# COMBINATION OF MMI AND ENZYME LEACH METHODS IN EXPLORATION FOR GOLD IN AN AREA OF THE CANADIAN SHIELD COVERED WITH GLACIAL SEDIMENTS: A CASE STUDY

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## Introduction

This property covers approximately 20 kilometres of prospective geology. Historical mineral exploration work recorded several Au occurrences with potential. The mineralization and alteration occur along and across the stratigraphic boundary between meta-sedimentary rocks and a bi-model volcanic sequence.

The study area is situated within Precambrian aged rocks of the Canadian Shield. A long greenstone belt that crosses through the property is noted for its Au and base metal mineral potential (Stott & Corfu, 1991). The rocks on the property are part of an easterly-trending, bi-modal sequence of meta-volcanic rocks that are intercalated with meta-sedimentary rocks. A late NE shear crosses the property. The Au occurrences were discovered and worked in the 1930's. Signs of the historic work include a trench that is 2 m wide and 15m long. In 1974 comprehensive sampling yielded 13.9 g/t over 3.3 m. Gold mineralization is hosted in a silicified shear zone cutting greywacke. Associated sulphide minerals are reported to be pyrite, pyrrhotite and arsenopyrite. Assay data for 2 holes drilled under the trench returned a value of 15.3 g/t over 0.2 m and a value of 18.19 g/t over 0.3 m. The drill data suggested that the trench occurrence has limited strike extent in the NE-SW direction and probably pinches out at depth.

A geochemical survey conducted in 1987 collected humus samples at various depths to sample the base of the "A" soil horizon. An Au anomaly was detected in the vicinity of the trench. This geochemical anomaly was drilled in 2010 and intersected a new zone with 9.47 g/t Au over 7.2 m approximately 100 m north of the trench. The area was surveyed with soil geochemical surveys in 2011 and 2012. The objective of the geochemical survey was to establish if there was any potential extent to the Au occurrence and to evaluate the merits of the previous geochemical survey.

Much of the topography in the area consists of flat swamps or thick muskeg with mature forest cover, typical of the Canadian Shield. The few hills present appear to be comprised primarily of glacial clay, sand, gravel and rounded granitic boulders with small outcrop areas. Peat or sphagnum overlay the inorganic layers. In some instances the thickness of peat exceeds 4.5 m.

## Methodology

During 2 field seasons MMI and Enzyme Leach analytical methods were tested. In the first field season the company collected samples using either a shovel or Dutch auger from 317 sites over 6.75 km of the 25*100 m grid. For MMI analytical method samples were taken from the top of the B soil horizon. In some instances it was not possible to obtain a sample of the inorganic material because the thickness of peat exceeded the 4.5 m length of the auger. In addition to the MMI samples a second sample of the same material was collected for analysis by the Enzyme Leach analytical method over the soil anomaly detected by the 1987 geochemical survey. In addition, organic samples were taken along one line over the soil anomaly to compare metal contents in the inorganic material with those in the humus layer. These samples were collected from 10-25 cm interval of the A soil horizon.

The next season 67 samples for MMI analysis using the same sample technique were collected along three lines with the purpose of extending the geochemical anomalies identified during the first season. Organic samples were taken at the same sites from 10-25 cm interval of A soil horizon to compare metal contents in the inorganic material identified by MMI with those of the humus samples analysed by Enzyme Leach.

Samples were analyzed by the MMI-M5 method at SGS Laboratories in Toronto and by the Enzyme Leach 7 method at Actlabs in Ancaster, ON. The MMI analytical data were separated into clay and till datasets and the Response Ratios were calculated separately for each dataset. The Response Ratios were defined by dividing the individual analytical values by the average value of the First Quartile for the sample set (as defined on the SGS website). These values were then plotted on maps. The Enzyme Leach analytical data were divided according to the sample media and the values were plotted separately using intervals of standard deviation in a sample set.

