Workshops on Multielement and Multisite Regional Geochemical Survey (RGS) Anomalies Meriting Follow-Up Work in British Columbia

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INTRODUCTION

In 2003, the Rocks to Riches program funded a re-evaluation of British Columbia's Regional Geochemical Sampling (RGS) database for new exploration targets (Smyth, 2004a). This evaluation employed state-of-the art data analysis techniques not previously applied in British Columbia. The results of the re-evaluation, which included assessment by the MineMatch® software system, were published on the Internet for easy public access and were also incorporated into the British Columbia Geological Survey's MapPlace website.

In 2004, the Rocks to Riches program funded the 'MineMatch Geochemistry Follow-Up Program' to assist the various exploration and prospecting communities in British Columbia to use the results of the RGS re-evaluation study to enhance their ability to find new mineral deposits in the province.

This was achieved by providing one-day 'target generation and follow-up' workshops free of charge in six centres throughout British Columbia, namely Smithers (16 attendees), Williams Lake (3), Cranbrook (1), Nelson (19), Kamloops (9) and Vancouver (23). These workshops taught participants how to use the the new RGS-based Internet resources to

pick the most promising areas of BC in which to conduct prospecting operations; and

use information on the www.rockstorichesbc.com website to assist with follow-up of the identified targets.

Each workshop used content drawn from the region in which it was being hosted, with an emphasis on identifying targets on ground unencumbered by existing claims, parkland or other restrictions. Heavy reliance was placed on using existing provincial Internet resources to assist with these considerations, as well as with integrating landform and other geological information into target characterization.

This paper clarifies the goals of the 2003 Rocks to Riches MineMatch Geochemistry Study, documents additional Internet resources developed for the 2004 project workshops, and summarizes the results of the six project workshops held in 2004.

PROJECT GOALS

Selecting areas in which to prospect is an activity undertaken at varying scales. At large (general) scales, it involves determining which broad regions are likely to be most rewarding; at small (area-specific) scales, it involves determining exactly where on the ground to expend costly human and mechanical effort on mapping, including sampling and data collection.

Although the project addressed the first of these in its publication of 27 deposit-type target distribution maps, the focus in the workshops was on the small scale — specifically on determining which individual drainages in British Columbia, based on their silt geochemistry, displayed evidence of economic mineralization **and might not have been investigated on the ground for this mineralization** — despite the long period of time over which the RGS data have been available and the free Internet-based mapping software available for their assessment.

This goal was achieved in two steps:

1) Selecting higher interest anomaly clusters from the MineMatch Geochemistry Study
2) Using the mapping capabilities of the MapPlace website (www.mapplace.ca) to establish whether the anomaly cluster may result from known mineralization.

The particular goal of the workshops was to make the results of the MineMatch Geochemistry study as accessible as possible to potential users not experienced in the Internet delivery of sophisticated mineral exploration aids.

WORKFLOW CONSIDERATIONS

Workflow issues are seldom considered explicitly in research-type activities such as anomaly identification and prioritization in mineral exploration. Where input datasets are large and complex, however, they can present significant barriers to successful completion of these tasks.

While the MineMatch Geochemistry study had automated the many potentially time-consuming steps in identifying anomaly clusters, the volume of data analyzed produced many targets for evaluation. Optimizing the workflow around deciding which of these may be of immediate interest to a prospector or exploration company, and documentation of the reasons for this interest, had not been addressed, and was therefore evaluated and optimized for these workshops.

In this regard, easy access to the primary analytical and lithological data on which anomaly clusters were based, as well as the need to print these data in a format easily reviewed by a human being, and easily filed, were considered important. The Filemaker Pro Version 7 database was identified as the most cost-effective means of providing for these needs on the Internet. All anomaly cluster sample data were imported into the system, and the necessary programs were written to provide the required functionality. Figure 1 illustrates the primary output from the resulting enhancement of the MineMatch Geochemistry Study, which is a single letter-sized printout showing all the analytical results available for an anomaly cluster sample, the primary rock type associated with the sample, the 99th percentile anomaly thresholds used for each analytical method, and the number of analyses used to determine this threshold. In the case of multiple-site anomaly clusters, the user can page between associated samples by clicking on the next/previous page icon in the left margin of the report. Reports and printouts from this system provided an important focus for the workshops.

