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MINNOVA INC.

DATE: December 4, 1990.

TO: Ian Pirie.

COPIES TO: Al Hill, Jim Clarke

FROM: John Bradford.

SUBJECT: **Lithogeochemistry Samatosum Property.**

As part of the 1:2500 mapping of the Samatosum property in April-May 1990, 30 samples of mafic volcanics were analyzed for major elements and a suite of trace elements. Later projects prevented me from looking at the results as a whole until recently.

These samples were collected to help solve two problems:
(1) Do the "Sam mafics" (EBG) represent a single stratigraphic succession, or a structural composite of different elements?
(2) Do the "Rea mafics" (EBF) represent a distinct package from the Sam mafics, or part of the same package (now structurally dismembered)? Essentially, the idea was to extend Hoy's published treatment of the Rea mafics to include the Sam mafics (Hoy, 1987), in order to help resolve some of the stratigraphic and structural problems affecting the Sam property.

These questions arise from three contradictory features of Sam geology: (1) the Rea horizon is a syngenetic sulphide horizon of Devonian age in stratigraphic contact with the Rea mafics, (2) the Sam hangingwall succession contains the Tshinikin limestone, which is regionally correlated with limestones of Cambrian age, and (3) the Rea mafics include rocks apparently identical to the Sam mafics.

One solution to this problem was to place a thrust fault within the Sam hangingwall sequence, separating the troublesome Tshinikin from the package containing Devonian mineralization and look-alike volcanics. An initially plausible place for this fault was the base of the Tailings Pond sediments, a sediment unit distinct in several ways from the Sam and Rea sediments. However, this solution fails on geological grounds. The Tailings Pond sediments map out as a basinal facies that pinches out within Sam mafics towards Twin Mountain, and the same mafics occur both above the sediments and above the Tshinikin. As well, Tshinikin - like marbles occur as large lenses within the mafics below the Tshinikin proper, and multiple sedimentary lenses similar to the Tailings Pond sediments occur below the Tailings Pond horizon on the Victory property. This means that the Sam hangingwall succession is a single stratigraphic entity containing complex sedimentary and volcanic facies.

This conclusion is supported by the geochemistry. Of 19 samples from the Sam mafics, 10 were from the section between the pit and the Tailings Pond sediments, 4 were from above the Tailings Pond sediments, 3 from above the Tshinikin, and 2 from the sediment - poor Twin Mountain facies (see map). Eighteen were flows or fragmentals, and 1 was a dioritic intrusion. Both whole rock and trace chemistry show some variability, but no definable sub-populations and no chemical-stratigraphic correlations.

The second aspect of the problem, the relation between the Rea mafics and the Sam mafics, became more complicated with the observation that the outcropping portion of the Rea mafics was a distinctive feldspar phyric volcaniclastic, that in core always occurs beneath more Sam-like mafics at the stratigraphic top of the overturned Rea mafic package. This lead to the idea that the Rea mafics were in fact a structural composite of Devonian and Cambrian elements. The only problem with this (and a very significant one) was that no one (even Keith) could find a structural contact within the Rea mafics.

Rea mafic samples analyzed here include only feldspar phyric lapilli tuffs which are known to be in gradational stratigraphic contact with the sericitic footwall alteration zone underlying the Rea horizon. If Rea is Devonian and syngenetic, these rocks are as well. The alteration assemblage is chlorite - dolomite. They do not include the more Sam-like chlorite - spotted calcareous chlorite schists that also occur in the Rea package. (These do not outcrop in the area of the Rea lenses). Two of the Rea samples from core were discarded from the suite due to highly anomalous geochemistry reflecting more intense alteration.

The Rea mafics are geochemically very similar to the Sam mafics. Both plot as alkali basalts on alkali - silica plots (Figures 1, 2) and trace element plots (Figure 10), and are indistinguishable on the triaxial oxide plots (here separated into Figures 3 and 4). The MgO/CaO plot (Figure 5), used to screen out alteration effects, shows a significantly higher MgO/CaO ratio in the Rea mafics. While this could be related to primary composition, it is also compatible with a higher degree of alteration in the Rea samples, i.e., VMS footwall - style Mg metasomatism. On trace element plots both plot as ocean floor basalts (Figure 7, 9) or within - plate basalts (Figures 6, 8). An ocean island or back arc setting is compatible with these options. I would favour an ocean island setting for the Sam mafics and a back arc setting for the Rea mafics. Neither EBG nor EBF is a true mid - ocean ridge basalt (Figure 6: the spread of EBG data here reflects poor quality Nb analyses).

The trace plots show a reasonable clustering of data (especially Figure 10), and a general conformity with Hoy's data, suggesting that use of geochemical values is not unreasonable. However, the weak separation of data in Figures 7-9 is not statistically significant with this number of samples (all mean values overlap within one standard deviation). Geochemical evidence therefore fails to distinguish between Devonian volcanics hosting the Rea VMS lenses and Cambrian (?) volcanics in the Sam hangingwall (and within the Rea mafic package). More expensive analytical techniques and a larger data set would be needed to prove this convincingly.

Major element data from Sam drilling compiled by Dave Heberlein (133 samples) were also compared with the present data set. The data show a clustering similar to that seen here, but are smeared out over a much larger area, reflecting varying degrees of silicification and sericitizaton. This is especially evident on plots involving SiO2, CaO and alkalis.

