VIRGINIA HORN ALTERATION CHEMISTRY, MICROPROBE, and PORTABLE XRF DATA

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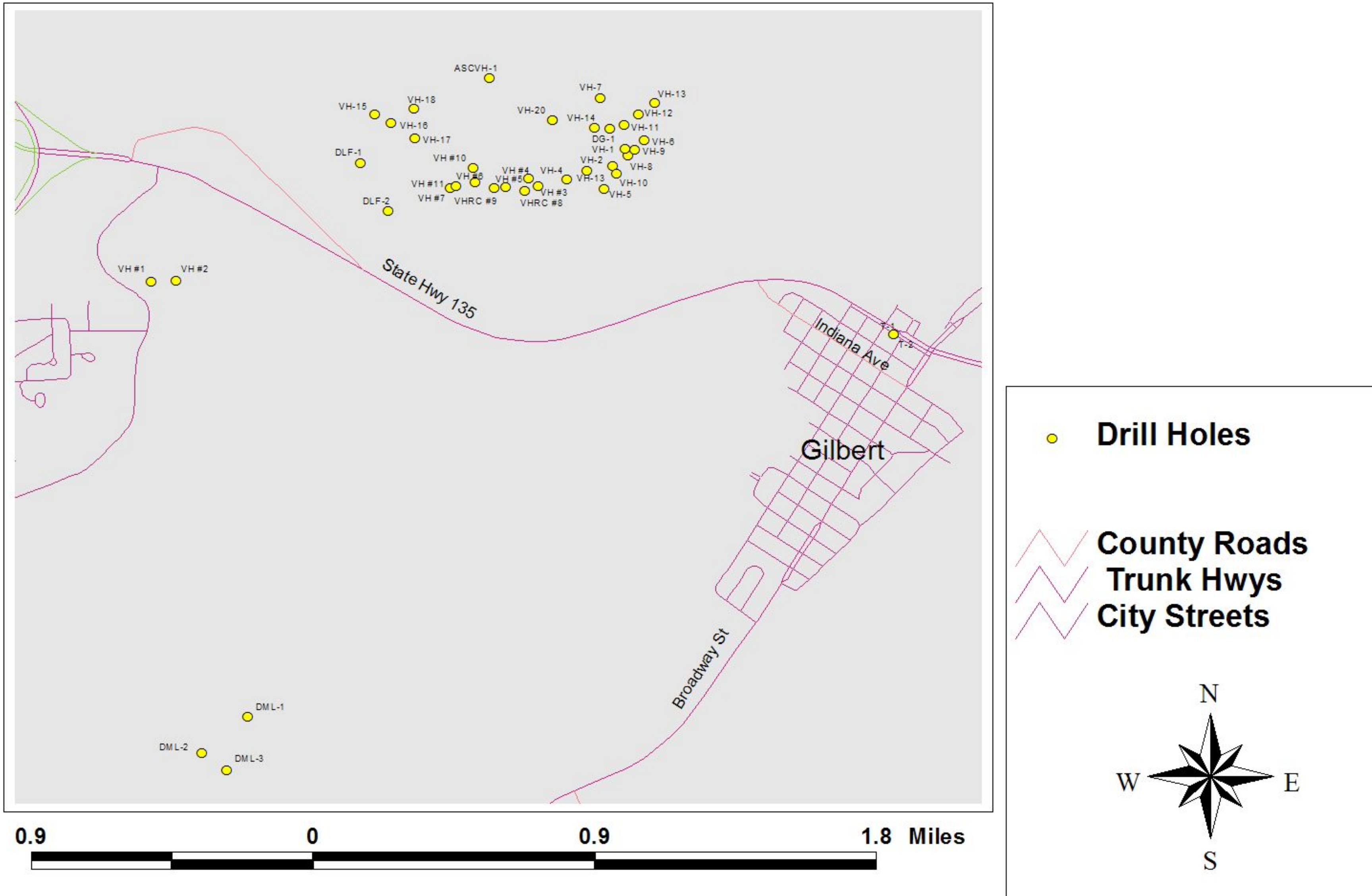
Division of Lands and Minerals
218-231-8484

Preliminary Work with Existing Data

- Assessment file company drill logs, chemistry, and other data
- Compilations of assessment file data
- Published mapping and reports
- Examine data and develop overall strategy
- Combine, clean-up existing chemistry including UTM conversions
- Create shape files for GIS
- Plot Au and As values on down-hole graphs
  - Lithologies represented by colored bar is from company logs
    - **BLUE colored bar** represents quartz-feldspar (dacite) porphyry
    - **RED colored bar** represents other igneous rocks
    - **GREEN colored bar** represents metasedimentary rocks

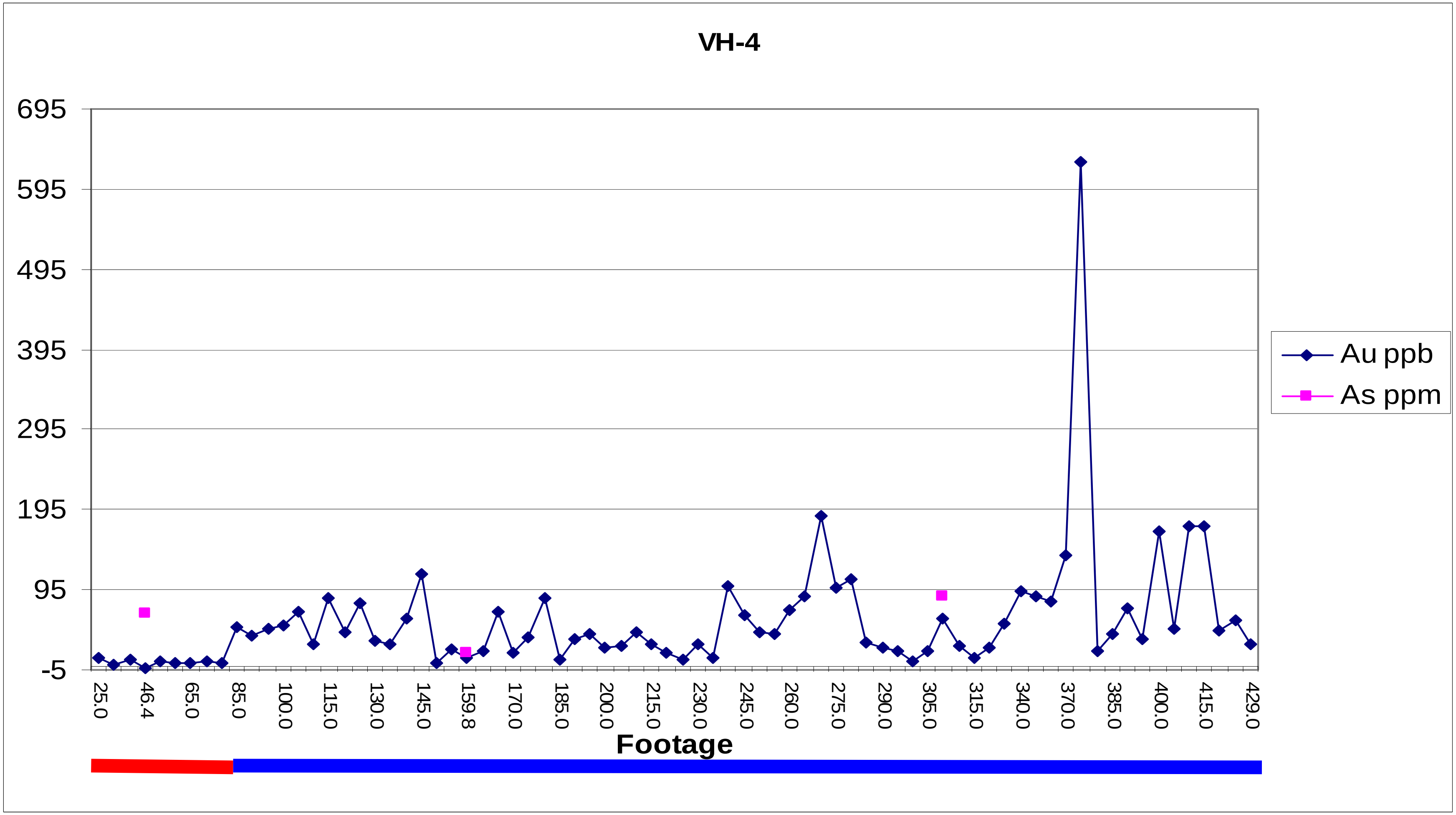
Partial Virginia Horn Drill Hole Locations