## Results and discussion

Figure 1 shows the Au response ratios (AU_RR) and a possible interpretation of the data as a series of Au-bearing veins. This diagram also shows the location of historic drillholes and trench. The MMI Au Response Ratios (Au_RR) show a strong response in the vicinity of the drillhole intersection of 9.47 g/t Au. The Au mineralization exposed in the trench, which occurs between two sample lines, did not give any response. Historic trenches and drill results indicate that the mineralization exposed in the trench does not extend as far west as 100m and a trench across the northeast trend of the mineralization indicates that the mineralization pinches out within 20m of the northeast end of the discovery trench.

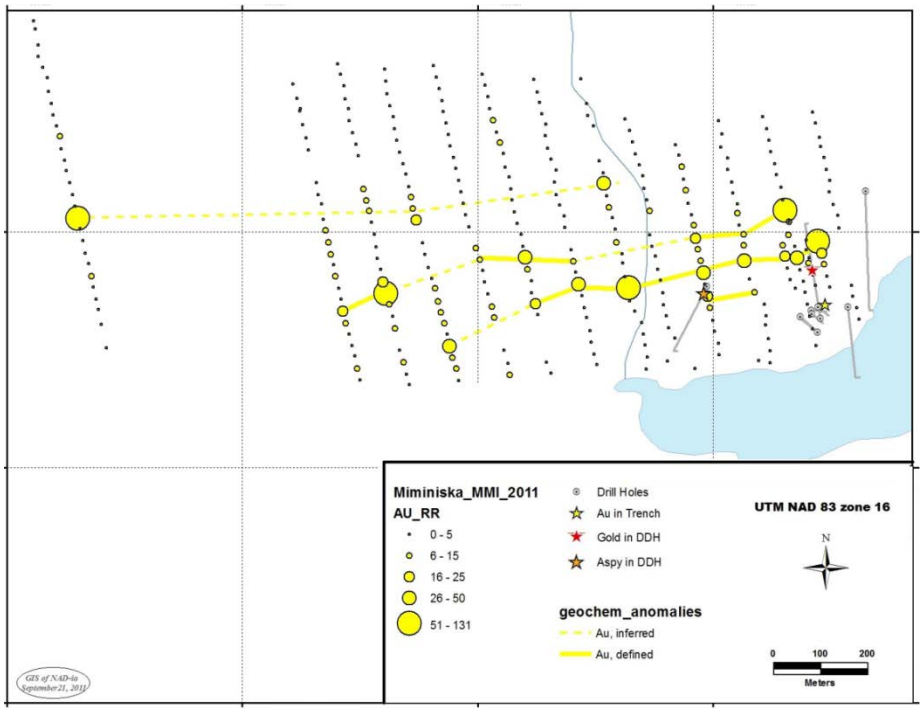


**Figure 1. Gold Response Ratios for samples analyzed by the MMI method with possible trend lines of vein system and previous drill holes.**

The MMI survey also indicates that there is anomalous Au along a continuous trend that has an overall strike length of nearly 1km (Figure 1). Strong Au anomalies extend westward from the drillhole intersection for over 600m. This data suggests that the silicified zone intersected in the drillhole probably extends for more than 1 km of strike length. A drillhole, located southwest of the trench, intersected 12 m of quartz-vein material with inclusions of arsenopyrite approximately 30 m down the hole. The MMI survey has identified both anomalous Au and arsenic Response Ratios in the vicinity of this intersection.

Background values in B soil horizon for Enzyme Leach analytical method were also obtained within 1km south of the mineralization. Figure 2 shows the Enzyme Leach Au results from reconnaissance survey lines sampled over the drillhole with Au mineralization. The method provides a distinct anomaly in the vicinity of the mineralization intersected in the drillhole, but in most cases the responses are not coincident with the MMI results.