In summary, geochemistry supports interpretation of the Sam hangingwall succession as a stratigraphic package which includes the Tshinikin limestone, but fails to distinguish conclusively the Rea and Sam mafics. Interpretation of the Rea mafics as a composite of Devonian and Cambrian elements is not ruled out, but the problem of the lack of a structural break is still with us. One possibility is that there is a major local unconformity within the Rea mafics, with Cambrian volcanics stratigraphically underlying Devonian volcanics and a normal fault separating the Rea mafics from the Sam sediments. The unconformity option implies the removal (or nondeposition) of EBS, interpreted by Schiarriza and Preto (1987) as Lardeau Group equivalents.

Hoy, T. (1987): Alteration chemistry and tectonic setting of volcanogenic massive sulphide-barite deposits at Rea Gold and Homestake, southeastern British Columbia. B.C. Ministry of Energy, Mines and Petroleum Resources, Exploration in B.C., 1986, pp. B7-B19.

Schiarrizza, P. and Preto, V.A. (1987): Geology of the Adams Plateau - Clearwater - Vavenby area. B.C. Ministry of Energy, Mines and Petroleum Resources, Paper 1987-2.

Geochemistry of Mafic Volcanics from the Samatosum Property

EBG ("Sam mafics")

SAMPLE #	AL2O3 %	BA %	CAO %	FE2O3 %	K2O %	MGO %	MNO2 %	NA2O %	P2O5 %
OBSMT001	12.03	0.045	13.31	8.02	1.11	5.42	0.16	2.21	0.22
OBSMT002	11.26	0.020	12.61	8.96	0.44	6.70	0.15	1.68	0.32
OBSMT003	16.32	0.010	8.70	9.83	0.17	9.64	0.19	2.74	0.19
OBSMT004	15.14	0.010	7.53	10.38	0.09	9.83	0.17	3.30	0.21
OBSMT005	13.17	0.015	10.24	8.35	0.64	7.65	0.15	3.34	0.25
OBSMT006	14.85	0.005	6.89	10.35	0.22	6.61	0.15	4.64	0.26
OBSMT007	11.47	0.035	9.22	6.89	0.09	7.69	0.16	5.33	0.20
OBSMT008	14.86	0.015	19.52	10.25	0.34	5.63	0.13	3.82	0.24
OBSMT009	12.78	0.035	8.74	10.96	0.72	7.96	0.12	3.47	0.28
OBSMT010	18.91	0.005	11.38	10.27	0.12	6.10	0.17	2.27	0.16
OBSMT011	14.71	0.010	7.18	12.28	0.05	12.72	0.19	2.00	0.25
OBSMT012	12.65	0.010	9.42	8.12	0.22	6.65	0.13	3.65	0.21
OBSMT013	13.13	0.005	8.48	8.78	0.01	9.82	0.19	2.72	0.32
OBSMT014	13.59	0.010	11.42	10.54	0.13	8.06	0.18	3.48	0.29
OBSMT015	17.56	0.015	4.04	14.12	0.49	3.93	0.20	5.38	0.66
OBSMT016	14.06	0.005	10.46	12.44	0.15	9.37	0.17	2.46	0.27
OBSMT017	12.83	0.015	9.34	11.59	0.23	9.85	0.20	2.51	0.86
OBSMT018	13.05	0.005	8.61	11.34	0.24	9.61	0.20	2.71	0.83
OBSMT019	13.22	0.020	6.53	11.01	0.29	11.34	0.14	1.59	0.42
AVERAGE	13.98	0.015	9.35	10.24	0.30	8.08	0.17	3.12	0.34
STD DEV	1.93	0.011	2.37	1.72	0.27	2.14	0.02	1.07	0.20

EBF ("Rea mafics")

SAMPLE #	AL2O3 %	BA %	CAO %	FE2O3 %	K2O %	MGO %	MNO2 %	NA2O %	P2O5 %
OBRMLOO'	13.42	0.005	3.96	9.93	0.01	13.64	0.15	1.83	0.50
OBRML002	14.08	0.010	3.62	10.02	0.01	13.56	0.13	2.18	0.50
OBRML003	13.32	0.005	3.57	9.63	0.01	13.50	0.20	2.71	0.50
OBRML004	13.90	0.005	3.54	9.95	0.01	12.24	0.20	2.74	0.55
OBRML005	12.44	0.005	5.61	8.90	0.01	13.76	0.16	1.70	0.56
OBRML008	14.61	0.010	4.01	10.46	0.14	11.40	0.13	3.21	0.62
OBRML009	12.31	0.005	6.70	10.48	0.03	16.07	0.15	0.52	0.62
OBRML010	13.59	0.005	5.14	9.44	0.18	7.94	0.17	5.16	0.68
OBRML011	13.53	0.005	6.07	9.63	0.05	11.64	0.14	2.91	0.63
AVERAGE	13.47	0.006	4.69	9.83	0.05	12.64	0.16	2.55	0.57
STD DEV	0.69	0.002	1.14	0.47	0.06	2.12	0.03	1.20	0.06