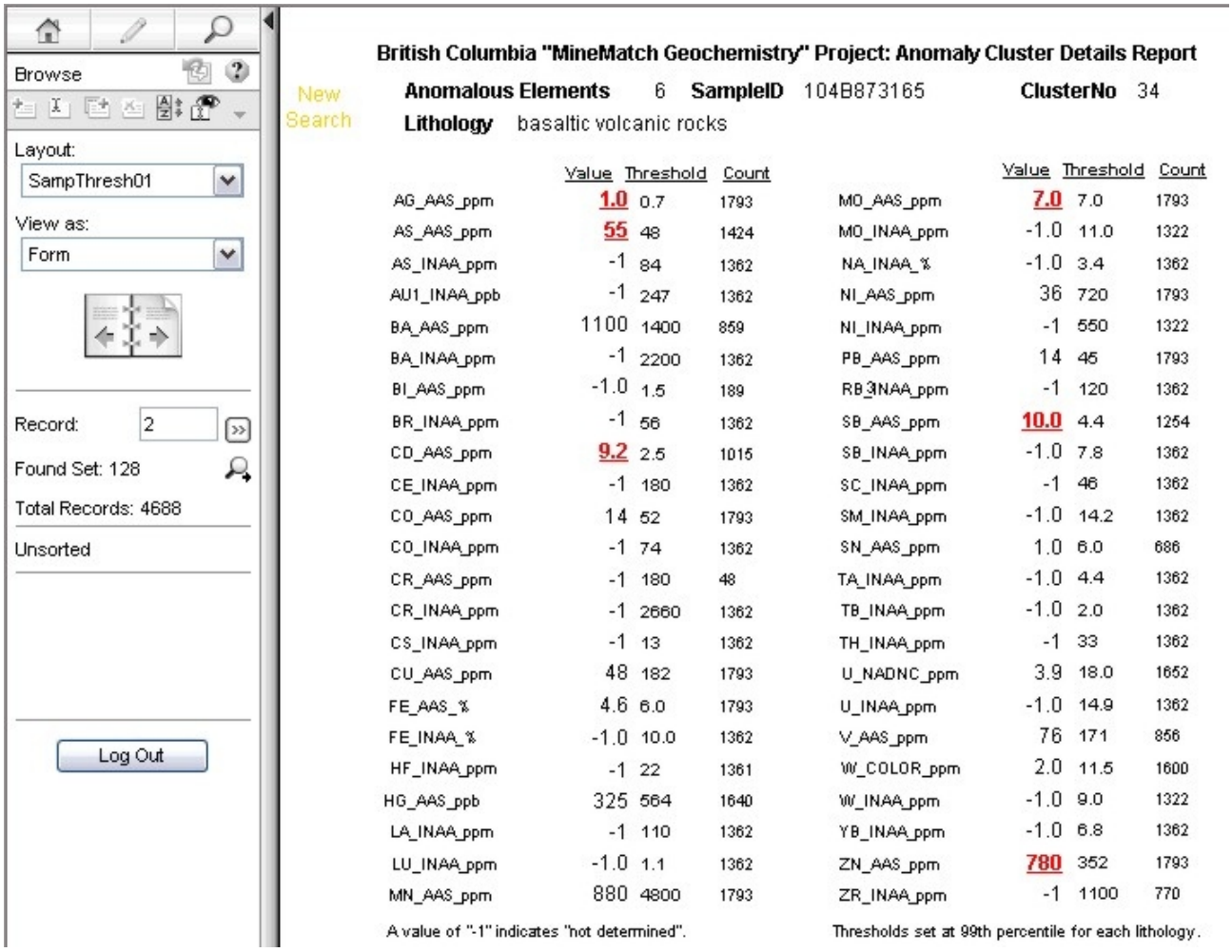
Easy access to and printing of maps explaining possible sources of anomaly clusters, as well as their ownership status, was an equally important component of the workshops. This was provided by the British Columbia Geological Survey's MapPlace website.