Existing Assessment File Chemistry Data

-Not Portable XRF-

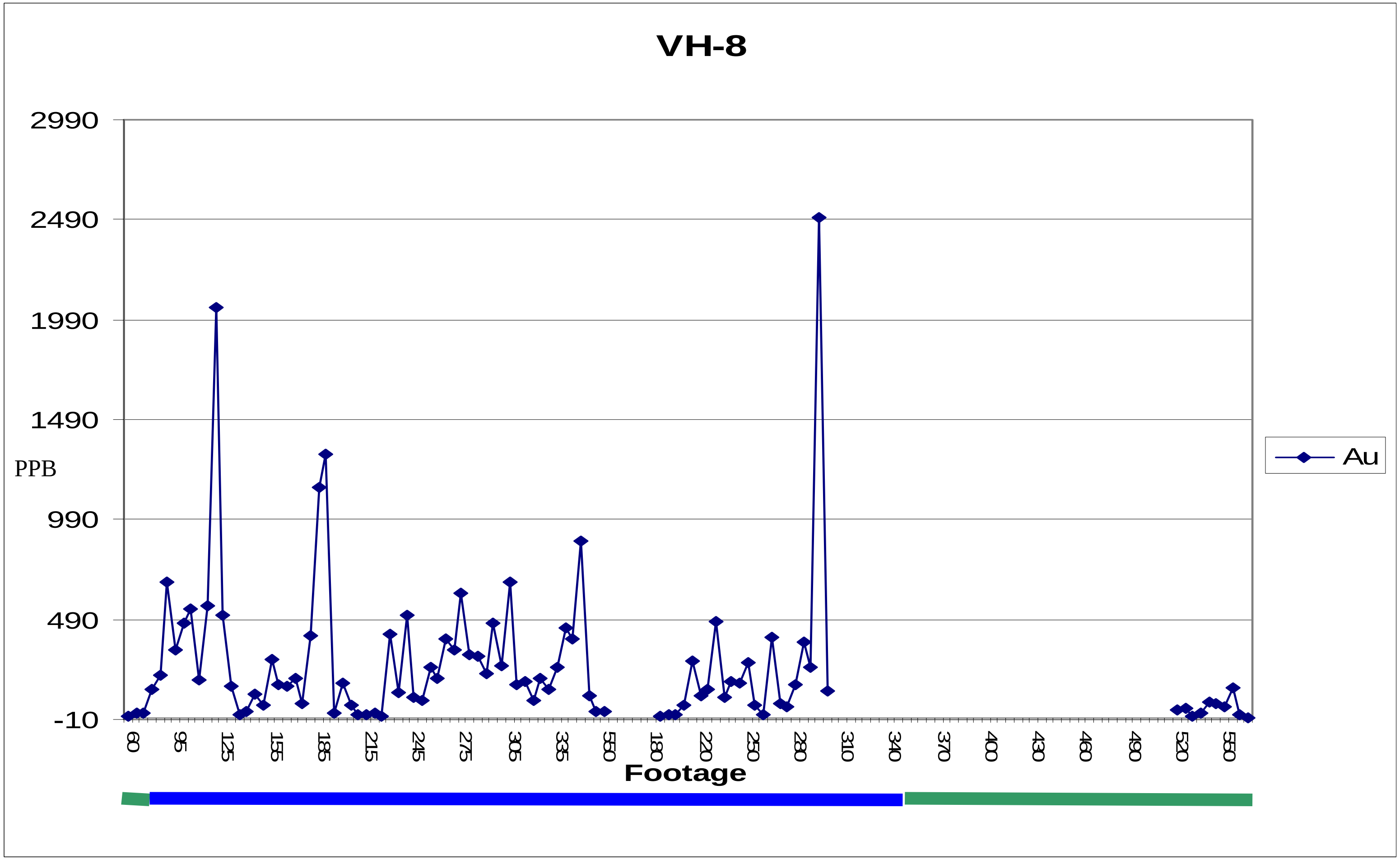
DDH VH-4 Au and As vs Footage



RED BAR represents other igneous rocks **BLUE BAR** represents Dacite Porphyry

Existing Assessment File Chemistry Data
-Not Portable XRF-

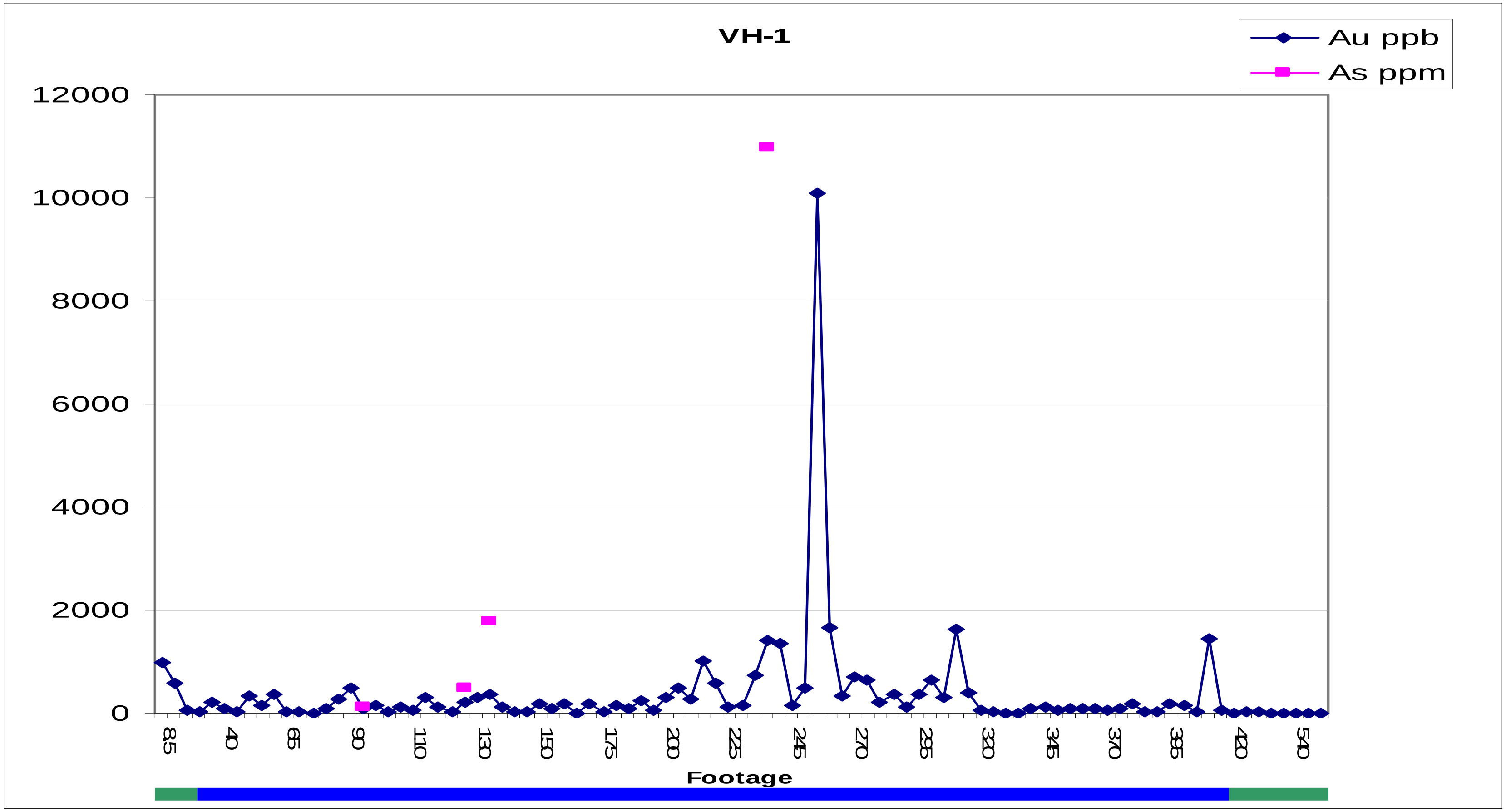
DDH VH-8 Au vs Footage



GREEN BAR represents metasediment rocks **BLUE BAR** represents Dacite Porphyry

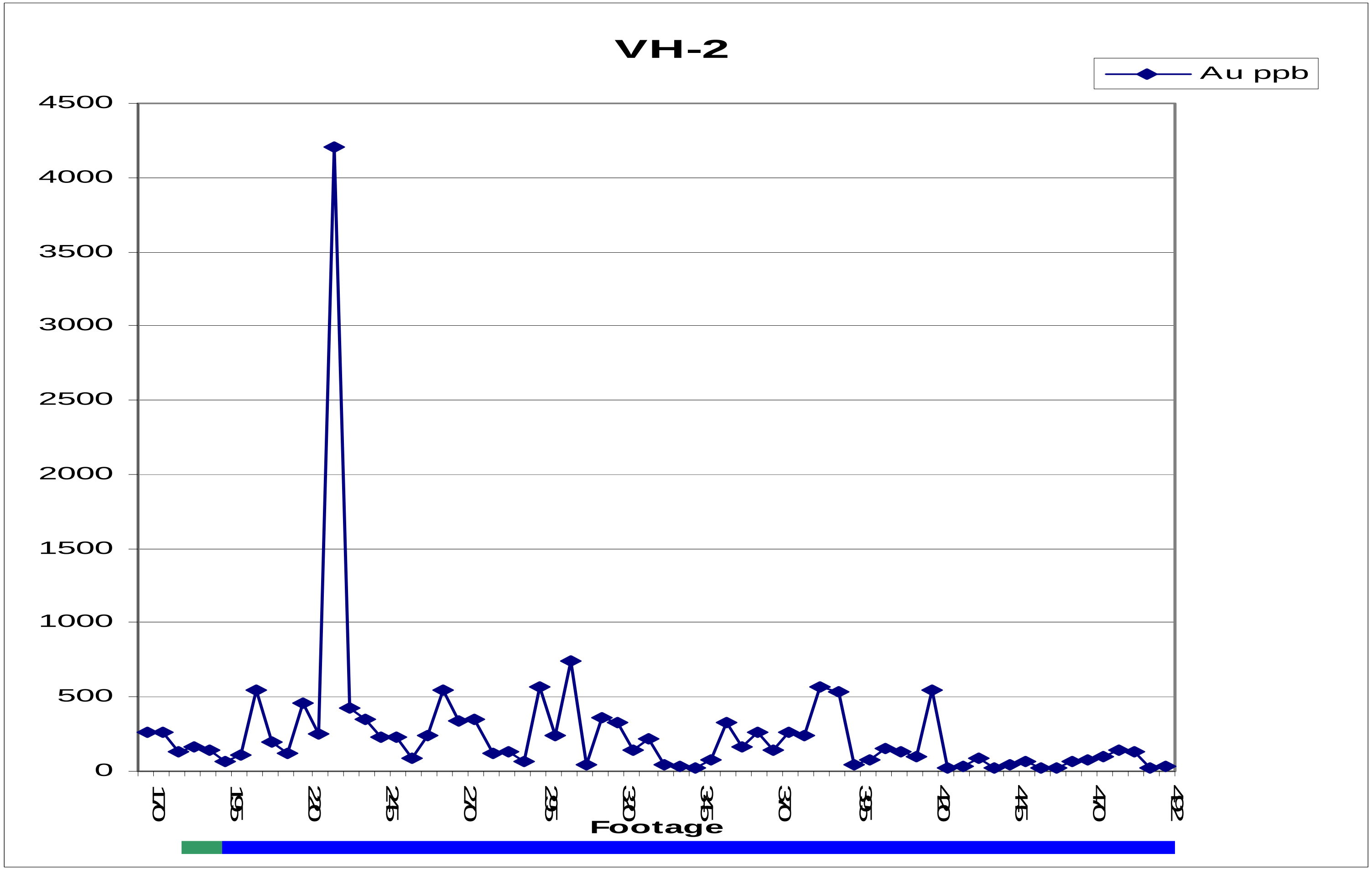
Existing Assessment File Chemistry Data
-Not Portable XRF-

DDH VH-1 Au and As vs Footage



GREEN BAR represents metasediment rocks **BLUE BAR** represents Dacite Porphyry

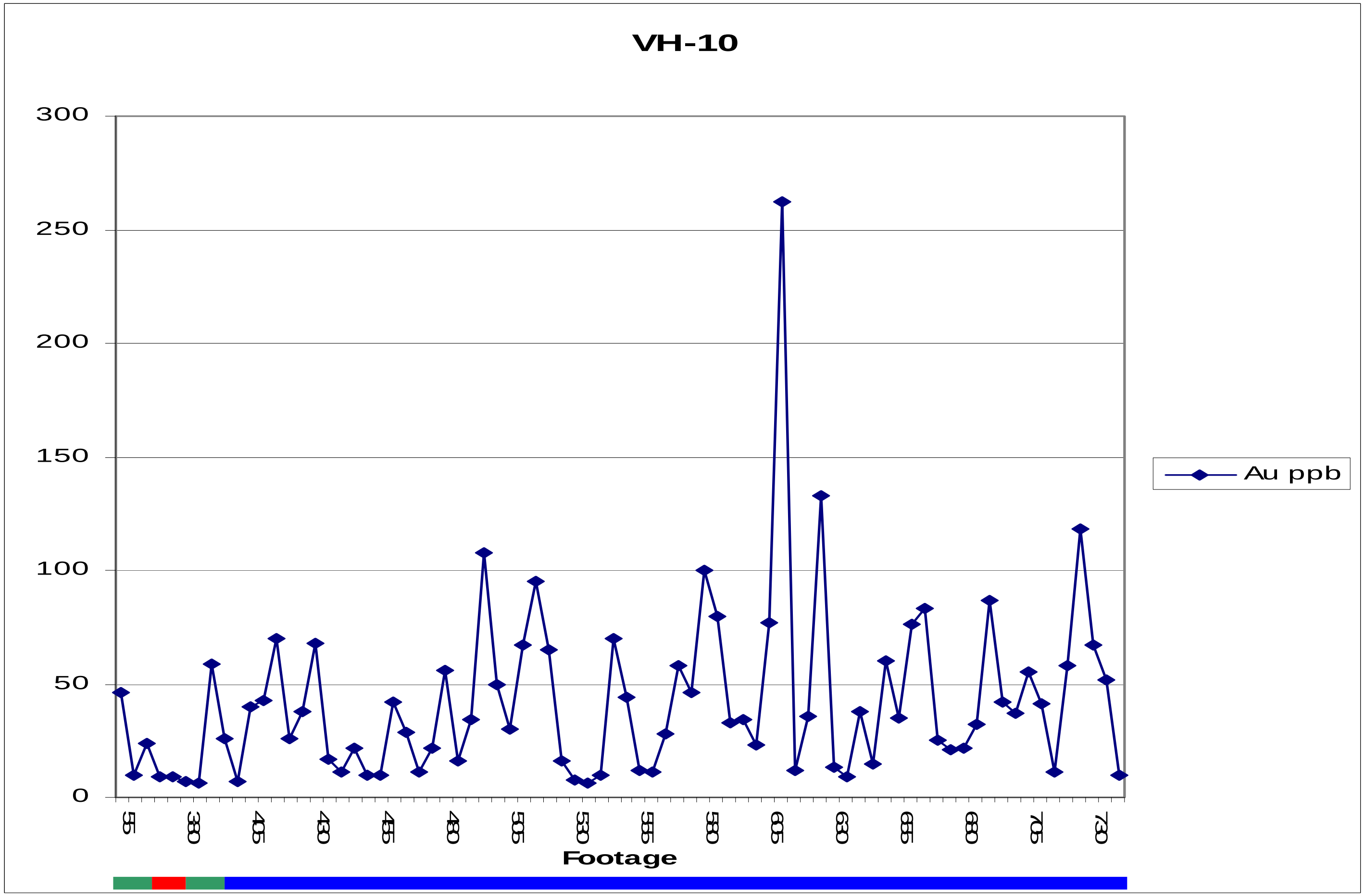
Existing Assessment File Chemistry Data
-Not Portable XRF-
DDH VH-2 Au vs Footage



GREEN BAR represents metasediment rocks **BLUE BAR** represents Dacite Porphyry

Existing Assessment File Chemistry Data
-Not Portable XRF-

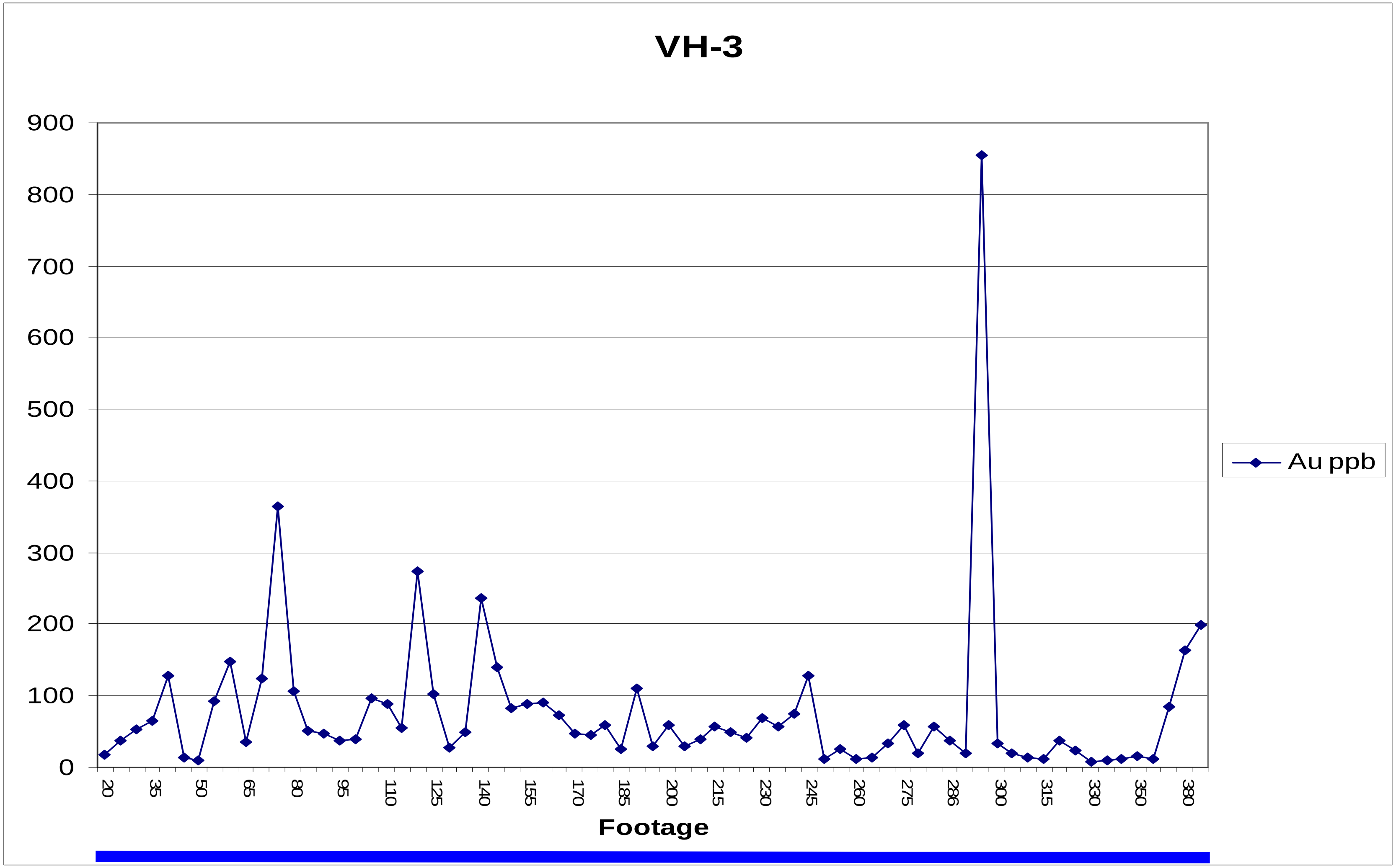
DDH VH-10 Au vs Footage



GREEN BAR represents metasediment rocks

RED BAR represents other igneous rocks **BLUE BAR** represents Dacite Porphyry

Existing Assessment File Chemistry Data
-Not Portable XRF-
DDH VH-3 Au vs Footage



BLUE BAR represents Dacite Porphyry

Virginia Horn Alteration
- New Data -

Bulk Chemistry, ALS Chemex

- **40 Samples from 6 drill holes**
- **Wide spectrum of analyses performed**
- **All had more detailed lithologic descriptions**
- **Mineralized and non-mineralized dacite porphyry samples**
- **0.2 to 0.7 feet of drill core per sample**
- **Sample weights of 64 to 261 grams submitted to the lab**
- **11 samples had microprobe work**

Virginia Horn Alteration Data

-New Data-

Bulk Chemistry, ALS Chemex

- **Spreadsheet contains sample descriptions and chemistry results**
- **Spreadsheet contains some calculated chemistry ratios**
- **Spreadsheet contains summary statistics**
- **Spreadsheet contains correlation coefficient matrix**

  (Pearson, linear relationships)
- **Spreadsheet contains grouped correlation coefficients sorted for some elements**
- **Spreadsheet contains graphs and histograms of some analyses**

Correlation Coefficients (Pearson) of 40 Virginia Horn Alteration Samples for Au-ppb and

-New Data-

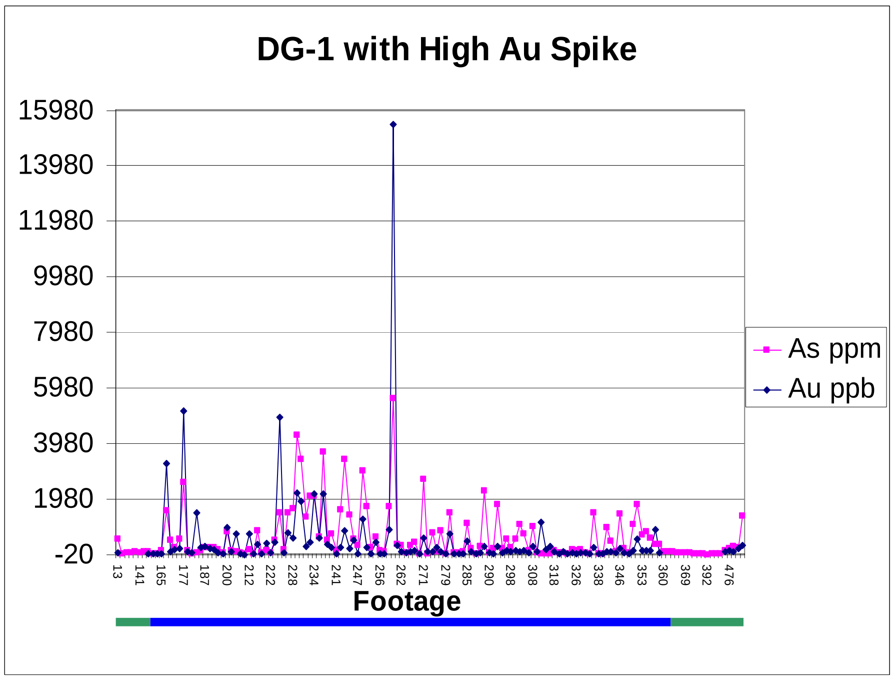
						LOI_%	-0.079
Au_ppb	**1.000**	Pb_ppm	0.182	La_ppm	0.009	Pr_ppm	-0.091
As_ppm	**0.931**	Co_ppm	0.169	Ho_ppm	0.006	Hg_ppb	-0.100
Pt_ppb	**0.831**	Ni_ppm	0.160	Ag_ppm	0.000	Ce_ppm	-0.112
S_%	**0.797**	TiO2_%	0.155	Tl_ppm	0.000	Ta_ppm	-0.122
Fe2O3_%	**0.736**	P2O5_%	0.136	Nb_ppm	-0.002	Zn_ppm	-0.130
Pd_ppb	**0.612**	Th_ppm	0.134	Er_ppm	-0.009	RecWt_kg	-0.131
Sb_ppm	**0.527**	Zr_ppm	0.130	Bi_ppm	-0.019	MgO_%	-0.150
K2O_%	**0.512**	Ga_ppm	0.076	Yb_ppm	-0.027	W_ppm	-0.154
Rb_ppm	0.492	F_ppm	0.054	C_org_%	-0.031	Total_%	-0.202
V_ppm	0.397	Tb_ppm	0.052	U_ppm	-0.032	MnO_%	-0.237
Cs_ppm	0.392	Dy_ppm	0.045	Sm_ppm	-0.041	C_inorg_%	-0.245
Fe2O3_tot%	0.354	Y_ppm	0.045	Cu_ppm	-0.052	CaO_%	-0.247
BaO_%	0.344	Eu_ppm	0.039	Mo_ppm	-0.055	C_%	-0.249
Ba_ppm	0.333	Cr_ppm	0.035	Cr2O3_%	-0.061	Cl_%	-0.304
H2O+_%	0.309	SiO2_%	0.029	Nd_ppm	-0.063	FeO/Fe2O3	-0.344
Sn_ppm	0.255	Tm_ppm	0.023	Lu_ppm	-0.064	SrO_%	-0.401
Hf_ppm	0.206	Se_ppm	0.018	Te_ppm	-0.067	**Sr_ppm**	**-0.515**
Al2O3_%	0.191	Gd_ppm	0.009	FeO_%	-0.074	**Na2O_%**	**-0.562**

