

Appendix 8: Comparison – Biogeochemical Sampling

In this comparison the 4 biogeochemical sample media are compared to each other and scored out of 10 points on cost, analytical methodology, collection accuracy and suitability for use on other Ni-cu-PGE projects in the Kluane Ranges.

COST

- Increased analysis costs over regular soil samples because more elaborate sample preparation and ultra trace analysis methods.
- But, biogeochemical samples are cheaper to collect than soil samples because of faster sampling time
- Samples must be washed, dried then macerated or ashed prior to analysis.
- Ultra trace methods are best for vegetation because of the relatively low concentration of elements compared to rocks or soils.
- May incur additional charges to include Pt, Pd and Au or to have lower detection limits for those elements.

Sample Media and Method	2013 analysis cost*	Projected cost late 2013 or early 2014	Score
Humus – SGH	52.76 per sample (reduced costs for this survey)	55.07 per sample + \$250 for GIS package	1
Humus – Actlabs B1 prep and 2E method	41.63 per sample	42.00 (shipping added)	4
Bark – ALS Chemex PRP-VEG01 and ME-VEG41	50.24 per sample (incl QAQC at 1.90 per sample)	50.24	2.5
Labrador Tea – ALS Chemex PRP-VEG01 and ME-VEG41	50.24 per sample (incl QAQC at 1.90 per sample)	50.24	2.5
ACME 1D ICP-ES and Fire assay/ICP-MS for Au, Pt and Pd. (soil sample for comparison)	35.00 per sample	37.00	Comparison only

*includes: shipping, admin fees, disposal, preparation, analysis, GST

Discussion

- May not be worthwhile spending extra to get Au, Pd, Pt. If already included in ultra trace group then fine, but don't bother spending extra. Ni and other elements may be better pointers at reconnaissance level.

ANALYTICAL METHODOLOGY

Sample Media and Method	Preparation	Analysis Method	DL Au ppb	DL Pt ppb	DL Pd ppb	Final product	Pro	Con	Score
SGH (humus)	Dry at 40 degrees C, sieve at -60 mesh	Measure heavy hydrocarbons	Na to method. Measures hydrocarbons in ppt.			Report, target maps, spreadsheet of results	2 nd fastest turnaround.	Specialized, only useable with interpretation report	4
Actlabs 2E (humus)	Dry and blend, Ashed @ 480 degrees C,	Ash digested in acid, read using ICP/MS	5	2	3	Spreadsheet of results	Shortest turnaround. Ru included in elements.	DL too high for exploration precious metals. Ashing not as satisfactory a method.	1
ALS Chemex VEG41 (bark)	Wash, randomize, dry, macerate (-177 um), archive	HNO ₃ /HCl ICPAES and ICPMS	0.2	1	1	Spreadsheet of results	Low DLs, no ashing	Slow, preparation done in US. Good preparation and analysis method.	2.5
ALS Chemex VEG41 (lab tea)	See bark above								2.5

Discussion

- Ashing was traditional for vegetation but is being superseded by other methods. ALS Chemex has the leading method for non ashed vegetation with ultra trace detection limits.

COLLECTION

- All methods are faster than a traditional soil sample that requires digging into mineral soil. All media are above permafrost and the ash layer often found in this area.
- A ground and vegetation survey is required prior to starting survey. Look for the most widespread and consistent sample medium.
- All collection methods are suitable for Class I activities under current YG regulations.

Sample Media and Method	tools and equipment	Speed and ease of collection	Evidence of sample collection	Pro	Con	Score
Humus – SGH	Trowel, Ziploc brand plastic bags	Some digging required, but only through moss and organics.	Cone-shaped hole in moss up to 12” wide at top. Can be covered by replacing plug of moss.	Multiple media types can be collected in one survey (including snow). Cheap sample bags. Wider sample spacing than most other surveys)	Cannot collect ground samples if frozen or covered with snow.	3.5
Humus – Actlabs 2E	Trowel, polypropylene sample bags	Some digging required, but only through moss and organics.	Cone-shaped hole in moss up to 12” wide at top. Can be covered by replacing plug of moss.	Found almost everywhere there is some vegetation. Expensive sample bags	Cannot collect if ground is frozen or covered with snow	2
Bark – ALS Chemex VEG41	Paint scraper, dustpan, Kraft paper soil bags	Easy and fast	Band of lighter bark left around tree. On thin trees band is quite tall.	Can be collected year round. Cheap sample bags.	Difficulty of distinguishing black and white spruce. No trees in alpine or in active river floodplains.	3.5
Labrador Tea – ALS Chemex VEG41	Snippers, polypropylene sample bags	Easy and fast	Barely noticeable unless there were only a few plants.	Cannot collect if covered with snow. Expensive sample bags	Limited distribution. On mini grid, only 4 of 10 sites had lab tea.	1

Discussion

- All collection methods are efficient and non-intrusive. None require packing heavy and awkward long shovels, soil augers or mechanized sampling equipment.
- Although not tested in this survey, SGH samples can be snow, which would make for efficient winter or early spring sampling.