Finally, it was necessary to provide access to paper maps suitably scaled for the pencil-and-paper work that supplements most large map-evaluation projects. These A0-size 1:500 000-scale maps were prepared before each workshop, and made available in Adobe PDF format for download from the www.rockstorichesbc.com website after each workshop.

EXAMPLE ANOMALY CLUSTER

Ensuring that participants understood the relationships between anomaly clusters, component samples, sample analytical results, known mineral occurrences, mineral claim locations and streams and watersheds was an important introductory element to each workshop.

Figure 2 presents anomaly cluster 2507, which illustrates all these aspects of the MineMatch Geochemistry Study, namely



	Value	Threshold	Count
AG_AAS_ppm	1.0	0.7	1793
AS_AAS_ppm	55	48	1424
AS_INAA_ppm	-1	84	1362
AU1_INAA_ppb	-1	247	1362
BA_AAS_ppm	1100	1400	859
BA_INAA_ppm	-1	2200	1362
BI_AAS_ppm	-1.0	1.5	189
BR_INAA_ppm	-1	56	1362
CD_AAS_ppm	9.2	2.5	1015
CE_INAA_ppm	-1	180	1362
CO_AAS_ppm	14	52	1793
CO_INAA_ppm	-1	74	1362
CR_AAS_ppm	-1	180	48
CR_INAA_ppm	-1	2660	1362
CS_INAA_ppm	-1	13	1362
CU_AAS_ppm	48	182	1793
FE_AAS_%	4.6	6.0	1793
FE_INAA_%	-1.0	10.0	1362
HF_INAA_ppm	-1	22	1361
HG_AAS_ppb	325	564	1640
LA_INAA_ppm	-1	110	1362
LU_INAA_ppm	-1.0	1.1	1362
MN_AAS_ppm	880	4800	1793

	Value	Threshold	Count
MO_AAS_ppm	7.0	7.0	1793
MO_INAA_ppm	-1.0	11.0	1322
NA_INAA_%	-1.0	3.4	1362
NI_AAS_ppm	36	720	1793
NI_INAA_ppm	-1	550	1322
PB_AAS_ppm	14	45	1793
RB_INAA_ppm	-1	120	1362
SB_AAS_ppm	10.0	4.4	1254
SB_INAA_ppm	-1.0	7.8	1362
SC_INAA_ppm	-1	46	1362
SM_INAA_ppm	-1.0	14.2	1362
SN_AAS_ppm	1.0	6.0	686
TA_INAA_ppm	-1.0	4.4	1362
TB_INAA_ppm	-1.0	2.0	1362
TH_INAA_ppm	-1	33	1362
U_NADNC_ppm	3.9	18.0	1652
U_INAA_ppm	-1.0	14.9	1362
V_AAS_ppm	76	171	856
W_COLOR_ppm	2.0	11.5	1600
W_INAA_ppm	-1.0	9.0	1322
YB_INAA_ppm	-1.0	6.8	1362
ZN_AAS_ppm	780	352	1793
ZR_INAA_ppm	-1	1100	770

Figure 1. MineMatch Geochemistry Study anomaly cluster details report.