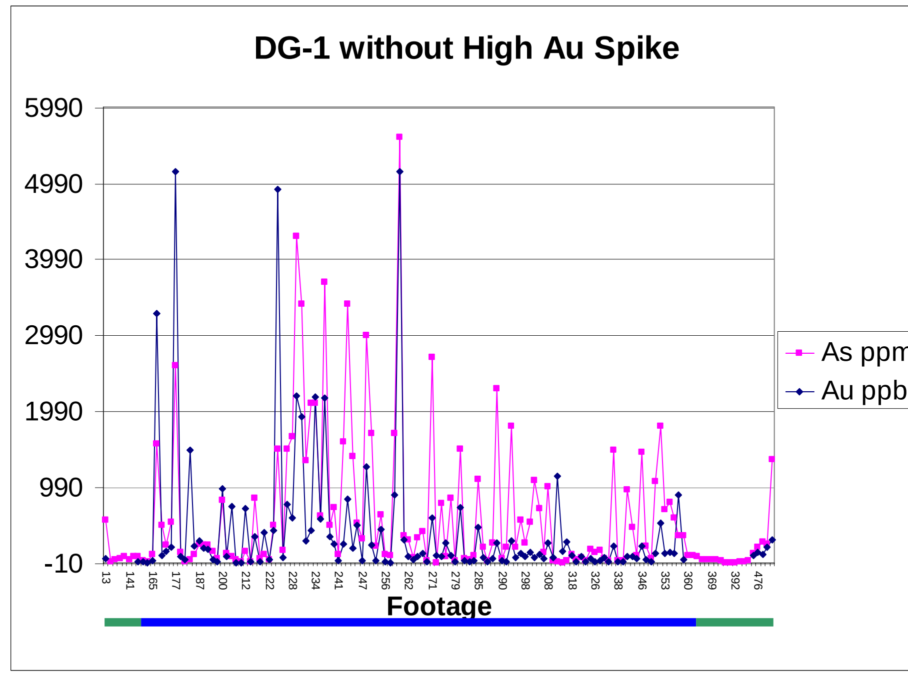
Drill Hole Chemistry Plots with High Gold Spikes Make Lower Value Trends Difficult to See

Existing Assessment File Chemistry Data
-Not Portable XRF-

DDH DG-1 Au and As vs Footage

Comparison of DDH DG-1 Plots with and without Highest Gold Spike

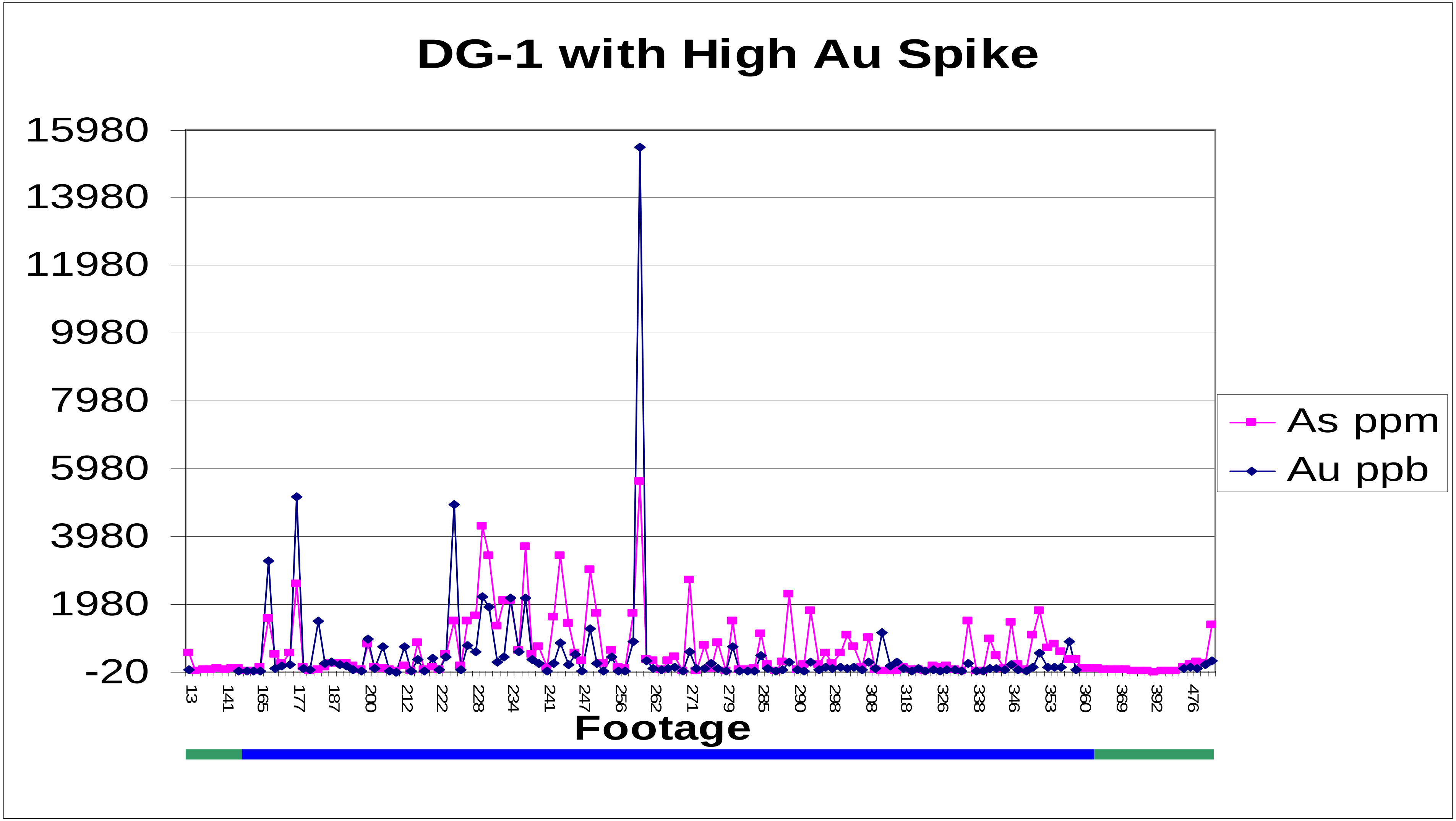




GREEN BAR represents metasediment rocks **BLUE BAR** represents Dacite Porphyry

Existing Assessment File Chemistry Data
-Not Portable XRF-

DDH DG-1 Au and As vs Footage



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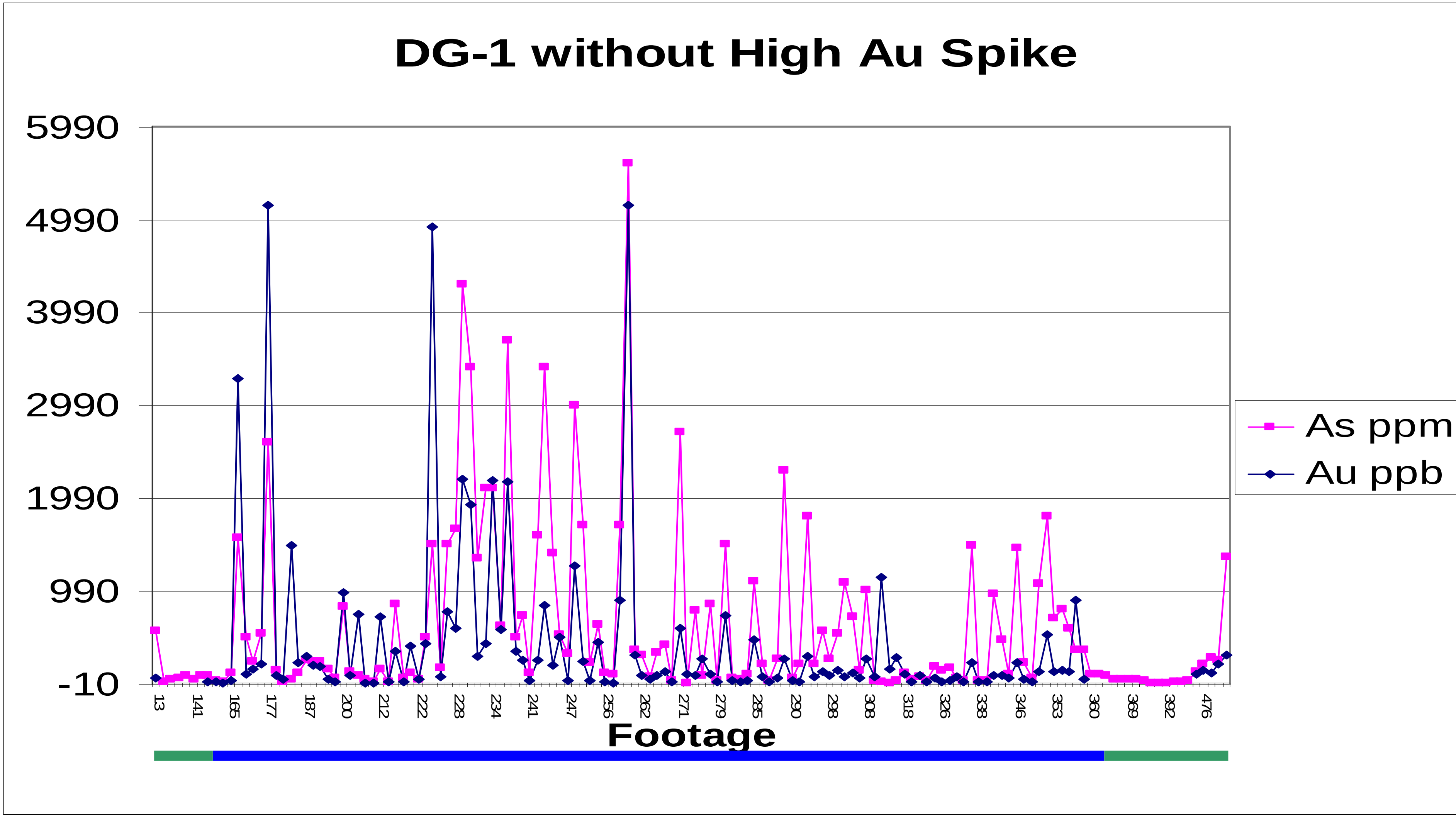
-Not Portable XRF-

DDH DG-1 Au and As vs Footage



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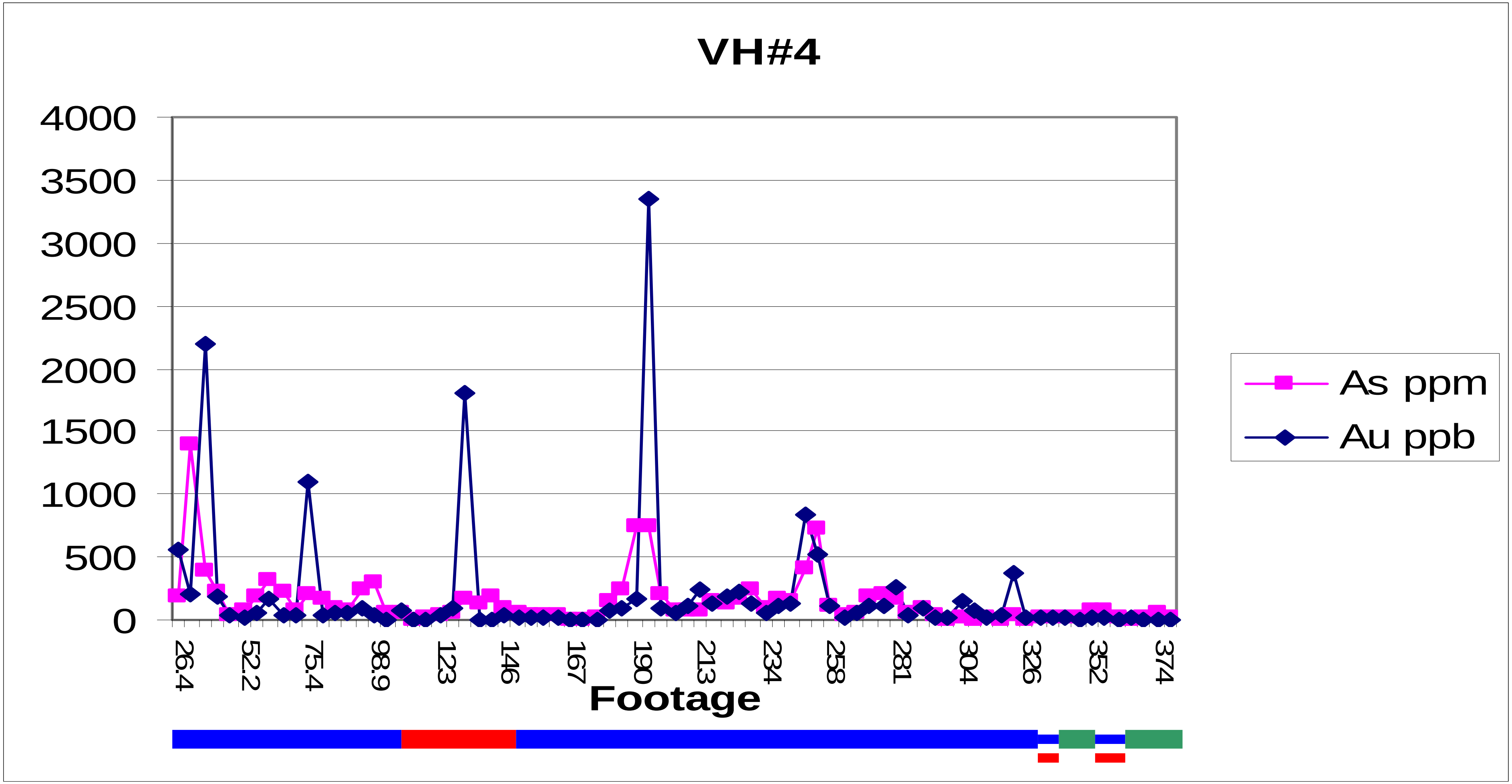
Existing Assessment File Chemistry Data
-Not Portable XRF-
DDH VH#4 Au and As vs Footage