SIO2 %	SR %	TIO2 %	S %	LOI %	TOT%	NB/PPM	TI/PPM	V/PPM	Y/PPM	ZR/PPM
40.75	0.020	1.02	0.06	14.5	98.88	7	6020	235	7	50
46.08	0.045	1.42	0.01	9.2	98.90	42	8070	200	11	79
47.13	0.005	0.85	0.01	3.5	99.29	1	5090	308	10	41
46.87	0.010	1.10	0.01	4.3	98.95	13	6520	220	13	52
44.92	0.015	1.35	0.01	8.9	99.00	17	8010	220	13	82
44.89	0.015	1.72	0.01	8.6	99.21	15	10080	248	16	78
49.91	0.020	0.74	0.01	7.3	99.07	5	4330	154	10	44
37.18	0.025	1.28	0.01	11.6	98.90	2	7450	264	16	54
45.67	0.005	1.80	0.01	6.5	99.05	39	10130	284	15	83
44.82	0.015	0.80	0.01	4.1	99.08	9	4550	330	19	33
42.92	0.040	1.54	0.01	5.0	98.85	24	8750	275	16	73
48.59	0.020	1.24	0.01	8.2	99.12	26	6820	182	11	65
43.18	0.020	1.53	0.03	10.7	98.92	28	8580	228	12	83
40.27	0.050	1.47	0.01	9.8	99.30	12	8340	259	19	103
45.25	0.025	2.96	0.01	4.4	98.99	59	17130	130	38	375
43.08	0.025	1.95	0.01	5.6	99.03	25	11320	359	24	112
44.92	0.025	2.01	0.01	4.4	98.79	33	12480	241	20	117
46.67	0.030	2.00	0.01	3.5	98.81	8	12750	234	21	107
39.26	0.005	1.69	0.01	13.6	99.13	42	10000	268	18	111
44.33	0.022	1.50	0.01	7.56	99.01	21.42	8758.95	244.16	16.26	91.68
3.14	0.012	0.52	0.01	3.32	0.15	15.58	3091.55	54.76	6.68	71.35

SIO2 %	SR %	TIO2 %	S %	LOI %	TOT%	NB/PPM	TI/PPM	V/PPM	Y/PPM	ZR/PPM
42.32	0.010	1.84	0.01	11.2	98.83	48	9900	202	16	150
42.12	0.010	1.89	0.02	10.7	98.85	51	10690	222	17	165
41.64	0.010	1.85	0.02	12.3	99.27	47	10060	205	17	166
43.47	0.010	1.9	0.01	10.4	98.93	37	10790	226	17	181
40.77	0.010	1.73	0.63	13.3	99.59	45	9500	193	16	182
42.22	0.015	1.98	0.03	10.4	99.24	57	12000	231	18	139
34.81	0.030	1.88	0.04	15.3	98.95	46	11450	264	27	94
43.22	0.015	1.82	0.04	11.6	99.00	57	11050	208	44	174
40.67	0.015	1.79	0.04	12.1	99.22	53	10900	220	28	144
41.25	0.01	1.85	0.09	11.92	99.09	49.00	10704.4	219.00	22.22	155.00
2.45	0.01	0.07	0.19	1.50	0.24	5.98	738.81	19.75	8.87	26.06