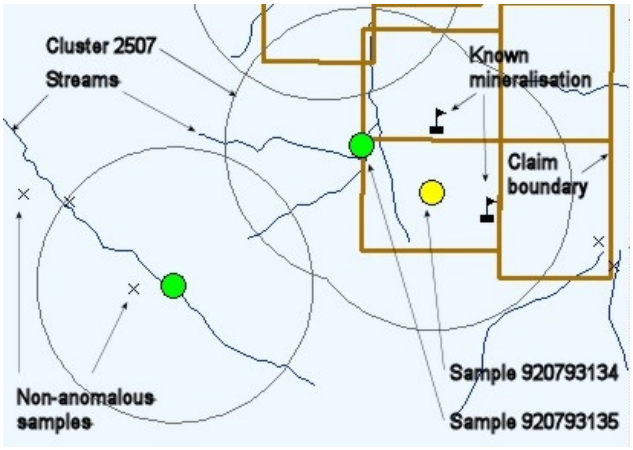


Figure 2. Relationships among anomaly clusters, component samples, known mineral occurrences, mineral claim locations and streams.

1) anomalous levels in economically interesting elements in two samples taken less than 2.5 km apart:

   Sample 920793134 – anomalous in Ag, Cu. Hg, Mo and W

   Sample 920793135 – anomalous in Ag, As and Pb

2) anomalism in one of the samples (920793134) probably explained by known mineralization within the catchment area of the sampled stream;

3) anomalism in the other sample (920793135) without a source in known mineralization — and which, unlike the former sample, is likely to arise from ground that is not subject to mineral claims. Note that the relatively subdued (but nevertheless real) levels of anomalism in this sample make it quite possible that it had not, with the data analysis tools readily available prior to the MineMatch Geochemistry Study, previously been identified as anomalous.

WORKSHOP STRUCTURE AND PRODUCTS

Workshops took place over one day, according to the following general structure:

9.00 am–10.30 am: Using the www.rockstorichesbc.com website to identify and prioritize drainages for follow-up work in the field

11.00 am–12.30 pm: Working toward establishing the ten best unstaked targets in the (workshop) region

1.30 pm–3.00 pm: Describing mineral deposits and deposit models: fieldwork and computer considerations

3.30 pm–5.00 pm: Evaluation of targets in areas of specific interest to attendees using the project and www.mapplace.ca websites, including those in already-staked ground

During the first part of the workshop, attendees were taken through the mapping and database querying tools available on the project website, advised on how to interpret the site's statistical reports and graphics, and shown how to investigate the contextual details of interesting anomaly clusters on the www.mapplace.ca website.

During the second session, the principles covered in the first session were applied to the workshop's focus area, starting with a precompiled list of anomaly clusters illustrating various aspects of anomaly assessment. Records were kept of anomaly clusters assessed, and conclusions regarding their level of interest to explorers. These records were posted on the project web site after the workshop. Table 1 illustrates the results of the Smithers workshop.

The third session examined the challenges inherent in describing mineral deposits, models and occurrences, and the advantages of using standard terminology for these purposes. With this background, which was fundamental to the development of the MineMatch system, attendees were advised on how to use the MineMatch reports available for each anomaly cluster as checklists of important geological criteria to look for when following up anomalies on the ground.

The final session was devoted to assessing project data from any areas of interest to attendees. This usually led to an active exchange of information between attendees, particularly between explorers and British Columbia Geological Survey staff, when the latter were present. On a number of occasions, it became apparent that an attendee had staked claims based on anomaly clusters observed on the project website prior to the workshop.

INTEGRATION WITH ADJOINING JURISDICTIONS

Since publication in January 2004 of the MineMatch Geochemistry Study, a similar study had been completed for the Yukon Territory (Smyth, 2004b). Arrangements were therefore made to plot anomaly clusters from southern Yukon on the same map as clusters from northern British Columbia for the Vancouver workshop, which focused on northwestern British Columbia because southwestern British Columbia had been covered during the Kamloops workshop. Although splitting and lumping of rock types into lithological units has been conducted according to different criteria north and south of the boundary, leading to occasional apparent geological discontinuities at the boundary, anomaly cluster groups are generally continuous across the border, a characteristic that assists in efficient prospecting on both sides of the boundary.