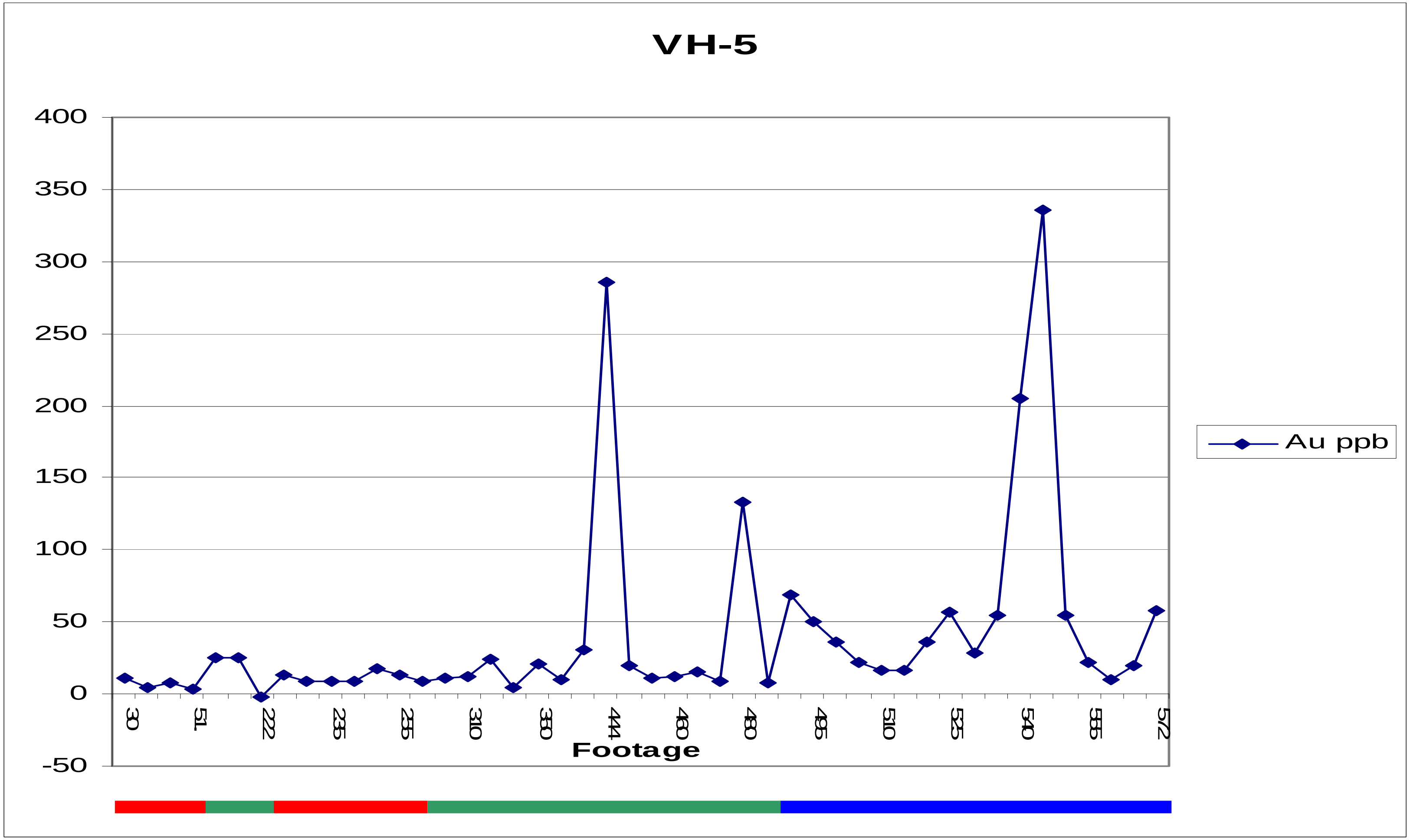
GREEN BAR represents metasediment rocks

RED BAR represents other igneous rocks

BLUE BAR represents Dacite Porphyry

- Note mixed intervals -

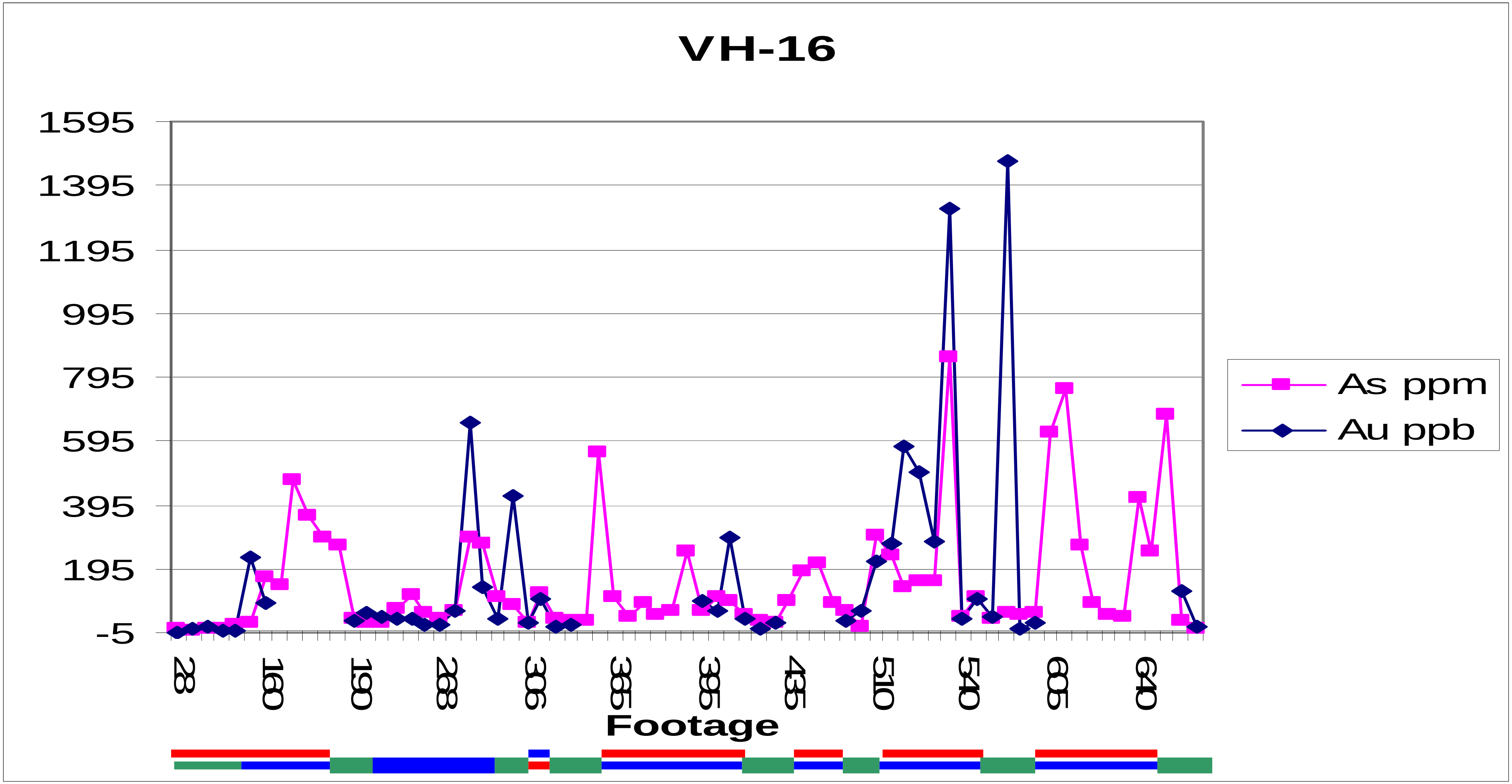
Existing Assessment File Chemistry Data
-Not Portable XRF-
DDH VH-5 Au and As vs Footage



GREEN BAR represents metasediment rocks

RED BAR represents other igneous rocks **BLUE BAR** represents Dacite Porphyry

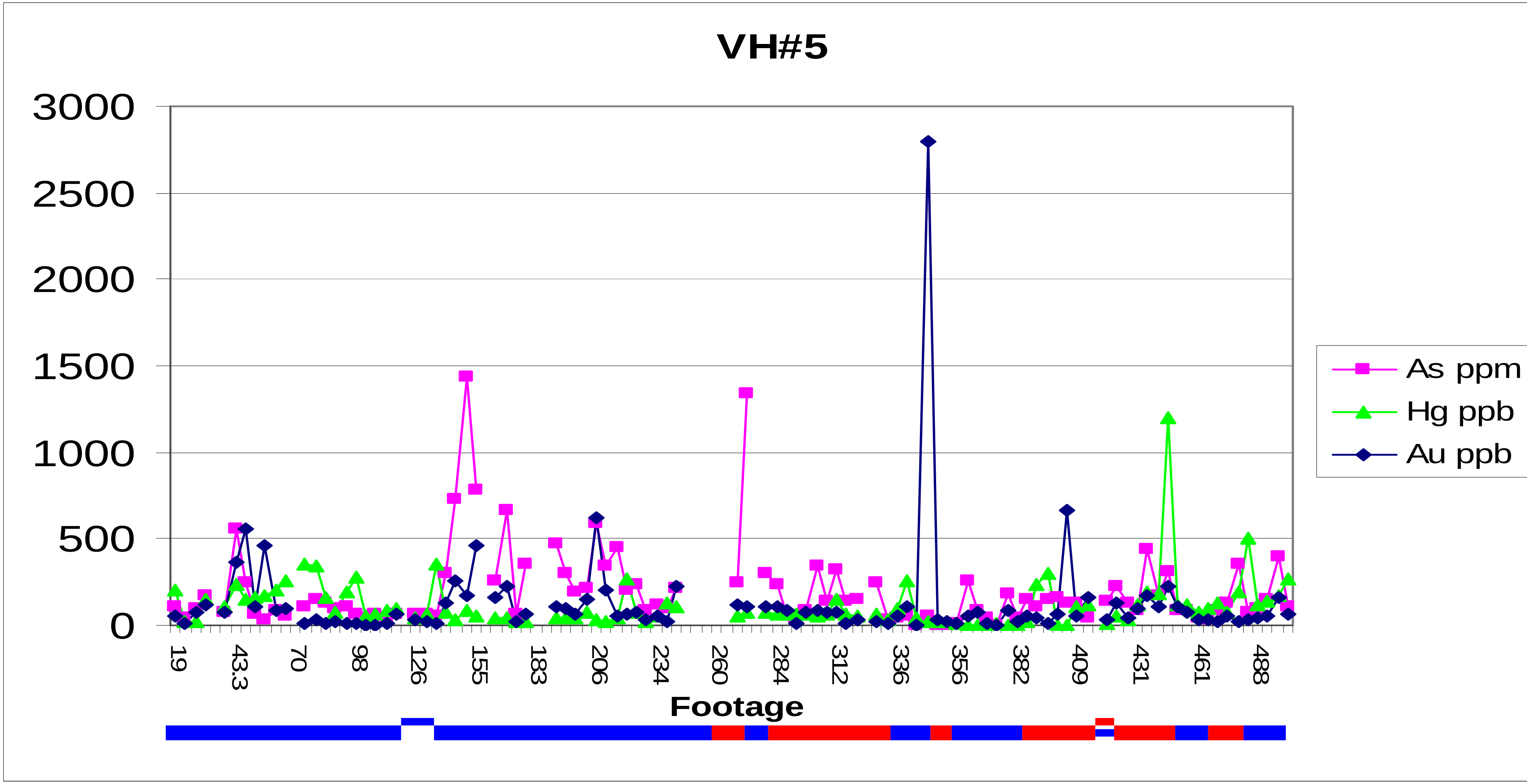
Existing Assessment File Chemistry Data
-Not Portable XRF-
DDH VH-16 Au and As vs Footage



GREEN BAR represents metasediment rocks **RED BAR** represents other igneous rocks
BLUE BAR represents Dacite Porphyry - Note mixed intervals -

Existing Assessment File Chemistry Data
-Not Portable XRF-

DDH VH#5 Au, As, and Hg vs Footage



RED BAR represents other igneous rocks **BLUE BAR** represents Dacite Porphyry

- Note mixed intervals -

Correlation Coefficients (Pearson) of 40 Virginia Horn Alteration Samples for As-ppm and

-New Data-

						Pr_ppm	-0.075
As_ppm	**1.000**	Al2O3_%	0.171	Ho_ppm	0.004	RecWt_kg	-0.091
Au_ppb	**0.931**	Sn_ppm	0.170	Bi_ppm	0.002	Ce_ppm	-0.102
Pt_ppb	**0.850**	Co_ppm	0.166	Ag_ppm	0.000	LOI_%	-0.108
S_%	**0.789**	Te_ppm	0.142	Tl_ppm	0.000	Zn_ppm	-0.111
Fe2O3_%	**0.709**	Th_ppm	0.142	Gd_ppm	-0.011	Hg_ppb	-0.128
Sb_ppm	**0.537**	TiO2_%	0.139	W_ppm	-0.013	Ta_ppm	-0.153
Pd_ppb	**0.537**	Ga_ppm	0.114	Tm_ppm	-0.022	FeO_%	-0.164
K2O_%	**0.516**	Zr_ppm	0.112	C_org_%	-0.032	MgO_%	-0.170
Rb_ppm	**0.508**	P2O5_%	0.106	Nb_ppm	-0.033	CaO_%	-0.244
V_ppm	0.425	F_ppm	0.089	Sm_ppm	-0.036	C_inorg_%	-0.253
Cs_ppm	0.416	Se_ppm	0.062	Nd_ppm	-0.039	MnO_%	-0.255
BaO_%	0.388	Eu_ppm	0.052	Yb_ppm	-0.044	C_%	-0.257
Ba_ppm	0.380	SiO2_%	0.041	La_ppm	-0.051	Cl_%	-0.323
Fe2O3_tot%	0.281	Cr_ppm	0.038	Cu_ppm	-0.056	Tot Al_%	-0.339
Pb_ppm	0.249	Tb_ppm	0.036	Lu_ppm	-0.056	SrO_%	-0.392
H2O+_%	0.244	Dy_ppm	0.024	Er_ppm	-0.062	FeO/Fe2O3	-0.416
Hf_ppm	0.198	Y_ppm	0.015	Mo_ppm	-0.064	**Sr_ppm**	**-0.509**
Ni_ppm	0.177	U_ppm	0.007	Cr2O3_%	-0.067	**Na2O_%**	**-0.550**

-New Data-

Correlation Coefficients (Pearson) of 40 Virginia Horn Alteration Samples for K2O and

						Se_ppm	0.032
K2O_%	1.000	Sb_ppm	0.438	RecWt_kg	0.139	Tot Al_%	0.007
Rb_ppm	**0.983**	Th_ppm	0.432	Bi_ppm	0.138	Ag_ppm	0.000
Cs_ppm	**0.911**	La_ppm	0.428	Tb_ppm	0.137	Tl_ppm	0.000
Ba_ppm	**0.833**	Pd_ppb	0.382	Gd_ppm	0.128	Cr_ppm	-0.060
BaO_%	**0.813**	Pt_ppb	0.342	Yb_ppm	0.119	FeO_%	-0.090
Al2O3_%	**0.684**	Ce_ppm	0.318	Pb_ppm	0.106	Mo_ppm	-0.097
Ga_ppm	**0.660**	Nb_ppm	0.294	Dy_ppm	0.102	MgO_%	-0.098
S_%	**0.621**	Pr_ppm	0.269	Ho_ppm	0.100	Cl_%	-0.115
V_ppm	**0.607**	Hg_ppb	0.268	Sn_ppm	0.100	SiO2_%	-0.116
TiO2_%	**0.602**	Fe2O3_tot%	0.258	Lu_ppm	0.099	Cr2O3_%	-0.116
Fe2O3_%	**0.579**	Eu_ppm	0.246	Tm_ppm	0.080	CaO_%	-0.178
Hf_ppm	**0.579**	Nd_ppm	0.231	Ta_ppm	0.078	MnO_%	-0.191
H2O+_%	**0.571**	P2O5_%	0.213	Er_ppm	0.071	C_%	-0.225
F_ppm	**0.570**	Ni_ppm	0.210	C_org_%	0.070	C_inorg_%	-0.229
As_ppm	**0.516**	W_ppm	0.198	Y_ppm	0.066	SrO_%	-0.484
Au_ppb	**0.512**	Co_ppm	0.177	Cu_ppm	0.055	FeO/Fe2O3	**-0.569**
U_ppm	**0.497**	Sm_ppm	0.167	Zn_ppm	0.050	Sr_ppm	**-0.630**
Zr_ppm	0.467	Te_ppm	0.150	LOI_%	0.037	Na2O_%	**-0.827**

Correlation Coefficients (Pearson) of 40 Virginia Horn Alteration Samples for SiO2_% and

-New Data-

						Lu_ppm	**-0.716**
SiO2_%	**1.000**	Au_ppb	0.029	Ga_ppm	-0.143	**Sm_ppm**	**-0.733**
Na2O_%	0.383	Zn_ppm	0.025	Hf_ppm	-0.179	**FeO_%**	**-0.747**
SrO_%	0.342	Al2O3_%	0.022	Zr_ppm	-0.223	**Yb_ppm**	**-0.752**
Sr_ppm	0.321	Cu_ppm	0.004	W_ppm	-0.232	**Fe2O3_tot%**	**-0.753**
RecWt_kg	0.161	Ag_ppm	0.000	U_ppm	-0.237	**Gd_ppm**	**-0.774**
FeO/Fe2O3	0.148	Tl_ppm	0.000	S_%	-0.312	**C_%**	**-0.786**
Cl_%	0.138	Th_ppm	-0.009	Te_ppm	-0.318	**C_inorg_%**	**-0.790**
BaO_%	0.113	Cs_ppm	-0.032	F_ppm	-0.337	**Tm_ppm**	**-0.803**
Ta_ppm	0.111	Pb_ppm	-0.046	La_ppm	-0.353	**Er_ppm**	**-0.818**
C_org_%	0.109	Nb_ppm	-0.078	Ce_ppm	-0.379	**Mo_ppm**	**-0.827**
P2O5_%	0.108	TiO2_%	-0.103	Co_ppm	-0.470	**MnO_%**	**-0.829**
Ba_ppm	0.106	Se_ppm	-0.110	Pr_ppm	-0.484	**CaO_%**	**-0.831**
Pt_ppb	0.094	Sb_ppm	-0.111	**Fe2O3_%**	**-0.508**	**Tb_ppm**	**-0.846**
Sn_ppm	0.085	Tot Al_%	-0.115	**Ni_ppm**	**-0.541**	**Dy_ppm**	**-0.878**
Cr_ppm	0.077	K2O_%	-0.116	**Nd_ppm**	**-0.554**	**Y_ppm**	**-0.881**
Pd_ppb	0.071	Cr2O3_%	-0.122	**H2O+_%**	**-0.562**	**Ho_ppm**	**-0.883**
Hg_ppb	0.048	V_ppm	-0.124	**Bi_ppm**	**-0.605**	**MgO_%**	**-0.888**
As_ppm	0.041	Rb_ppm	-0.127	**Eu_ppm**	**-0.608**	**LOI_%**	**-0.918**

Correlation Coefficients (Pearson) of 40 Virginia Horn Alteration Samples for C_inorganic and