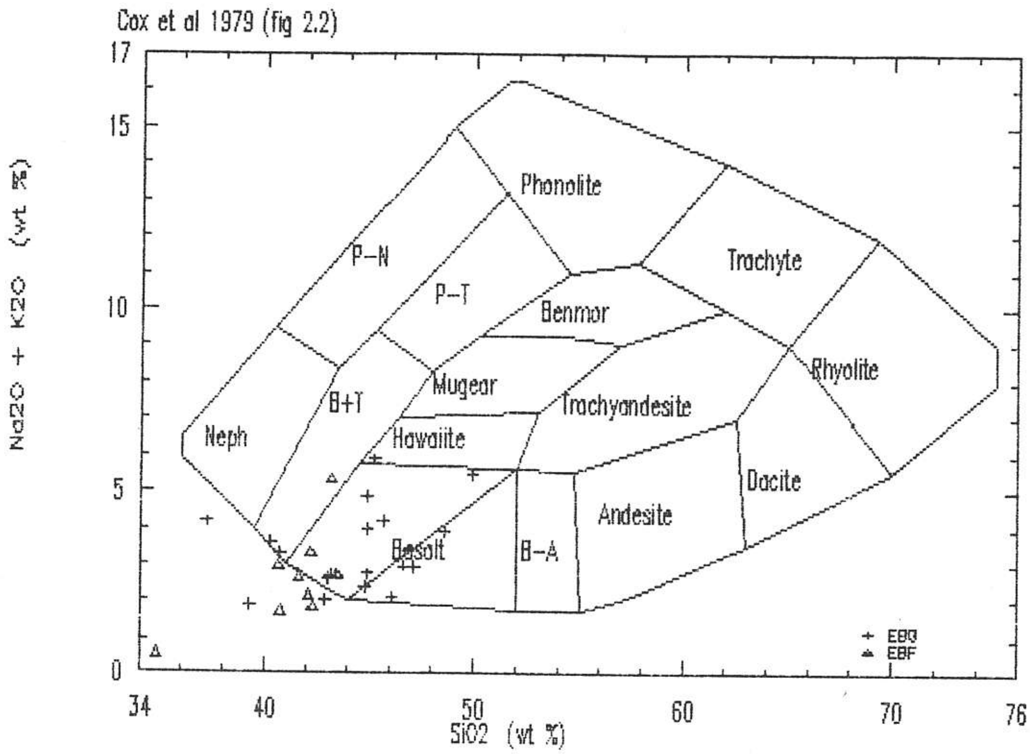


Figure 1

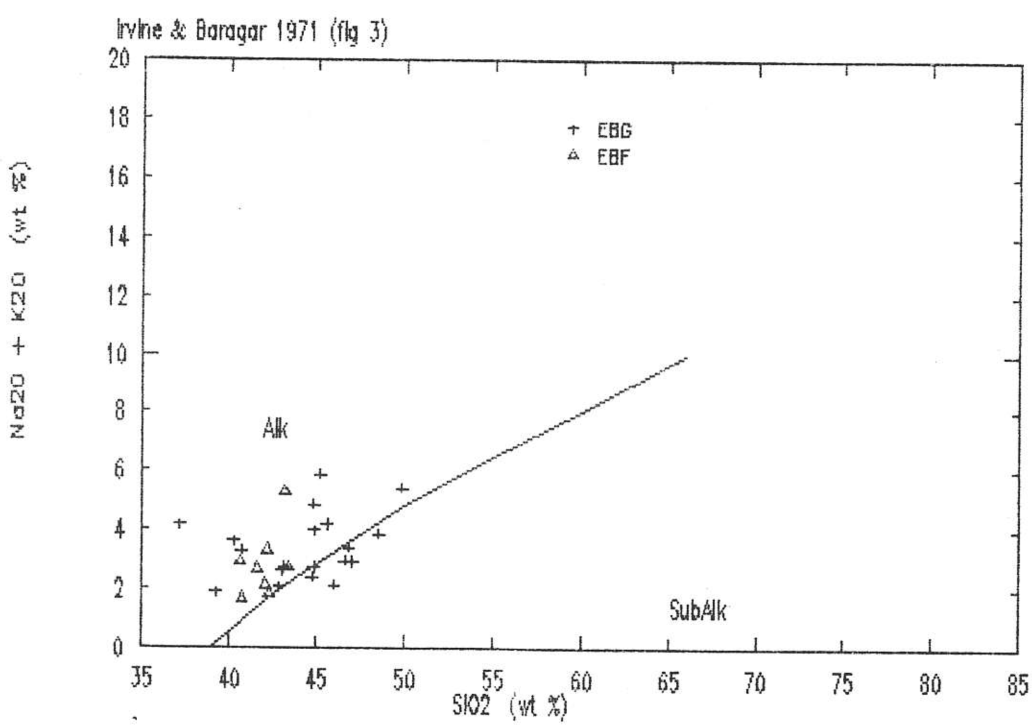


Figure 2

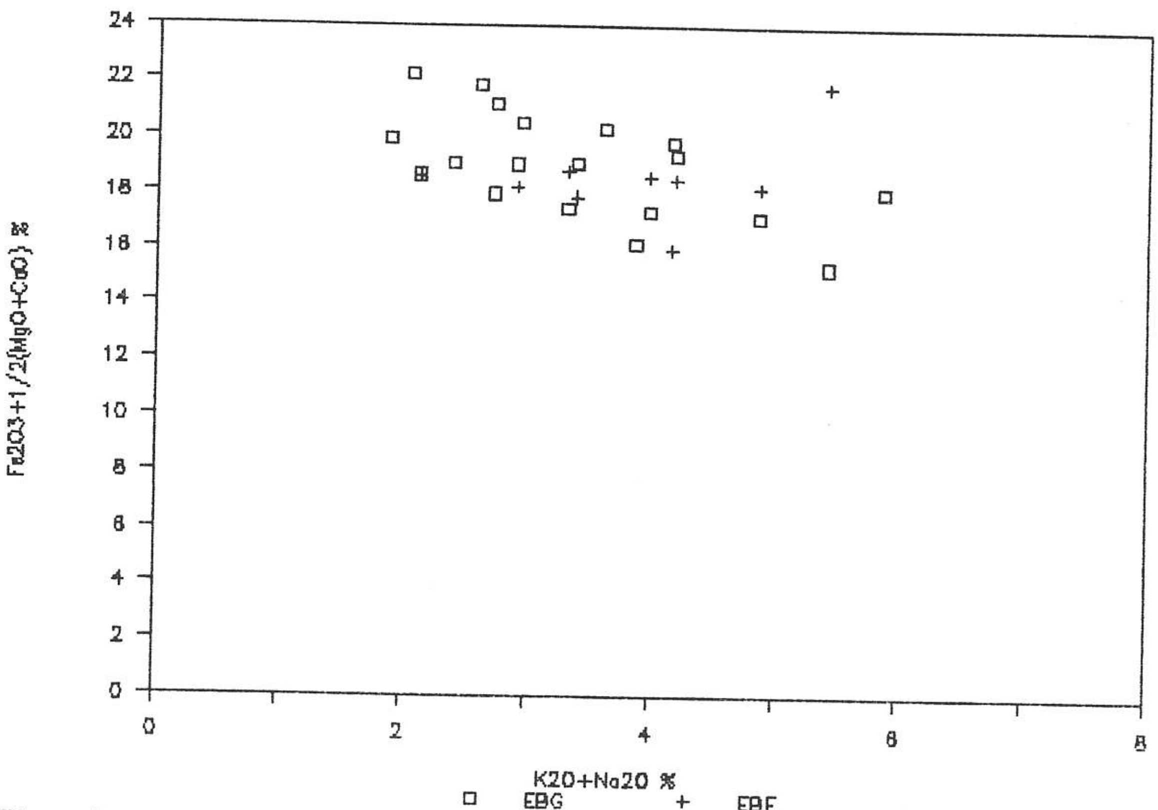

24
22
20
18
16
14
12
10
8
6
4
2
0
Fe2O3+1/2(MgO+CaO) %
0
2
4
6
8
K2O+Na2O %
EBG
EBF