WORKSHOP EFFECT ON WEBSITE UTILIZATION

Usage logs of the www.rockstorichesbc.com website (Fig. 3) show a considerable increase immediately before, during and after the workshops, suggesting that they were successful in reigniting the interest initially shown in the site after its publication, which is also evident in the logs. It

TABLE1.ANOMAL YCLUSTERWORKSHEET FORTHE SMITHERS WORKSHOP.

Category	Cluster	Comments
Free	127	1 sample: Ag, Co, Cu, Fe, Mo, Pb, W
Free	212	1 samp: As, Co, Cu, Mo, Sb. Very close to 2 porphyry mineral occurrences in cluster
Free	2855	2 samples: Au, Cs, Cu, Fe, Mo
Free	2869	4 samples: Ag, As, Au, Br, Ce, Co, Cs, Cu, Fe, Mo, Sb, W. Probably from the Red Rose mineral occurrence, which may also explain cluster 2870
Free	2904	1 sample: Ag, Cd, Pb, Sb, Zn. In Babine Park
Free	2912	3 samples: Cd, Co, Cu, W, Zn. Source from known mineralization?
Free	2986	1 sample: Ag, Br, Ce, Cu, Hf, La, Mo, Sm, Ta, Tb, Th, U
Free	3008	3 samples, 1 of which sourced over "monzodiorite" with a sample population of only 6, yielding a poor quality 99th percentile. The other 2 samples are anomalous in: bi, La, Mo, Na, U, W
Free	3088	1 sample: Ag, Br, Co, Cu, Fe, Hg, Mo, Ni, Sc, U, Zn. Good quality target
Free	3141	1 sample: Cu, Fe, Mo, W. Good quality target
Free	3157	2 samples: Cs, u, Tb, U, Yb
Free	3176	1 sample: Au, Ce, Co, Cr, Cs, Fe, Hf, La, Lu, na, Ni, Rb, Sc, Sm, Ta, Tb, U, Yb, Zr. Exotic skarn?
Free	3198	1 sample: Ag, Cu, Mo, Pb, Sb, Zn. Claim over best (main) stream
Free	3222	1 sample: Ag, cu, Hg, Lu, Sm, Tb, Yb. Good quality target
Free	3343	2 samples: Au, Cu, Mo, Sc. Low Cu, Mo, Au anomaly on free ground
Free	3370	2 samples: Bi, Cu, Fe, Mo, Th, U, W, Zn. Good quality target
Free	3387	2 samples: Cu, Mo, W. Good quality target
Held	26	2 samples: Ag, As, Cu, Mo, Ni, Sb, Zn
Held	205	5 samples: Ag, As, Au, Ba, Cu, Fe, Hg, Pb, Sb
Held	2888	1 sample: Ag, Pb, Sb
Held	2905	1 sample: Mo, W
Held	3058	3 samples: Ba, Cd, Hg, Mo, Ni, Pb, Zn
		Anomaly Clusters probabaly not of interest
Poor	2939	Smithers - Invalid anomaly: Sample population of one
Poor	2946	Smithers - Invalid anomaly: Only 12 to 20 samples in populations
Poor	2977	Smithers - Invalid anomaly: No indication of sample population size
Poor	3035	Smithers - Invalid anomaly: Only 6 samples in the monzondiorite class of samples
Poor	3310	Smithers - Invalid anomaly: Only three samples in population
Poor	2399	Williams Lake - Probably unmapped ultramafics in sample area
Poor	2529	Williams Lake - Hg, Cr, Ni in greenschist(?)
Poor	2570	Williams Lake - Lu, Sm, Tb, Yb association in volcanics
Poor	2688	Williams Lake - Probably unmapped ultramafics in sample area
Poor	2701	Williams Lake - Typical REE enhanced without other elements of interest

is likely that much of this interest was from parties who did not feel qualified to exploit the website without the supplementary instruction in computer techniques provided by the workshops.