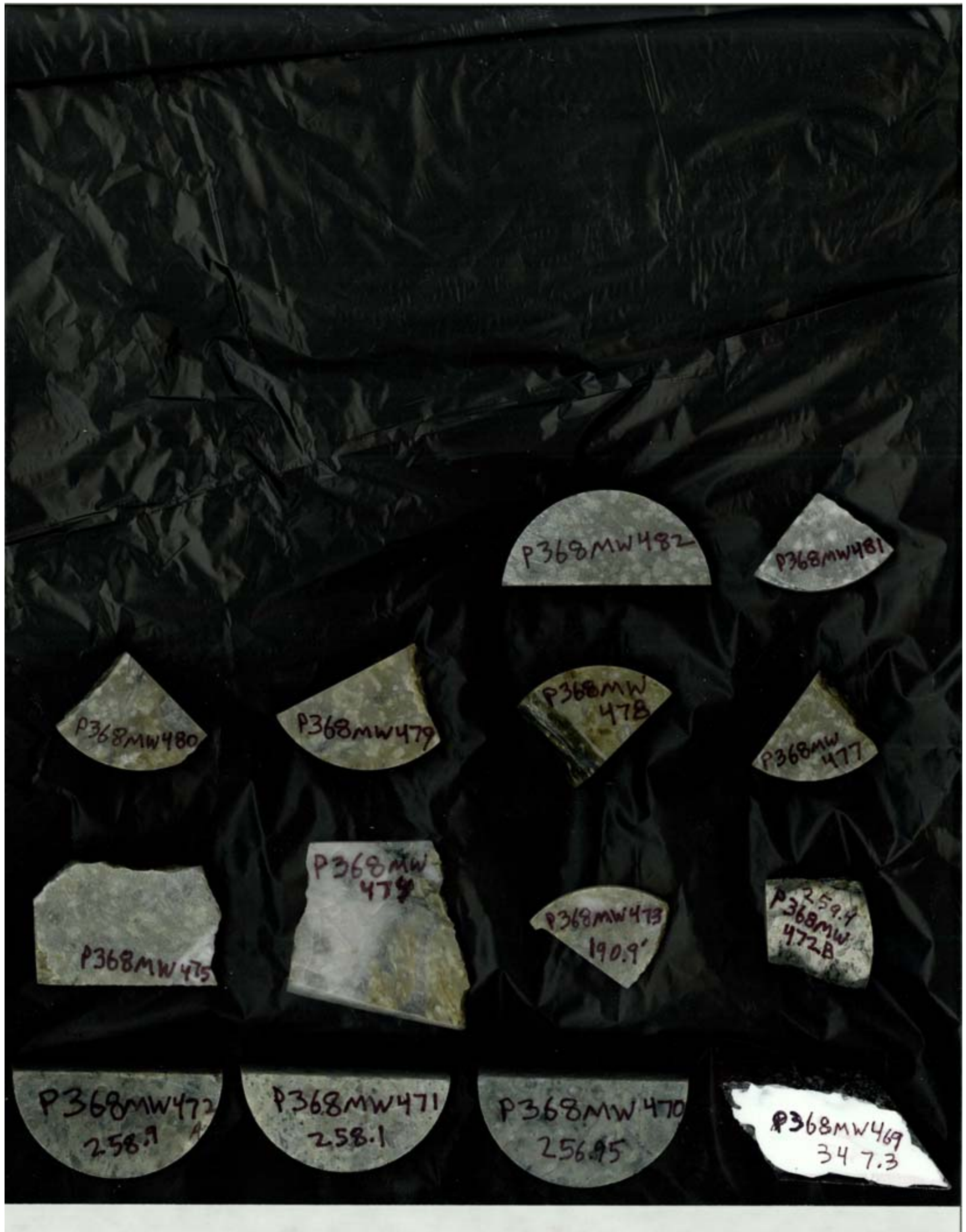
-New Data-

						Sn_ppm	-0.142
C_inorg_%	1.000	Bi_ppm	0.553	Sr_ppm	0.072	Pt_ppb	-0.179
C_%	0.997	Eu_ppm	0.486	Fe2O3_%	0.070	Nb_ppm	-0.187
MnO_%	0.944	Fe2O3_tot%	0.428	La_ppm	0.044	K2O_%	-0.229
CaO_%	0.921	Nd_ppm	0.344	Co_ppm	0.030	BaO_%	-0.236
LOI_%	0.882	FeO/Fe2O3	0.303	Cr_ppm	0.011	Rb_ppm	-0.242
Ho_ppm	0.809	Total_%	0.262	Zn_ppm	0.009	Au_ppb	-0.245
Y_ppm	0.800	Pr_ppm	0.256	SrO_%	0.003	Ba_ppm	-0.245
Dy_ppm	0.785	W_ppm	0.236	Ag_ppm	0.000	As_ppm	-0.253
Er_ppm	0.785	Cu_ppm	0.224	Tl_ppm	0.000	Zr_ppm	-0.259
MgO_%	0.763	Te_ppm	0.224	S_%	-0.012	Hf_ppm	-0.267
Tb_ppm	0.748	Cr2O3_%	0.211	F_ppm	-0.029	RecWt_kg	-0.282
Yb_ppm	0.725	Ce_ppm	0.168	Na2O_%	-0.058	TiO2_%	-0.300
Mo_ppm	0.705	H2O+_%	0.107	Ta_ppm	-0.070	Cs_ppm	-0.313
Tm_ppm	0.677	Pb_ppm	0.102	Hg_ppb	-0.087	Ga_ppm	-0.332
Gd_ppm	0.673	Se_ppm	0.097	U_ppm	-0.090	V_ppm	-0.357
Sm_ppm	0.626	Sb_ppm	0.095	C_org_%	-0.107	Th_ppm	-0.369
Lu_ppm	0.617	Ni_ppm	0.081	Pd_ppb	-0.136	Al2O3_%	-0.456
FeO_%	0.611	Cl_%	0.075	P2O5_%	-0.139	SiO2_%	-0.790

MICROPROBE MINERAL WORK

- **Establish information sought**
- **Develop sample criteria**
- **Sample Selection**
- **Prepare polished thin sections**
- **Examine under polarizing microscope to select targets of interest**
- **Actual interactive microprobe work**
  - **Note taking to complement chemistry**
- **Review results**
- **Work was done at 2 different times with different goals**


P368MW465 237.2'
P368MW461 143.2'
P368MW457 71'
P368MW449 16.5
P368MW 031
P368MW 027
P368MW466 242'
P368MW462 145.5
P368MW458 96.5
P368MW454 44'
P368MW450 25.5'
P368MW 032
P368MW028
P368MW467
P368MW463 182.3
126.4' P368MW459
P368MW455 60.1
P368MW451 27.8'
P368MW033
P368MW029
P368MW468
192.8 464
P368MW 460 126.6'
P368MW456 69'
P368MW452 40.7'
P368MW034
P368MW030


P368MW482
P368MW481
P368MW480
P368MW479
P368MW
478
P368MW
477
P368MW475
P368MW
P368MW473
190.9'
259.4
P368MW
472B
P368MW472
258.9
P368MW471
258.1
P368MW470
256.95
P368MW469
347.3