ACCURACY

- Accuracy was judged on the mini grid placed around the Teck Showing, one of the few rock outcrops in the grid and a known mineralized area. Rock samples were collected from the Teck Showing and these are shown for comparison. See maps
- SGH maps redox cells so does not produce the same type of anomaly as the other methods. Compared redox cell locations to mapped location of ultramafic sill

Sample Media and Method	Results (# of anomalous samples in mini grid). Anomalous is $\geq 90^{\text{th}}$ percentile in at least one of Au, Pd, Pt, Cu, Ni, Ru	Anomalous elements	Above background (51 to 89 th percentile)	Above background elements	Score
Humus – SGH	Grid included in larger, overlapping redox cells with Ni and Cu signatures.				3.5
Humus – Actlabs 2E	3 of 10 (0.3)	1 in Ru, 1 in Ni and Au, 1 in Cu and Ni.	6 of 10 (.6)	4 in Cu + Ni 2 in Cu	2
Bark – ALS Chemex VEG-41	6 of 10 (.6)	1 in Au, 2 in Pd, 1 in Cu and Ni, 1 in Cu, 1 in Ni	3 of 10 (.3)	1 in Cu, 1 in Ni, 1 in Cu + Ni	3.5
Labrador Tea – ALS Chemex VEG-41	0 of 4		3 of 10 (0.3)	2 in Cu + Ni, 1 in Ni	1
Rocks for comparison	6 of 14 (.43)	Cu, Pt, Au + Pd, Au+Cu+Pd, all 5	2 of 14 (.14)	Au+Ni+Pd+Pt, Cu+Pt, Au+Cu+Pd, all 5	

Discussion

- Humus and Bark both have 9 samples out of 10 above background in at least one element, but bark has 6 anomalous samples while humus has 3.
- Humus and bark have a better success rate (9/10) than rocks (8/14).
- Nickel shows up more often as anomalous or above background in biogeochem samples than in rock.

FLEXIBILITY – suitability for use on other Ni-Cu PGE projects in Kluane Ranges

- Not all sample media are present at each site.
- For example, on the Arch grid all samples were below treeline, but if the lines were further north then the grid would have gone into the alpine where there were no spruce trees.
- There are historical soil geochemistry surveys. The need to mesh and compare datasets is part of the flexibility criteria.

Sample Media and Method	Used in combination with other geochemical surveys	Sample spacing	Comments	Score
Humus – SGH	No. Compliment only	Depending on target, can be wide	Minimum of 50 samples required. Best used on grid or parallel transects. Can sample any media in same survey but all must be analyzed by SGH. Can be used to compliment other types of surveys but maps redox cells rather than element concentrations. Not suitable for single line contour or ridgeline surveys.	1.5
Humus – Actlabs 2E	Yes		No minimum number of samples. Can be combined with results from other media, but need to normalize or treat each sample media separately and need to sample reasonable number of each type to get statically valid information.	3.5
Bark – ALS Chemex VEG41	Yes	Minimum 25m	No minimum number of samples. Can be combined with results from other media, but need to normalize or treat each sample media separately and need to sample reasonable number of each type to get statically valid information.	3.5
Labrador Tea – ALS Chemex VEG41	Yes		Limited distribution. No minimum number of samples. Can be combined with results from other media, but need to normalize or treat each sample media separately and need to sample reasonable number of each type to get statically valid information.	1.5

Discussion

- Vegetation and humus can be combined with regular soil samples and each other which is more useful to a prospector
- SGH better for company able to afford a minimum 50 sample grid.

FINAL SCORES

Sample Media and Method	COST	Analysis methodology	Collection	Accuracy	flexibility	total
Humus – SGH	1	4	3.5	3.5	1.5	13.5
Humus – Actlabs 2E	4	1	2	2	3.5	12.5
Bark – ALS Chemex VEG41	2.5	2.5	3.5	3.5	3.5	15.5
Labrador Tea – ALS Chemex VEG41	2.5	2.5	1	1	1.5	8.5

Discussion

- Other than Labrador tea, which was not tested thoroughly in this orientation survey, the scores are close for the different media. No one method stands out as a clear favourite, instead all methods would be useful in their place.
- SGH is difficult to compare directly because it needs specialized interpretation and it detects redox cells instead of element concentrations.

PREDICTION

How successfully are the biogeochemical samples in predicting the location of the ultramafic sill that traverses the grid?

The Teck Showing is the only known mineralization on the Arch Grid and was discussed in the Accuracy section of this report. An ultramafic sill (Donjek complex) crosses the grid. Outside of the Teck Showing, few outcrops and no significant mineralization have been found so far. The predicted location is based on mapping and historic magnetic surveys.

The sill has been located in outcrop in 2 locations; one starts at the Teck showing and extends north to 12350 station and another is in the Arch Creek canyon 100m west of line 1000. Rock sampling at the Teck Showing indicates that Ni and Cu values should be higher directly over middle of the sill and precious metal values should increase towards the edge and in the altered wallrock on either side.

A linear anomaly is seen in most elements in both bark and humus that trends NW across the grid, parallel to the sill, but the anomaly may be offset from the mapped location of the sill. Generally the linear anomaly does not stretch across the entire grid. Once it reaches line 1200 the anomaly weakens, is offset or disappears. This may be caused by erosion from Serpentine Creek or the creek valley may be a NE trending fault that has weakened and/or offset the sill.

The SGH Cu redox cell is bisected by the peridotite sill and the Ni redox cell is centred on the southwest side of the sill. The star indicating the highest possibility of Ni-Cu PGE mineralization is located in the middle of the sill. The deep Ni trend is at a steeper angle (NNW) than the peridotite sill.

Conwest Showing

The Conwest showing is located 500m due north, directly upslope and upstream from station 10000 so is not covered by the Arch grid. However the Arch grid is downslope and there could be some downslope movement of material from the Conwest. This is indicated by anomalous point values at station 10000 in precious metals in humus and in precious and base metals in bark samples.