CONCLUSION

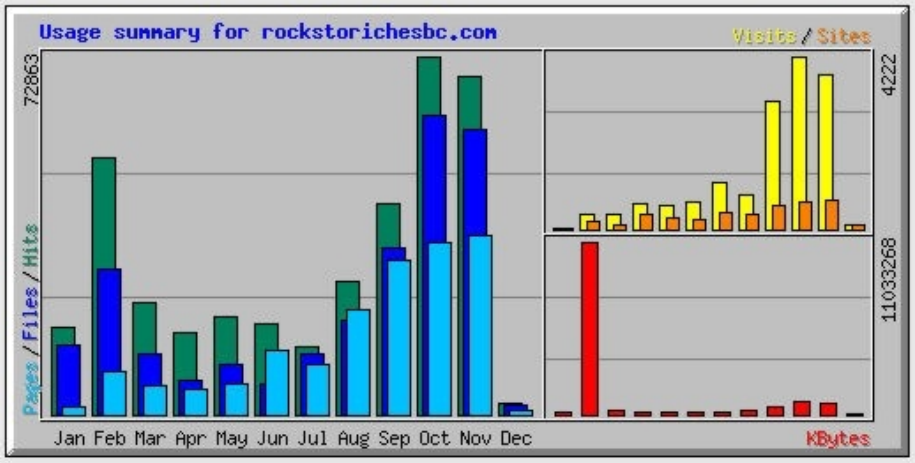
The Rocks to Riches Project funded six one-day workshops on selecting anomaly clusters for follow-up work from those reported in the 2003 MineMatch Geochemistry Study, which was also funded by the Rocks to Riches program. A primary goal of the workshops was to make the results of the 2003 study as accessible as possible to potential users not experienced in the Internet delivery of sophisticated mineral exploration aids. While workshop attendance was varied, participation by attendees was enthusiastic, positive feedback was received from all workshops, and utilization of the project website was increased substantially by the workshops.

Preparation for the workshops focused significant attention on the workflow surrounding anomaly prioritiz ation and documentation. This resulted in upgrades to the project's website in respect of geochemical data querying and reporting, and in the provision of digital maps suitable for large-sheet plotting.

Lists of anomaly clusters on unclaimed ground with obvious economic potential were forthcoming from each workshop, and were posted to the project website. These lists are incomplete because of the relatively short duration of each workshop. Workshop attendees were provided with the skills to complete these lists in their own time.

Usage Statistics for rockstorichesbc.com

Summary Period: Last 12 Months
Generated 03-Dec-2004 07:46 Pacific Standard Time



Summary by Month

Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Dec 2004	811	697	343	41	88	73119	123	1031	2091	2433
Nov 2004	2292	1926	1219	125	713	770583	3756	36570	57807	68781
Oct 2004	2350	1964	1130	136	675	802320	4222	35034	60899	72863
Sep 2004	1424	1131	1042	103	591	464442	3113	31262	33958	42723
Aug 2004	875	624	684	27	346	325030	852	21228	19352	27145
Jul 2004	447	400	331	37	422	178716	1155	10291	12426	13863
Jun 2004	615	210	431	22	229	127620	686	12956	6310	18471
May 2004	644	324	197	18	280	173007	579	6123	10053	19982
Apr 2004	555	227	178	21	375	156201	630	5362	6832	16673
Mar 2004	737	400	193	11	120	249424	366	5986	12415	22865
Feb 2004	1796	1020	302	12	185	11033268	370	8780	29583	52090
Jan 2004	4436	3524	415	10	23	127692	42	1662	14097	17747
Totals						**14481422**	**15894**	**176285**	**265823**	**375636**

Figure 3. Usage logs of the www.rockstorichesbc.com website, showing a significant increase during the period of the project workshops.

A map was produced, and posted to the project website, which shows good continuity between groups of anomaly clusters in northwestern British Columbia and southern Yukon. This map is of value to those assessing trans-boundary mineralization trends.

ACKNOWLEDGMENTS

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