Information Sought
– First Probe Work-

Characterize sulfides, especially arsenopyrite

Characterize matrix mineralogy/chemistry

Sample criteria/methodology

Run 2 sets of analyses on samples

S, As, Fe, Cu on sulfides

Major elements, As on “silicates” /matrix

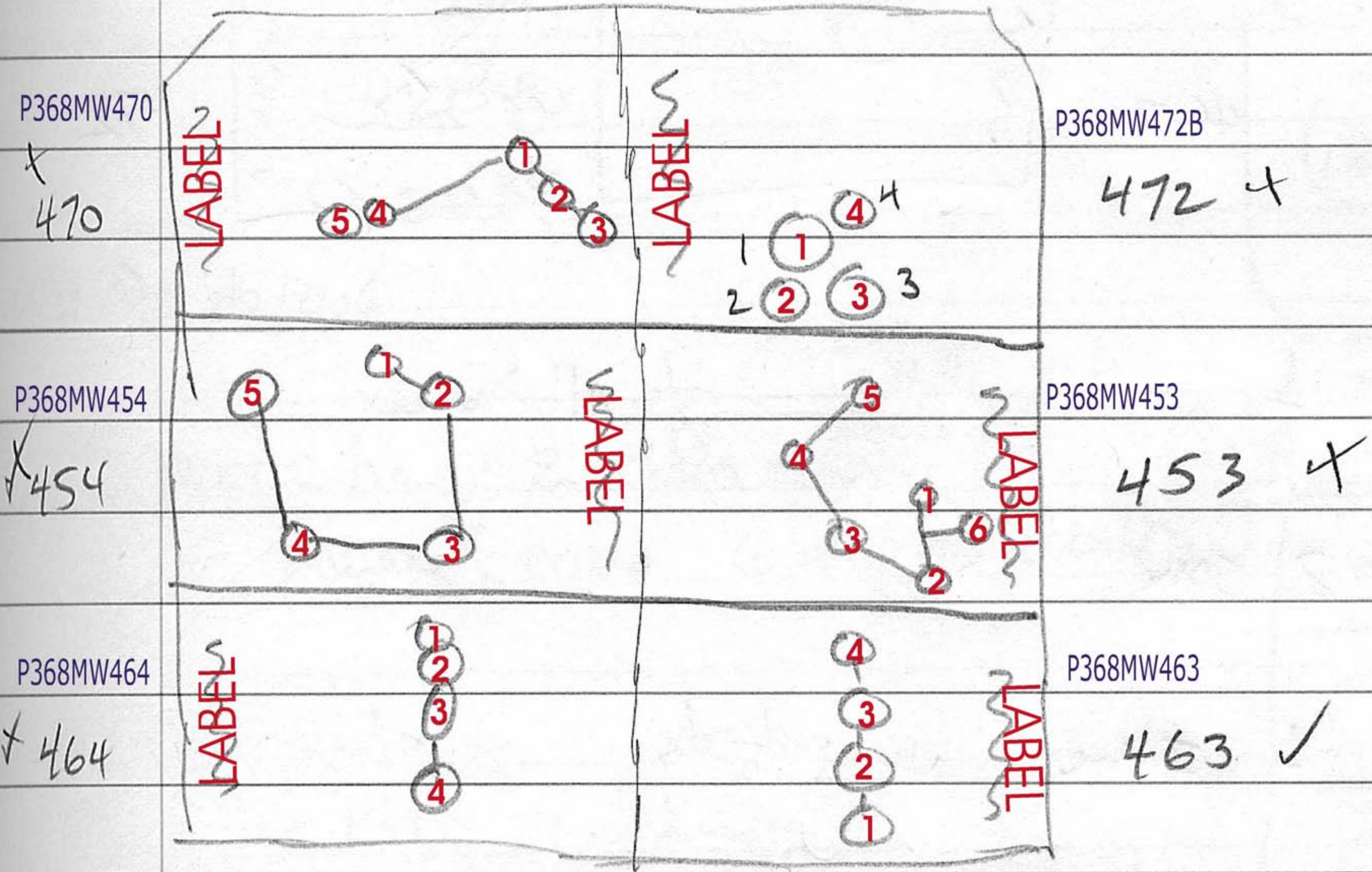
Record X-Y coordinates of all readings

Do both sets of analyses before moving samples

Identify unknowns as they are observed

Record notes as work progresses

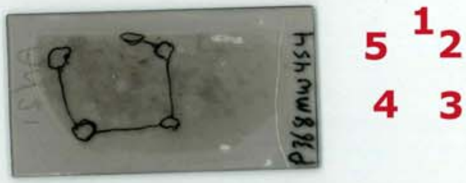
Thin section Set #1



SET 1

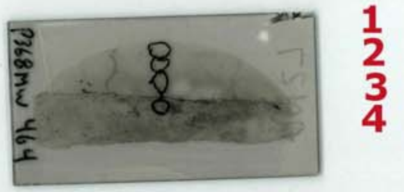
P368MW470

P368MW472B



P368MW454

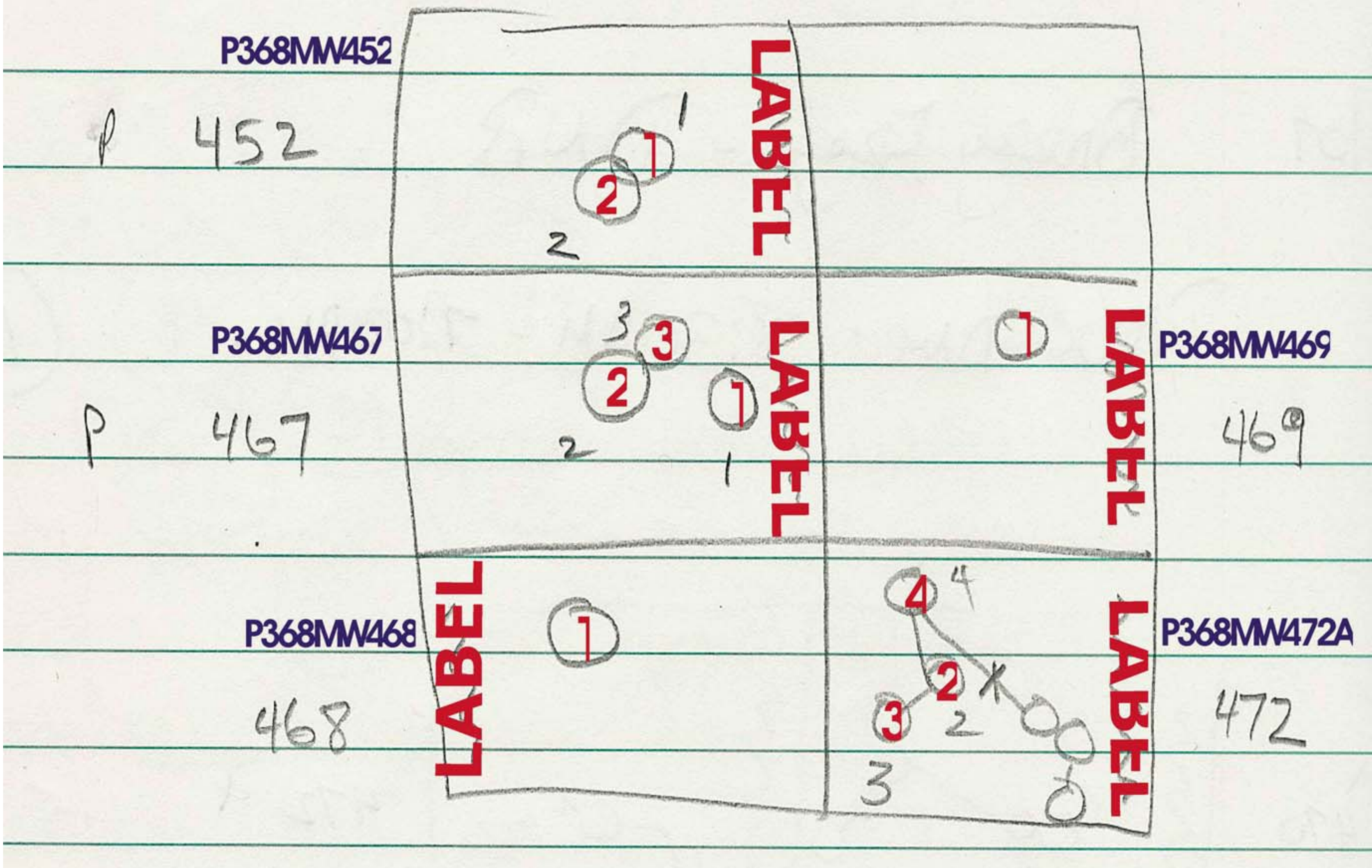
P368MW453



P368MW464

P368MW463

Thin section Set#2



Mineral Work Set 2

2 1

P368MW452

3 2 1

P368MW467

1

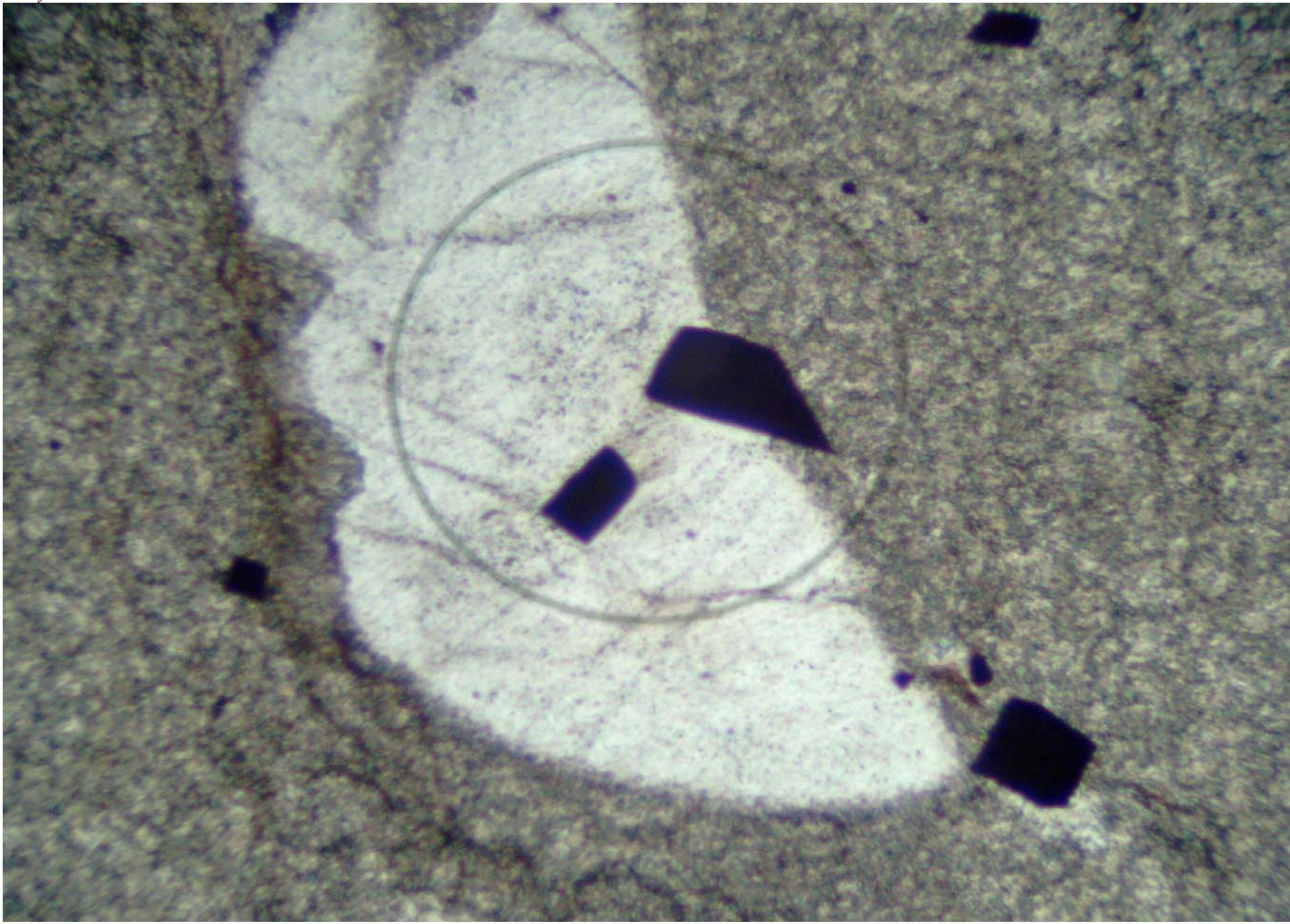
P368MW469

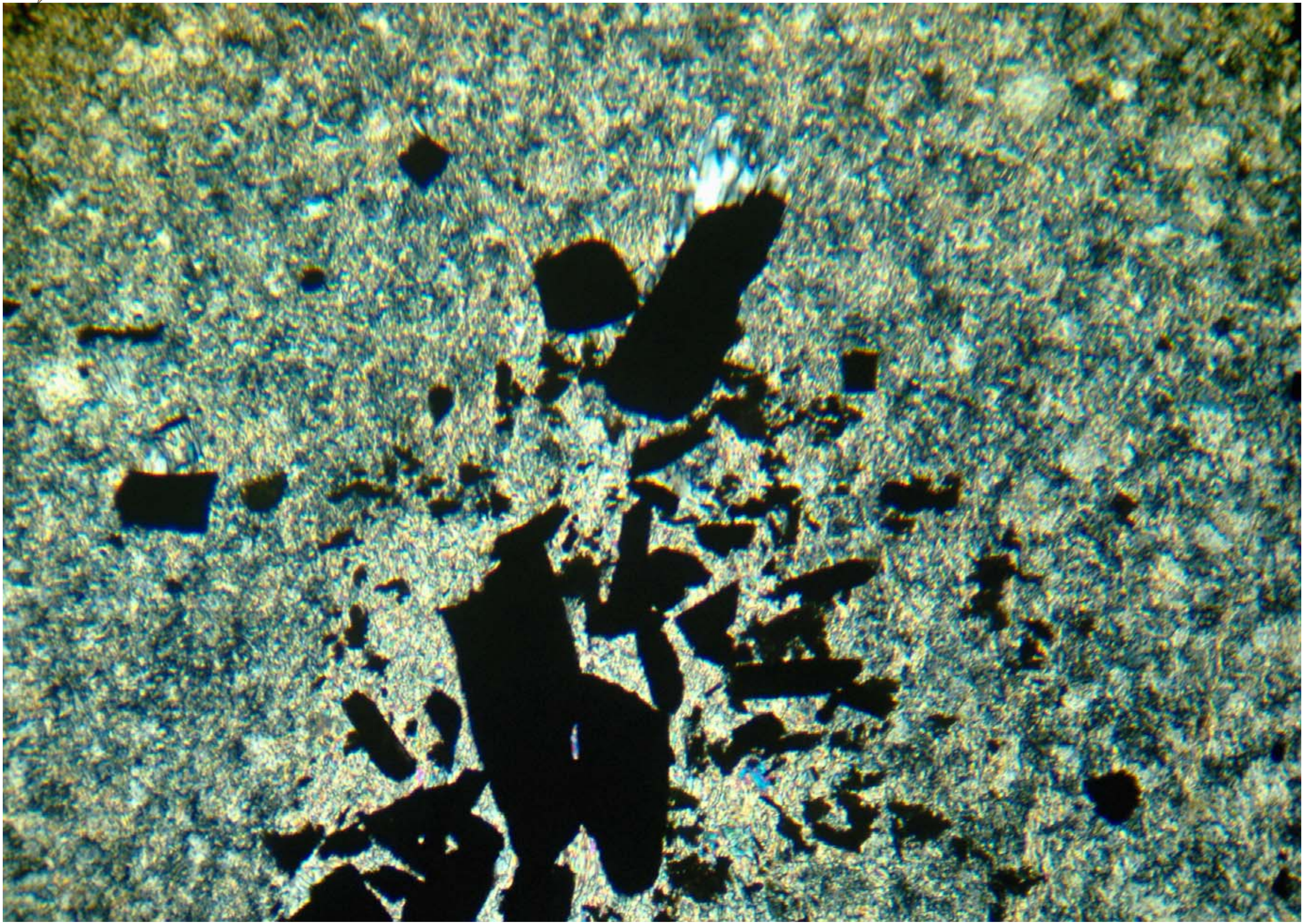
1

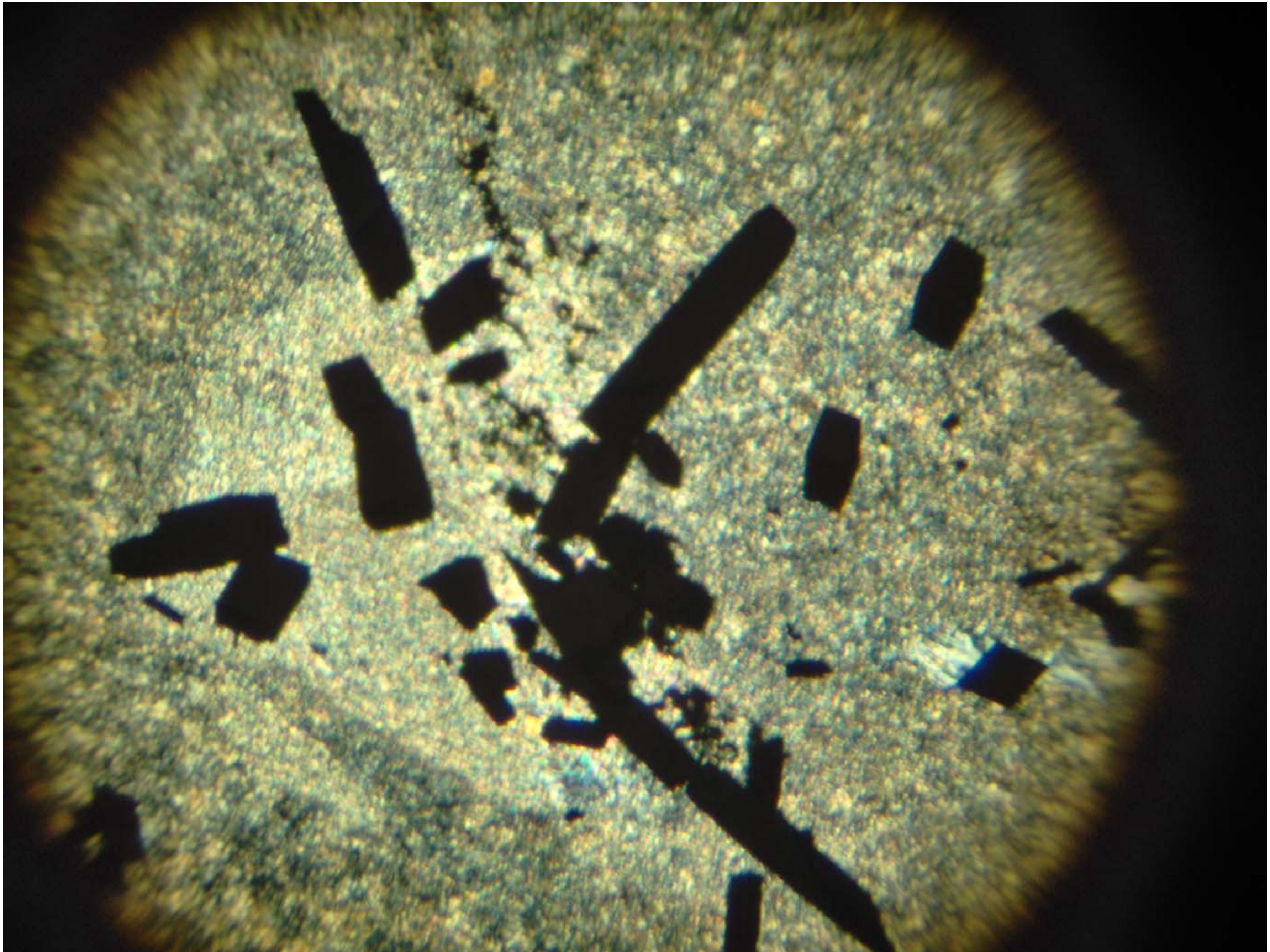
P368MW468