Figure 3

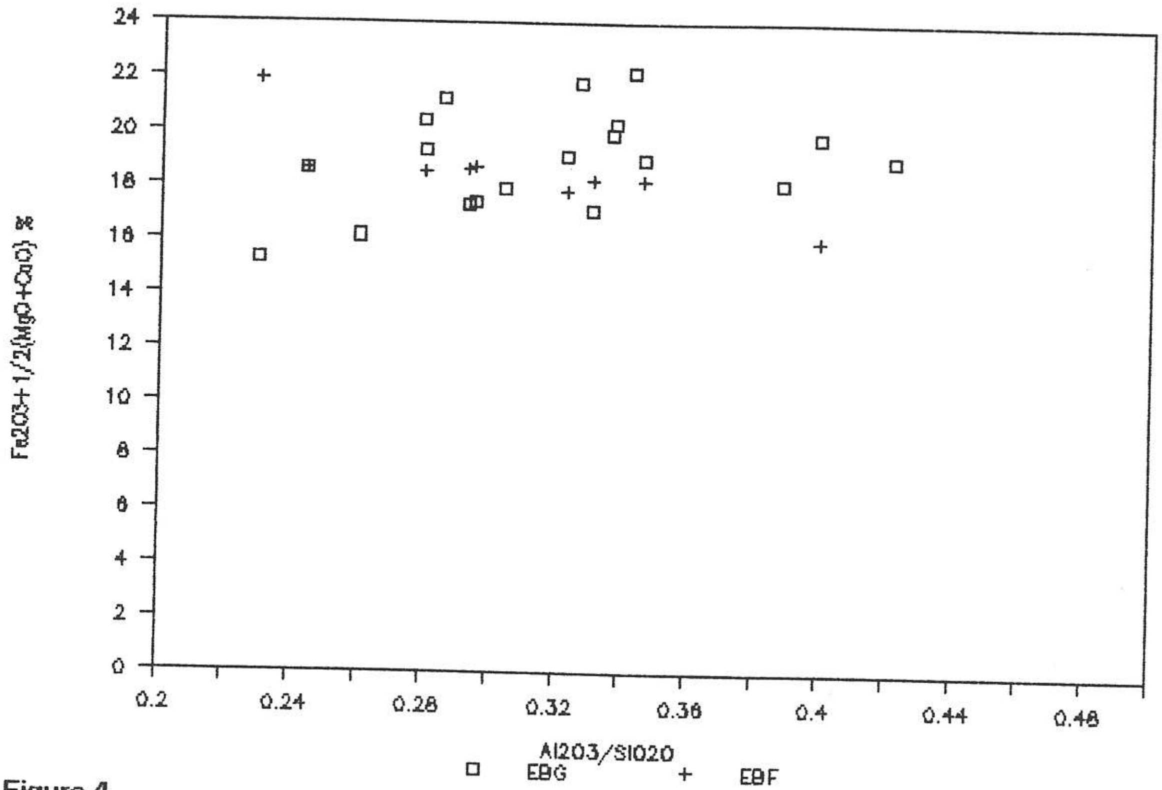

24
22
20
18
16
14
12
10
8
6
4
2
0
Fe2O3+1/2(MgO+CaO) %
0.2
0.24
0.28
0.32
0.36
0.4
0.44
0.48
Al2O3/SiO2O
EBG
EBF