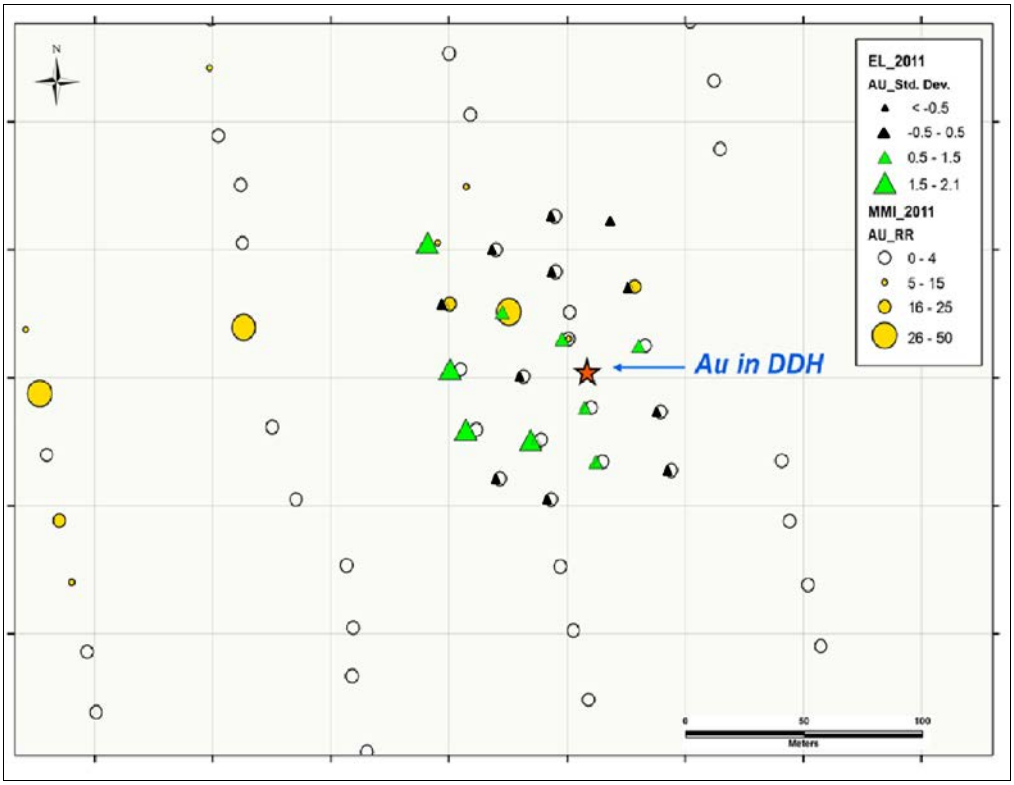


**Figure 2. Comparison of Au content in inorganic material analysed by Enzyme Leach and MMI analytical methods**

The humus samples collected during the 1984 geochemical survey were collected at various depths to sample the base of the "A" soil horizon. It became apparent during the early phase of the MMI survey that the 1984 samplers did not reach the base of the "A" horizon at many sites because they used a short auger. The current protocol for the collection of humus samples is to collect material that is 5 to 15 cm below the forest litter. Six samples of humus material were collected in the vicinity of the known mineralization and analyzed by the Enzyme Leach method in order to provide a means to evaluate the 1984 data. The plot of the analytical results (Figure 3) shows a strong anomaly immediately south of the vertical projection of the mineralization in the drillhole. The 1984 survey did not show any anomaly in these locations. This could be a result of inaccurate location of samples at that time or sample depth. The data obtained from the Enzyme Leach analysis of the humus layer suggests that the method is a viable exploration tool in this area.

The element assemblage for Au mineralization in the area was obtained from factor analysis of the MMI data. Sample media and depth were coded and included in the calculations. Table 1 summarizes the results for components that are influenced by Au. Only statistically important score values are presented in the table. The main part of Au variability contributes to factor 8 (F8) with an Au score 0.53. This factor also has positive influence on Ag, Cu and Sb and negative influence on Hg, Ba, Li, Sr. Sampling depth does not depend on this factor. It was assumed that Au-Ag-Cu-Sb assemblage represents mineralization.