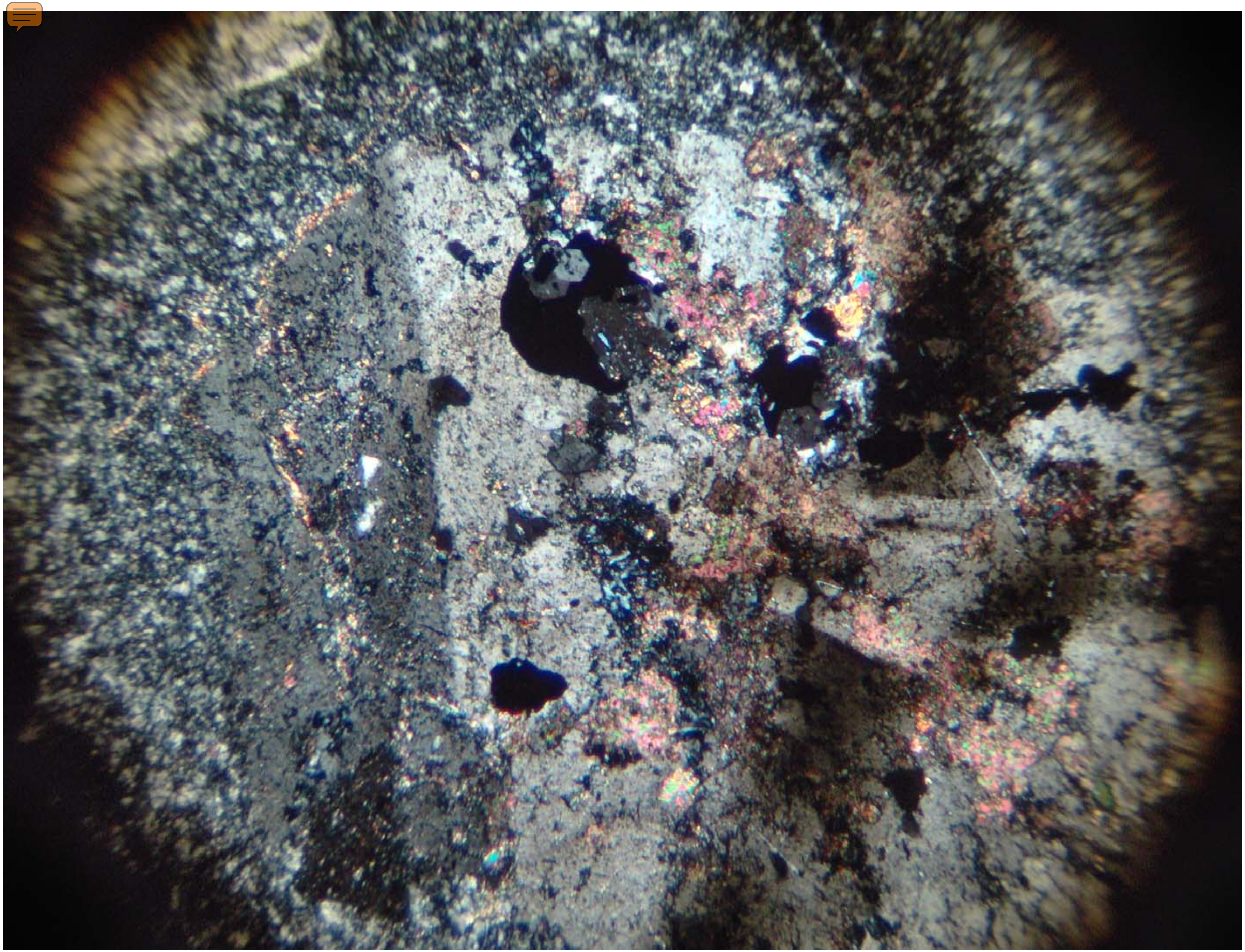
4 2 3

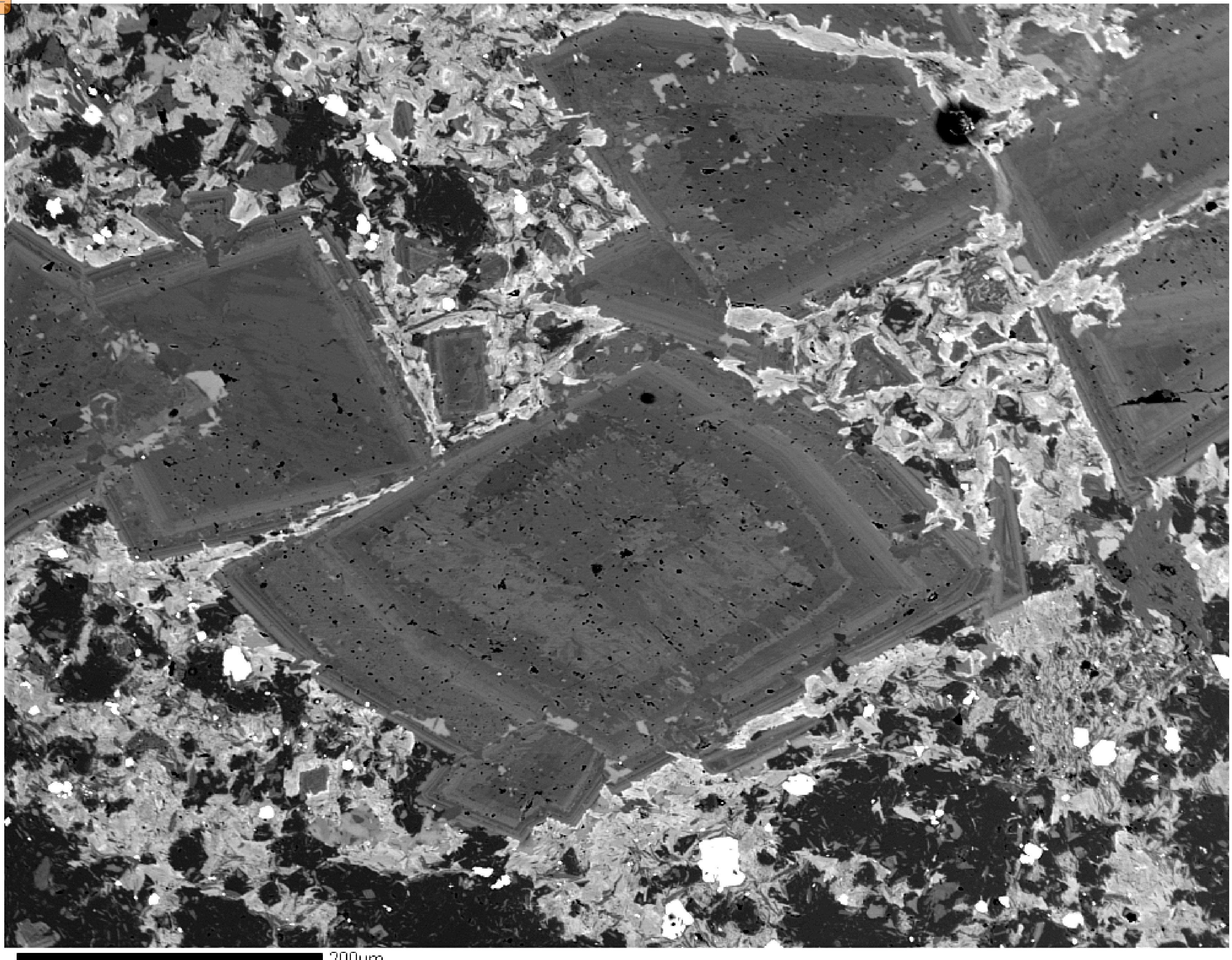
P368MW472A



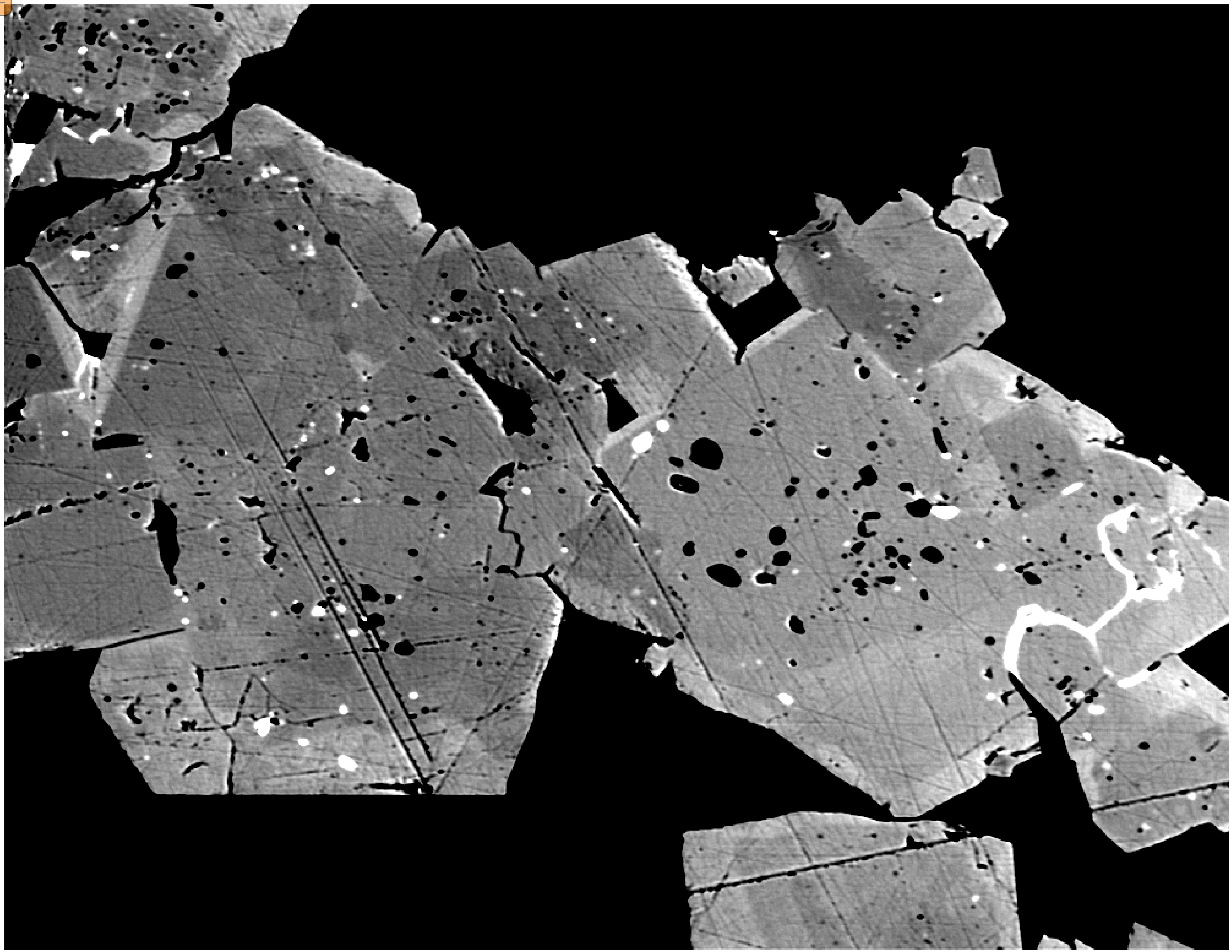






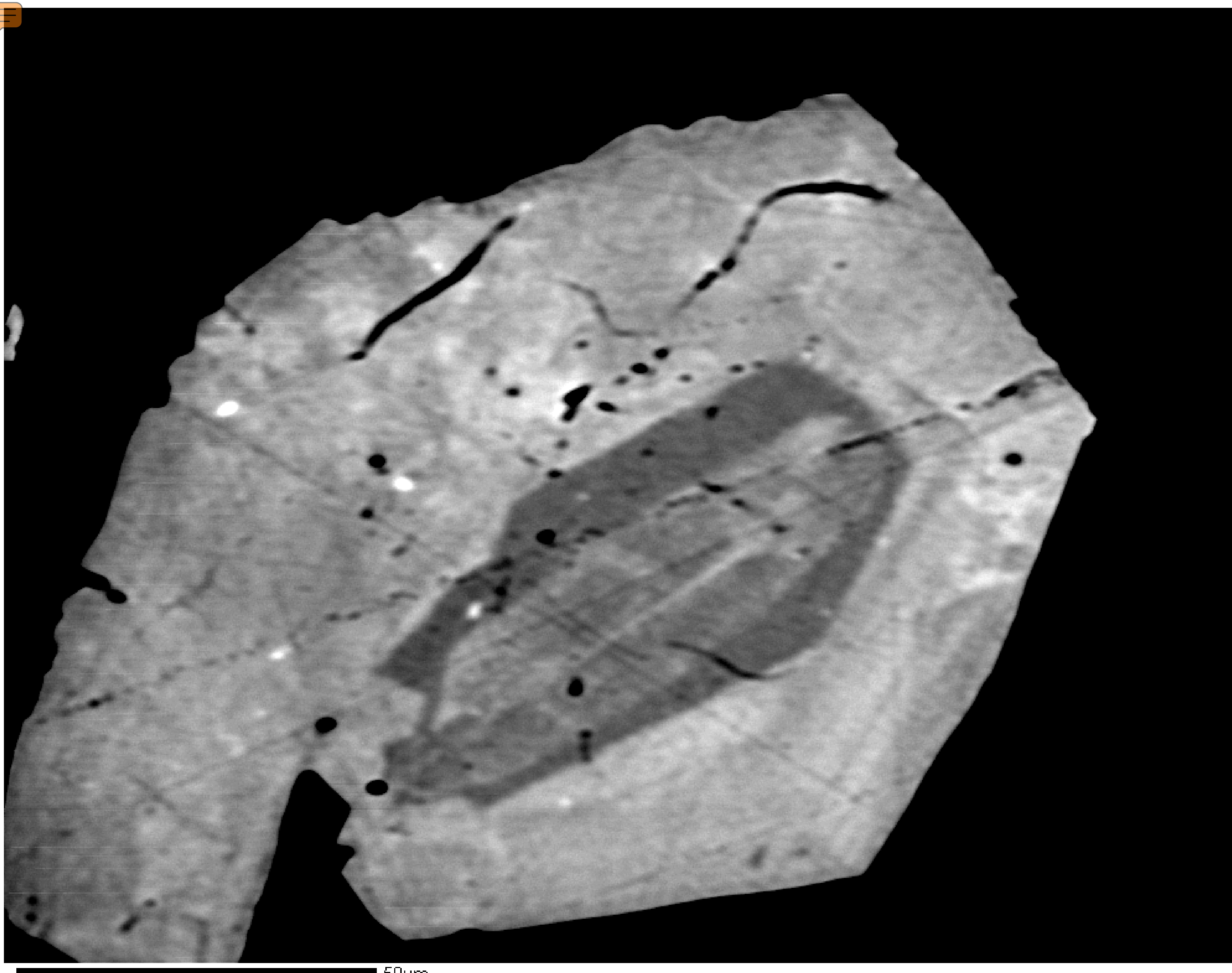


BSI Thin section 464; circle 4; carbonates

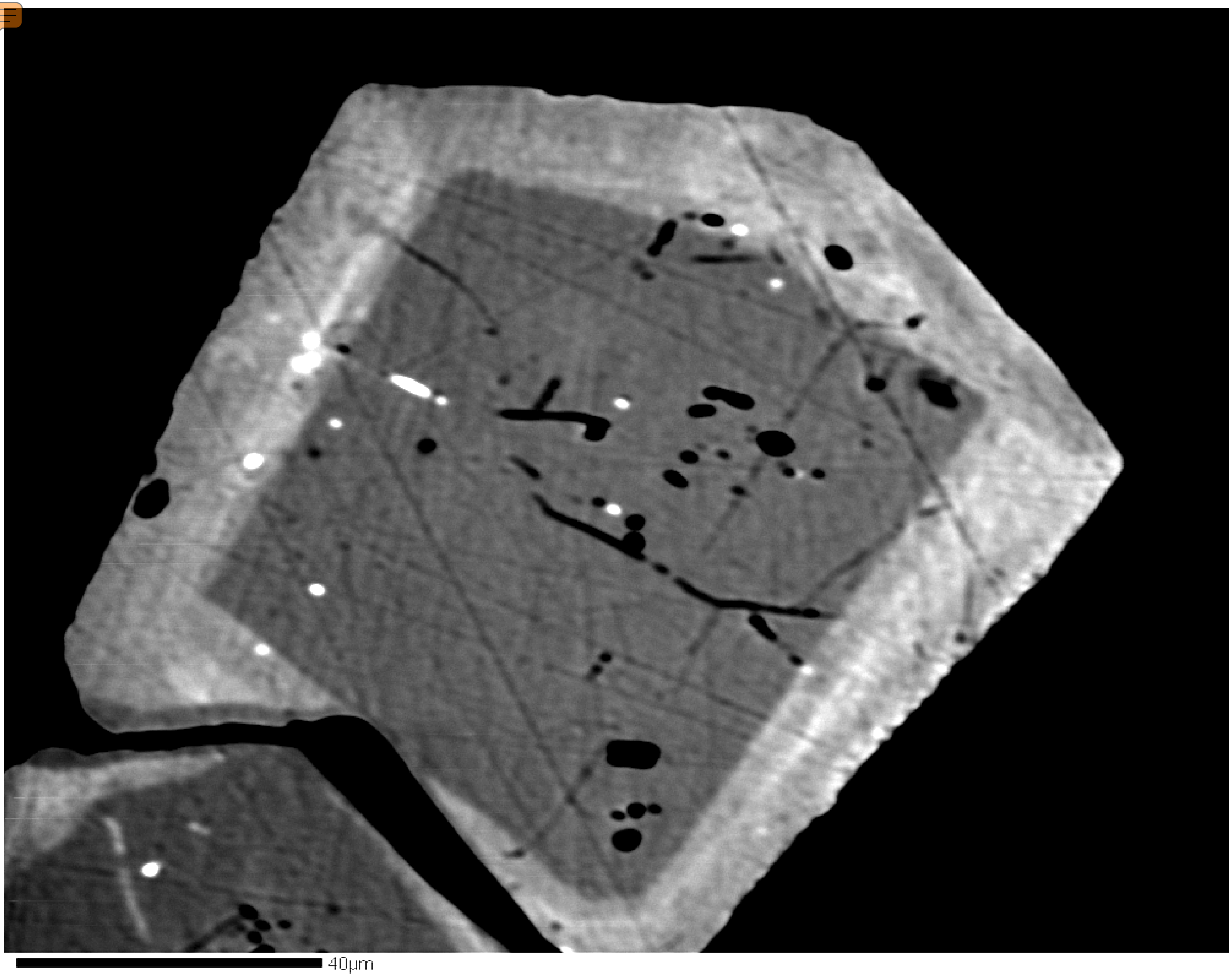


100µm

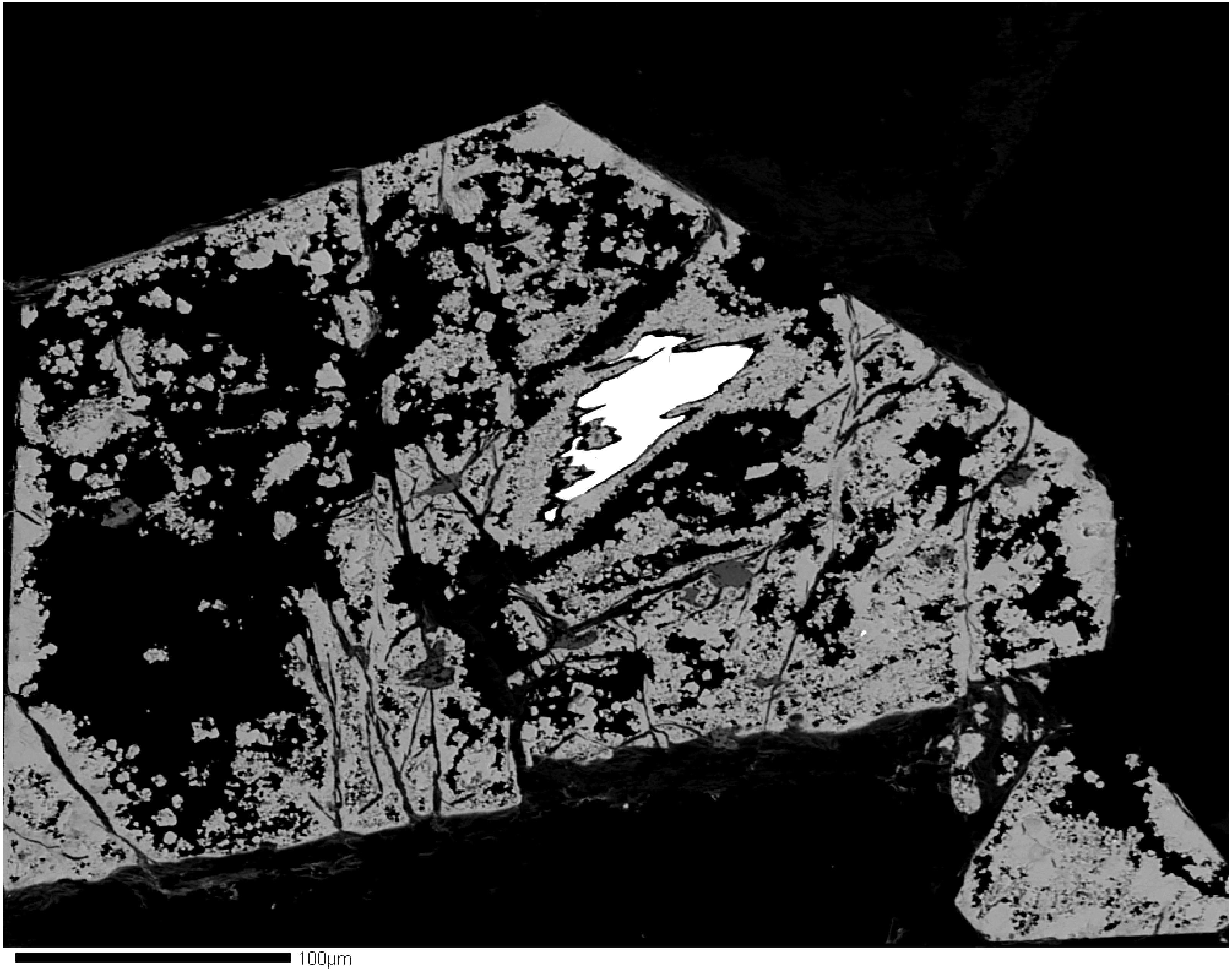
BSI Thin section 470; circle 5; pyrite



BSI Thin section 472; circle 4; pyrite



BSI Thin section 472; circle 3; pyrite



BSI Thin section 453; circle 2; As-pyrite rem in Fe-oxide

Test of a Portable Hand-held X-RAY Fluorescence Spectrometer

DDH DG-1

Portable XRF Analyses on DDH DG-1

-New Data-

- Offers the possibility of real-time correlating of chemistry and observed geologic features
- The high Au detection limit is not very useful in many exploration scenarios, but DDH DG-1 was known to have anomalous high gold values
- Target area is about ½ cm^2
- Footages/brief notes were recorded