Figure 4

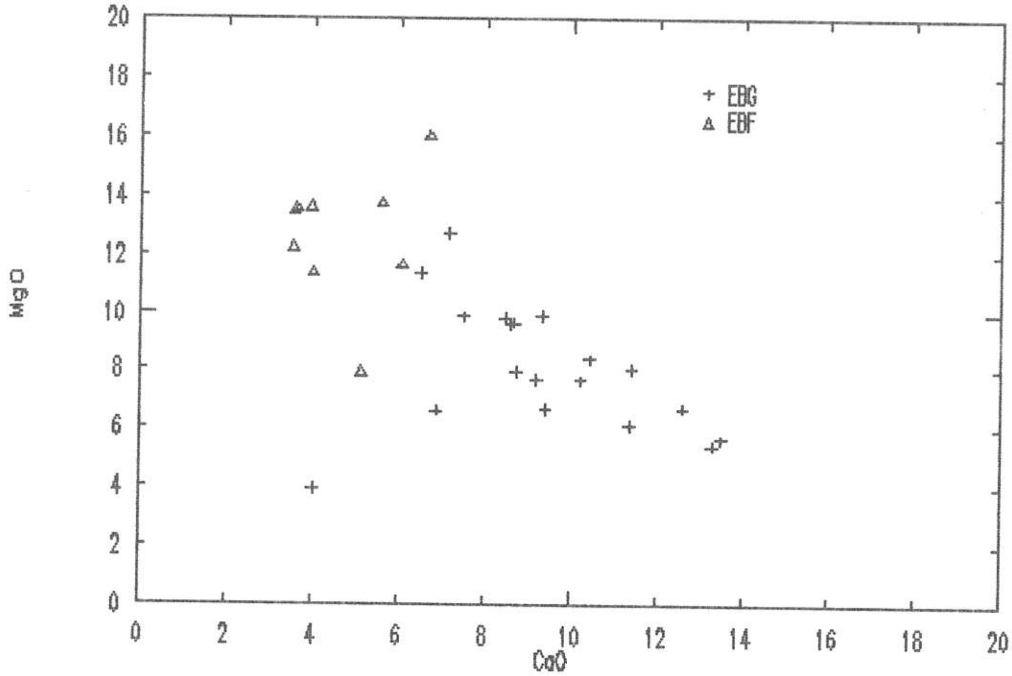


Figure 5

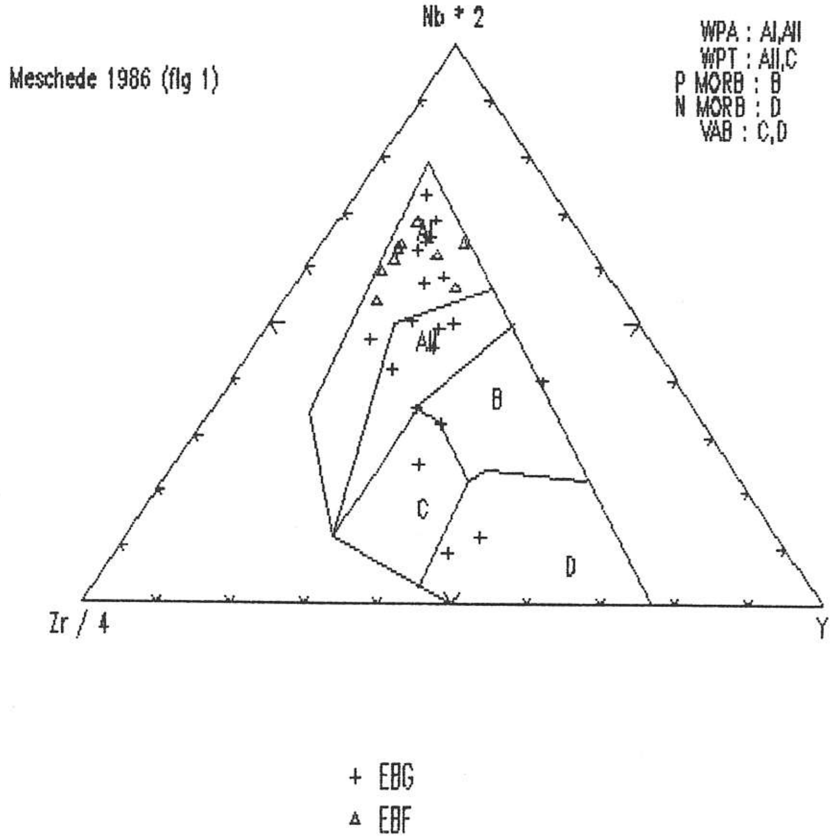

Meschede 1986 (fig 1)
Nb * 2
WPA : AI,AII
WPT : AII,C
P MORB : B
N MORB : D
VAB : C,D
AI
AII
B
C
D
Zr / 4
Y
+ EBG
▵ EBF

Figure 6

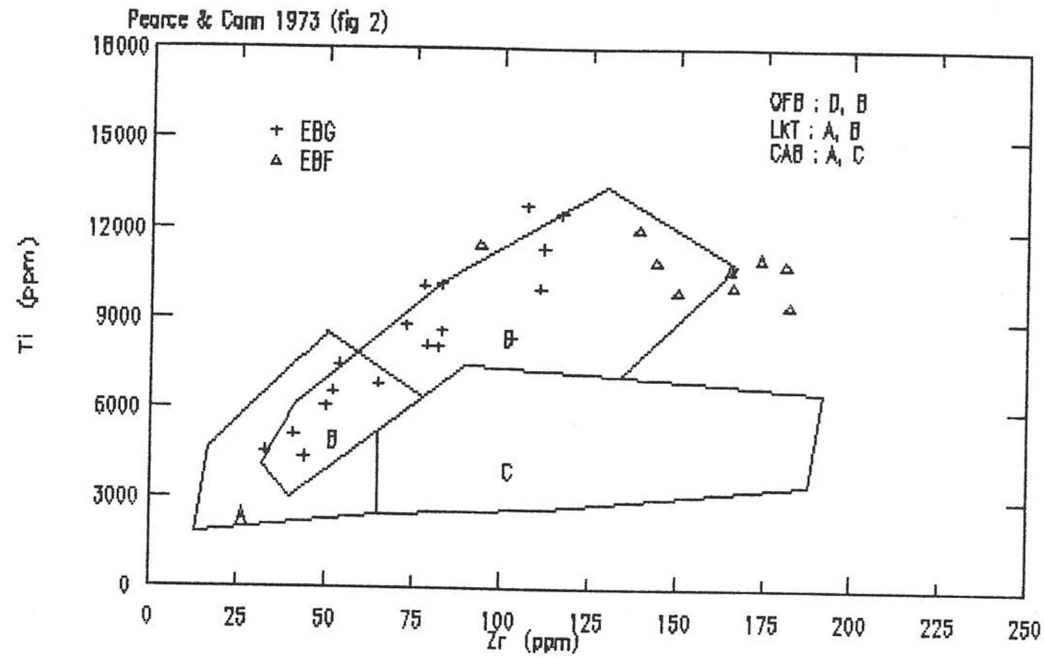