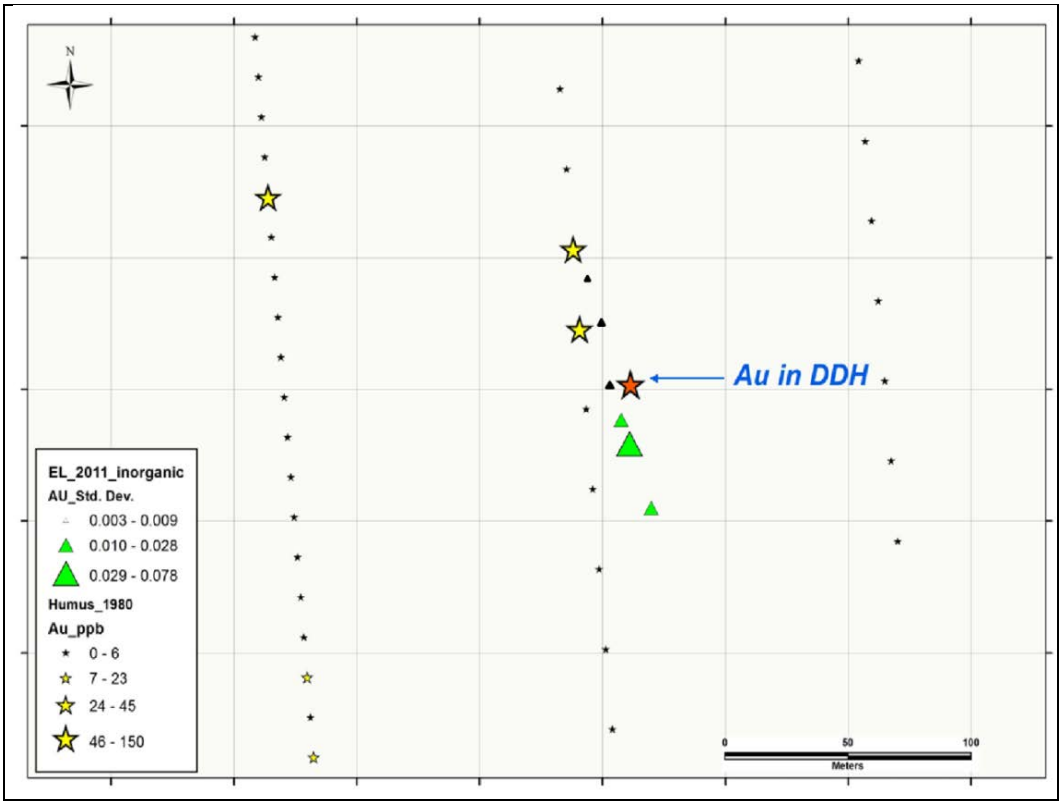


**Figure 3. Comparison of Au content in humus samples from 1984 survey and from humus samples analysed by Enzyme Leach method.**

**Table 1.Gold scores and element assemblages for factors influence on Au variation in inorganic sediments**

| | Factors | | | | |
|---|---|---|---|---|---|
| | **F5** | **F6** | **F7** | **F8** | **F10** |
| **Depth** | -0.29 | - | - | - | - |
| **AU score** | 0.20 | 0.18 | 0.29 | 0.53 | 0.18 |
| **important positive scores** | Cd-Mg-Ca-Sr-(Al-Au) | Bi-W-Pb-Hg-Au-Zn-(Ca-Mg) | Li-K-Al-Co-Ag-Au-Tl-Hg-As | Au-Ag-Cu-Sb | Ba-Au |
| **important negative scores** | Zr-Sb | Sn-Rb-Nb-Tl | Ca-Sr-Zn | Hg-Ba-Li-Sr | U |

## Conclusions

1) The MMI analytical method identified multiple Au geochemical anomalies. The results of the survey indicate that the previously identified Au-bearing system can be traced for a distance of over 600 m.

2) The elements that associate with Au mineralization are Ag-Cu-Sb.
3) Based on the positive results of the reconnaissance survey, Enzyme Leach analysis of the humus layer appears to be the most economical exploration tool in this area.

## References

STOTT, G.M. & Corfu, F. 1991. Uchi Subprovince; Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, 145-236. SGS website, http://www.geochem.sgs.com/mmi-theory.htm