaly, removal of every second sample (200m x100m grids) makes little difference to the anomaly outline.

GRID SELECTION AND SAMPLE DENSITIES

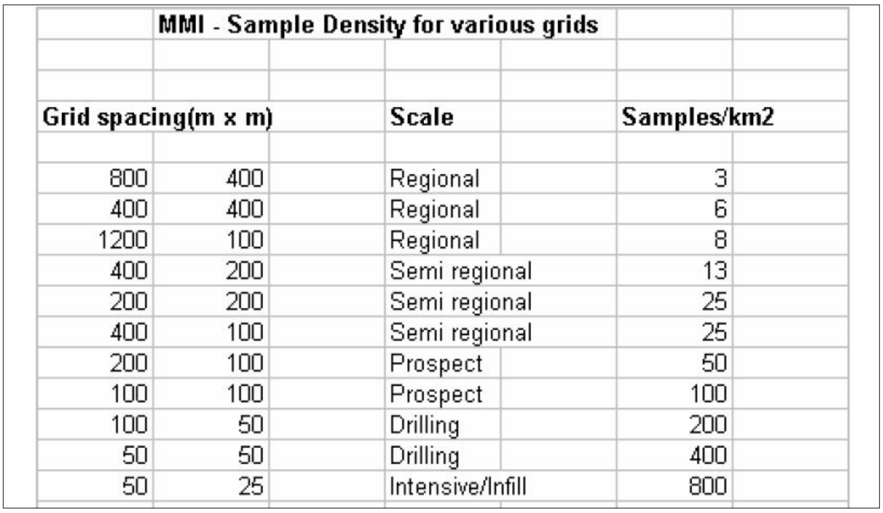
From the foregoing it is apparent that grid selection is important in planning a soil based exploration program. The following table (Table 2) gives the number of sample points per square kilometre for different grids.

SUCCESSIVE IMPLEMENTATION OF DIFFERENT SAMPLING GRIDS

Whilst many exploration programs can be undertaken in a single pass, a number of large MMI^{TM} programs are now undertaken, initially at low density (cost), with subsequent infill in second, and sometimes third passes.

One example of this was shown in Figure 1; another example of this is shown in Figure 6.

Table 2: Sampling Densities for Different Sampling Grids



		MMI - Sample Density for various grids	
Grid spacing(m x m)		**Scale**	**Samples/km2**
800	400	Regional	3
400	400	Regional	6
1200	100	Regional	8
400	200	Semi regional	13
200	200	Semi regional	25
400	100	Semi regional	25
200	100	Prospect	50
100	100	Prospect	100
100	50	Drilling	200
50	50	Drilling	400
50	25	Intensive/Infill	800

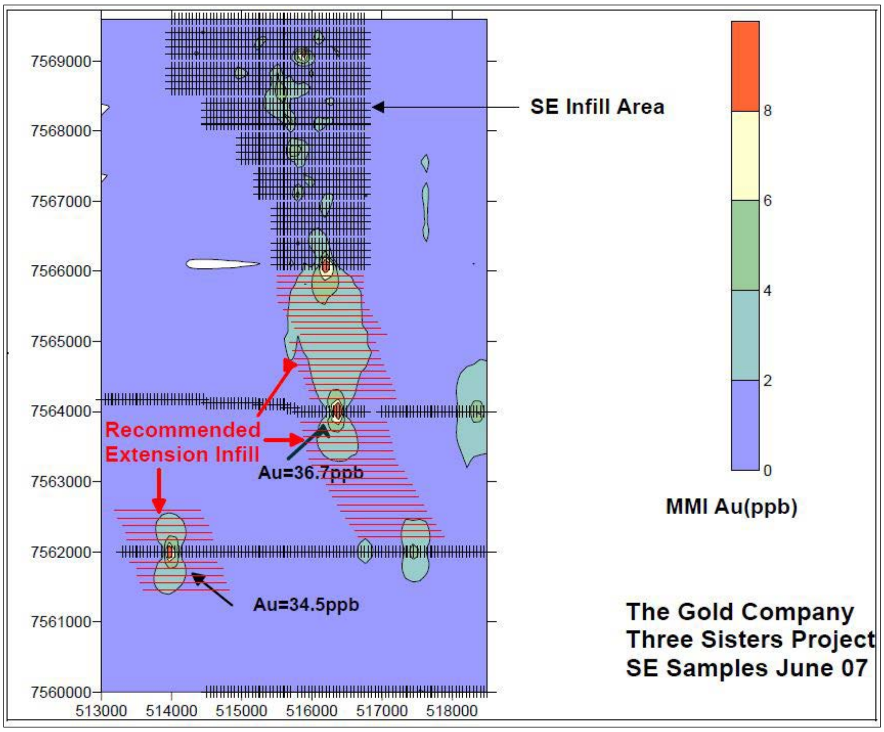


Figure 6: Example of Regionally Spaced MMI Followed by Infill. (Courtesy The Gold Company)

In this example, initial MMI^{TM} is carried out with samples at 50m interval on lines 2km apart. The regional strike (and trend of mineralization) is NNW-SSE, and the lines are oriented appropriately. The image above captures a period in the exploration when infill has been carried out in the northern part, and regional spaced (2km) lines only have been employed in the southern part.

The 2km (x 50m) spaced lines in the southern part have encountered several anomalous samples, and the appropriate infill has been suggested. This provides a very cost-effective method of covering large areas of ground.

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