Figure 7

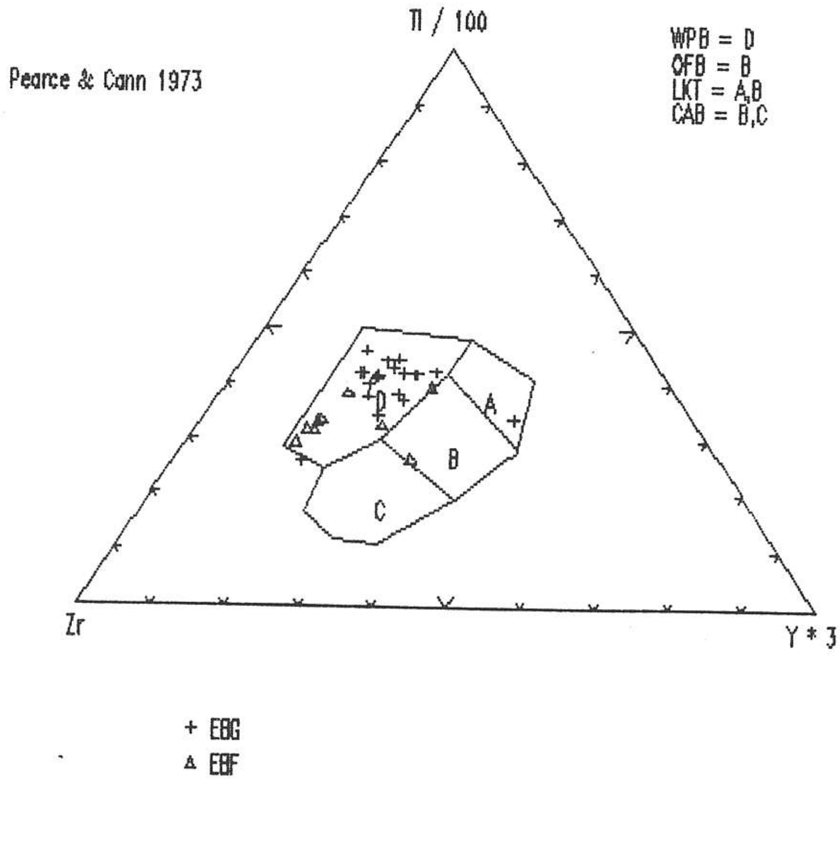


Figure 8

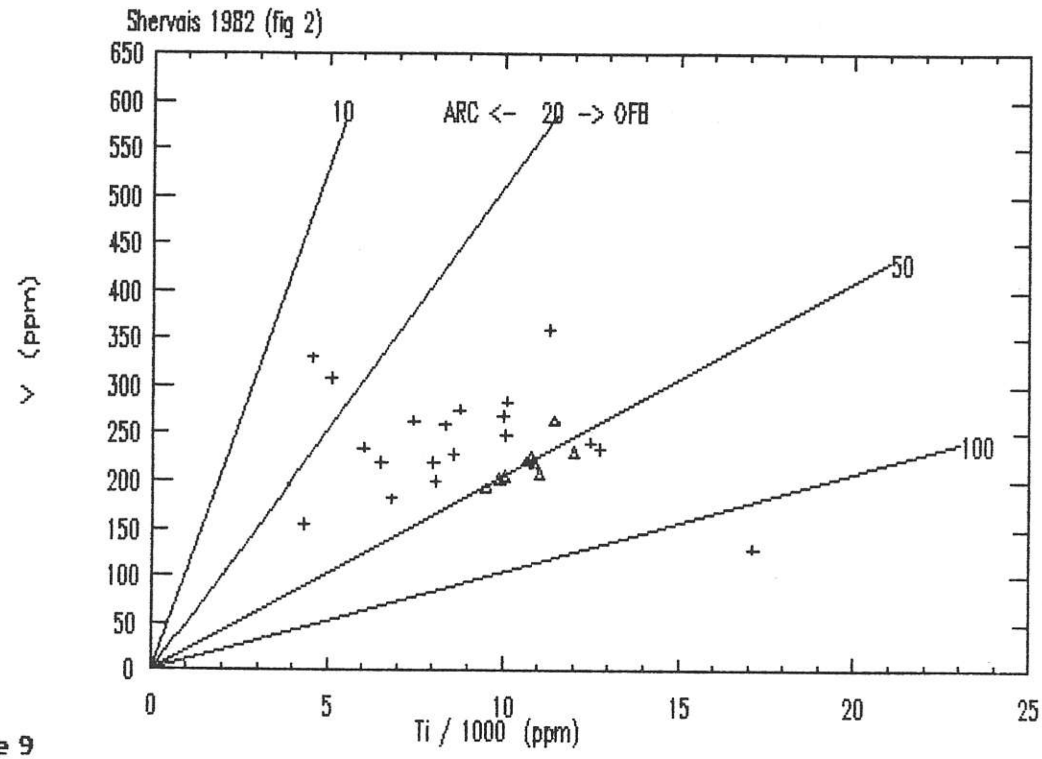


Figure 9

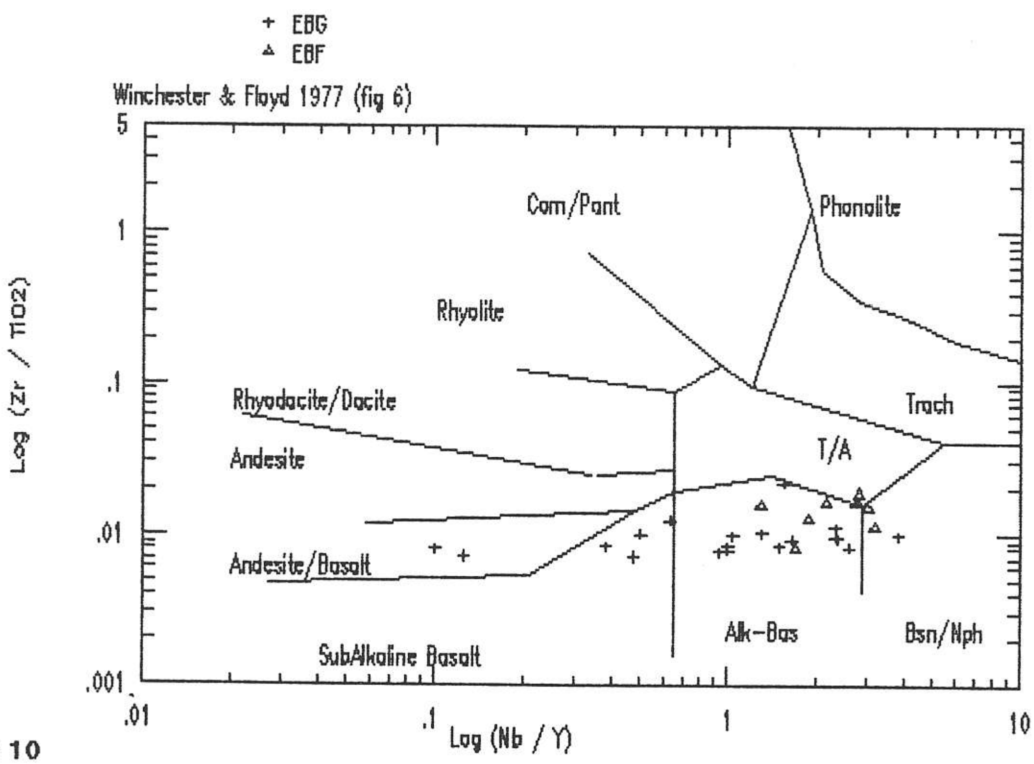
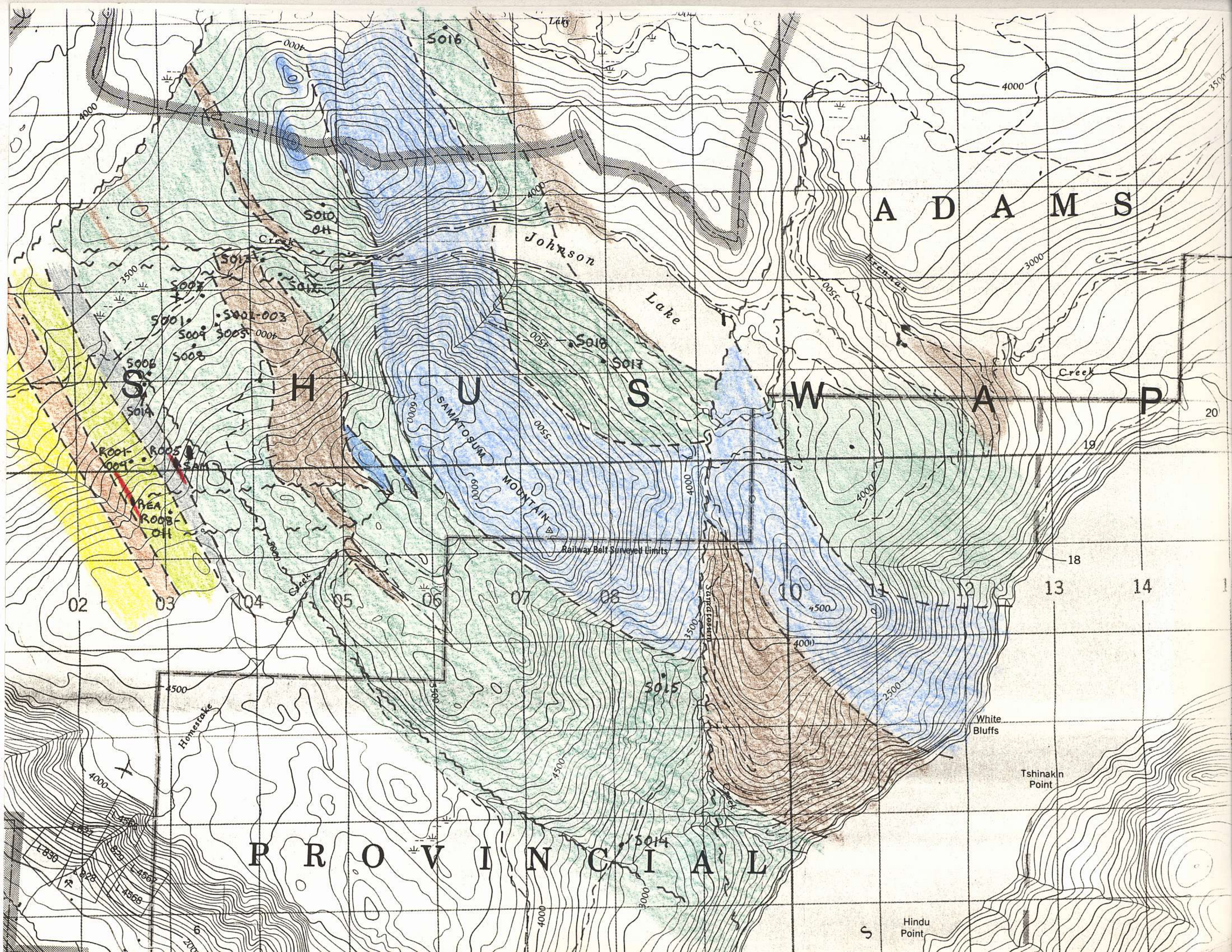


Figure 10



ADAMS
SHUSWAP
PROVINCIAL
Johnson Lake
Creek
Brennan Creek
SAMATOSUM MOUNTAIN
Railway Belt Surveyed Limits
Homestake
White Bluffs
Tshinakin Point
Hindu Point
S016
S010 OH
S013
S012
S007
S001
S002-003
S009
S005
S008
S006
S014
R001-009
R005
SAM
REA
R008-OH
S018
S017
S015
S014
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