Portable XRF Analyses on DDH DG-1

-New Data-

- Readings were generally taken every 2 to 10 feet, however multiple readings were taken at footages with visible variation, and extremely variable Au and As values resulted

- 2 people took 30 second readings (about 20 second Live Time)

- One sample done about every 2½ minutes

- Data shown in plots took about 6 hours to collect and transfer

Portable XRF Data on DDH DG-1

- New Data -

- **Sampling tested different rock types and observed lithologic, alteration, and mineralization differences**
- **Sampling tested variable visible arsenopyrite amounts**
- **136 analyses were performed on DG-1**

Portable XRF Data on DDH DG-1

- New Data -

- **Spreadsheet data file includes other data**
  - **Two different metallic calibration standards, supplied by the XRF manufacturer, were used eleven times**
  - **One of these internal metallic calibration standards included Au values, and was used six times**
    - **Four "passed" the standardization procedure**
    - **Two were analyzed and produced values of 84 and 82 ppm Au respectively**
  - **No certified rock references materials were analyzed**
  - **Three other analyses including Lake of the Woods fuchsite**

Portable XRF Data on DDH DG-1

- New Data -

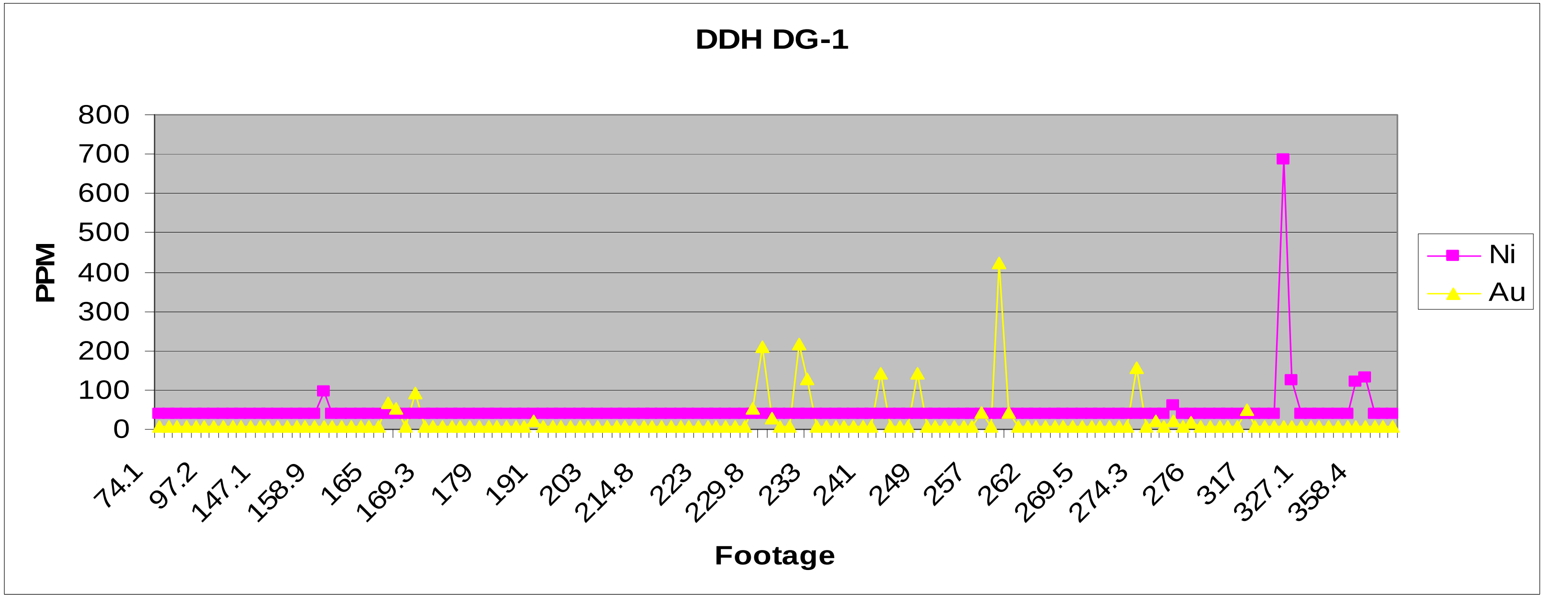
- For DG-1 XRF plots, data was first arranged in order in the spreadsheet, and plotted in the graphs

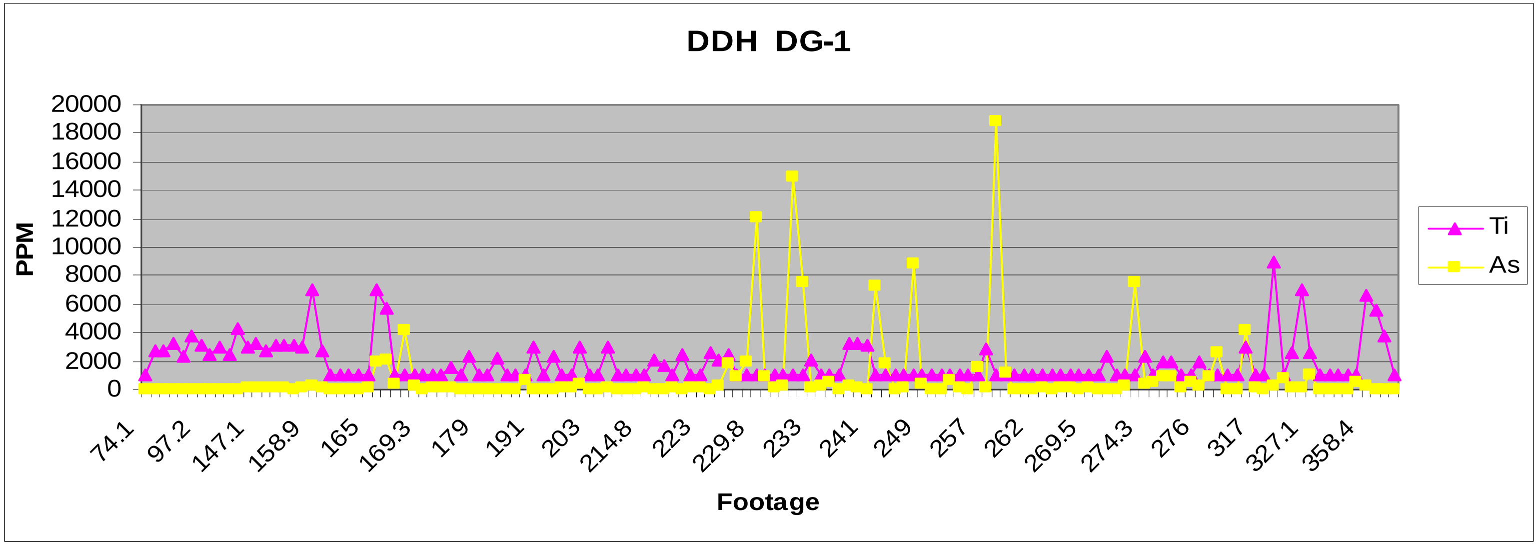
- X axis footage values are not plotted linearly, only by data order

- For Au plots, 19 values were above the detection limit, and 117 values below; and an arbitrary value was chosen to represent these (done for all elements below detection values)

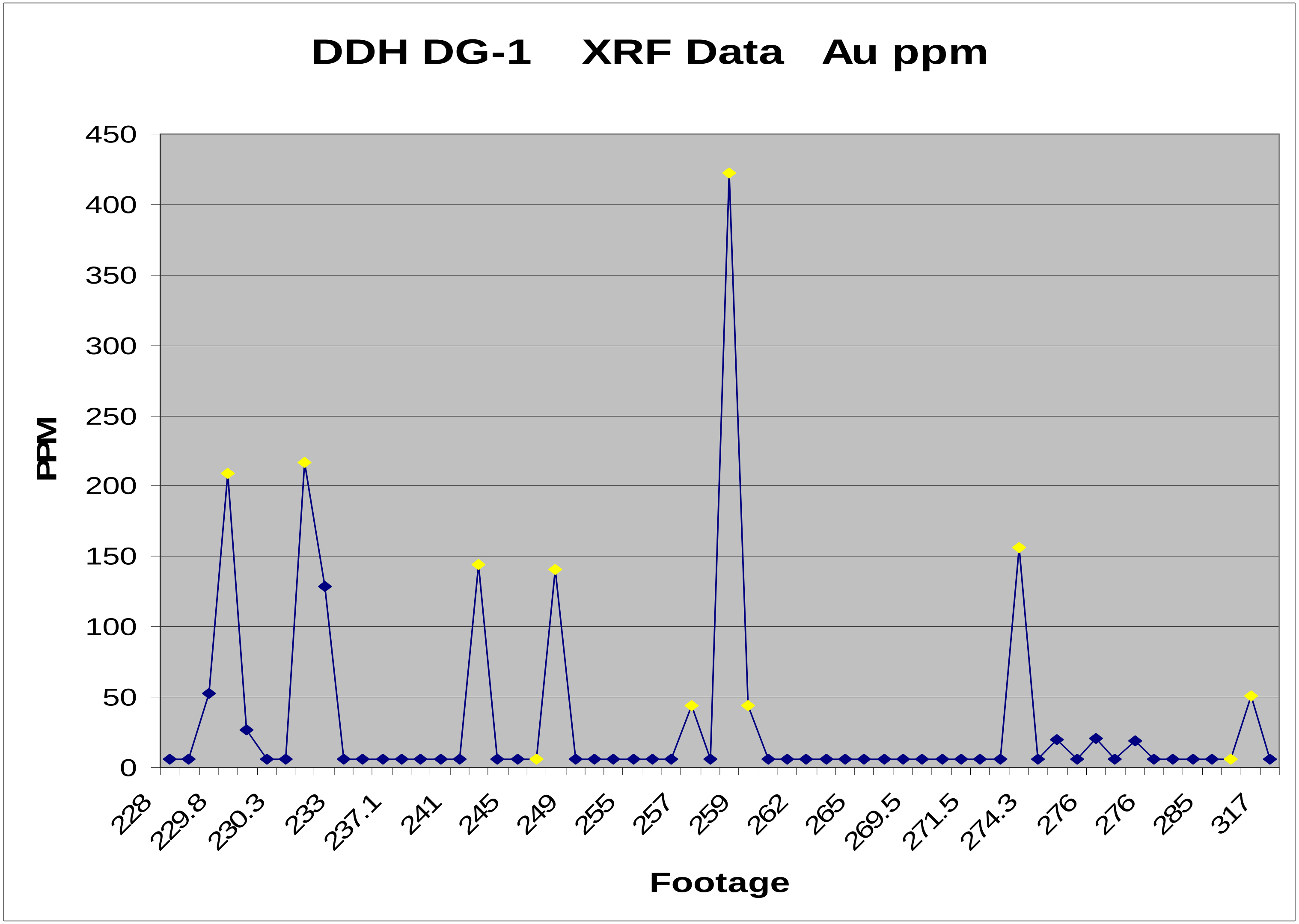
- 11 of the 19 high values had visible elongate arsenopyrite

Portable XRF Analyses - New Data -





Portable XRF Analyses - New Data -



Yellow data points have associated elongate arsenopyrite

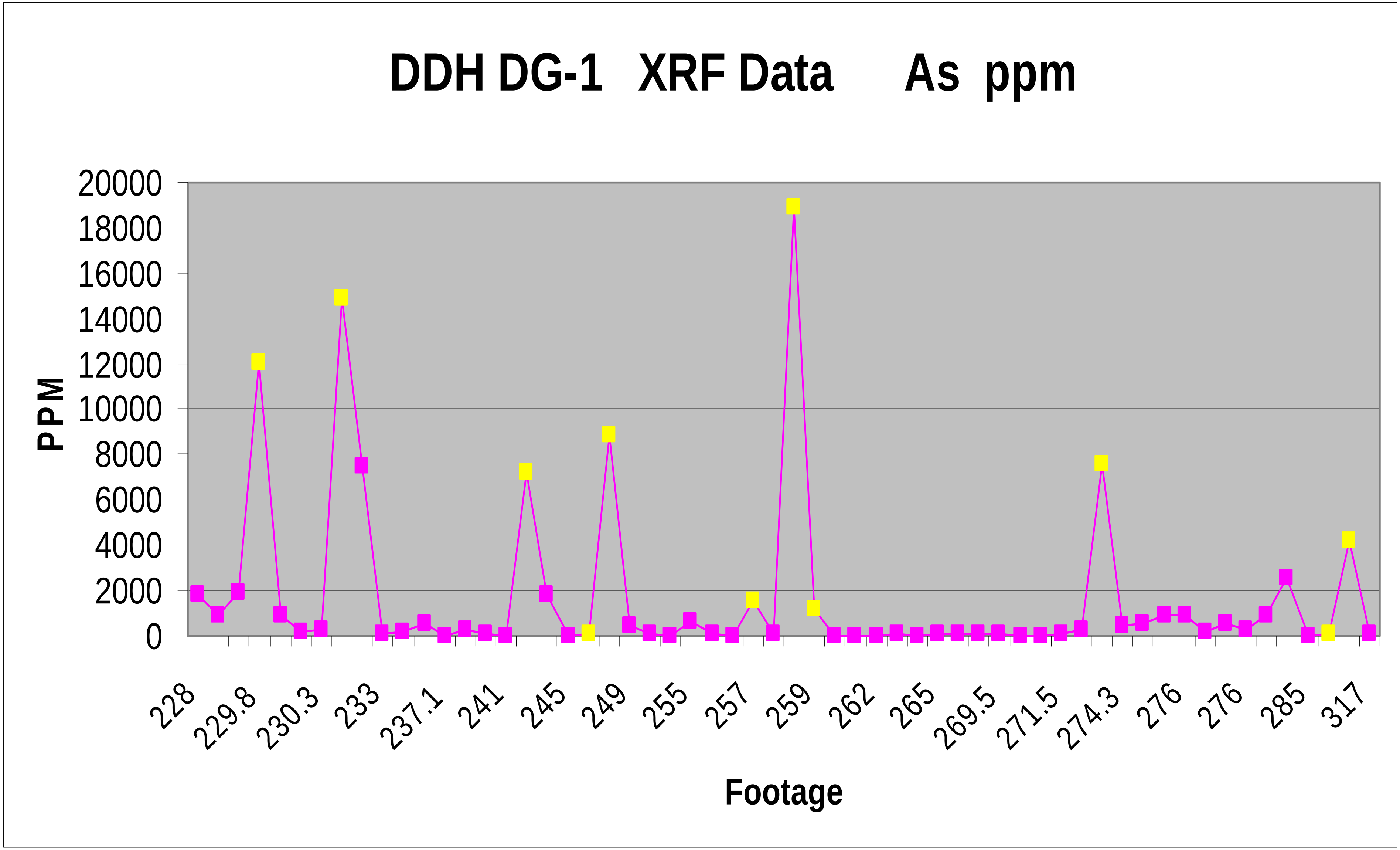
Correlation Coefficient (Pearson) for DG-1 XRF Analyses – All Samples
- New Data -

	Ti	*Cr*	*Mn*	*Fe*	*Co*	*Ni*	*Cu*	*Zn*	*As*	*Rb*	*Sr*	*Zr*	*Mo*	*Ag*	*Ba*	*Au*	*Pb*
Ti	1.00																
Cr	0.42	1.00															
Mn	0.32	0.46	1.00														
Fe	**0.54**	**0.56**	**0.63**	1.00													
Co	0.42	0.37	**0.53**	**0.92**	1.00												
Ni	0.02	0.30	0.19	0.14	0.12	1.00											
Cu	0.26	0.28	0.15	0.28	0.25	**0.50**	1.00										
Zn	0.12	0.07	0.38	0.24	0.24	0.07	0.01	1.00									
As	-0.11	-0.04	0.05	0.08	0.22	-0.01	-0.02	0.04	1.00								
Rb	0.24	0.06	-0.08	0.04	-0.01	-0.13	-0.02	-0.05	0.02	1.00							
Sr	0.31	0.41	0.37	0.30	0.23	0.28	0.14	0.10	-0.15	-0.14	1.00						
Zr	0.25	-0.20	-0.31	-0.11	-0.10	-0.22	-0.10	-0.09	-0.14	**0.54**	-0.14	1.00					
Mo	0.02	0.15	0.07	0.07	0.04	0.01	-0.01	0.11	-0.04	0.01	0.03	-0.03	1.00				
Ag	-0.09	-0.03	-0.07	0.01	0.01	-0.02	-0.04	-0.04	0.35	-0.05	-0.08	-0.04	-0.03	1.00			
Ba	-0.02	-0.03	-0.01	-0.05	-0.03	-0.02	-0.05	0.07	-0.05	0.24	0.17	0.13	-0.03	-0.03	1.00		
Au	-0.09	-0.05	0.05	0.06	0.21	-0.03	-0.07	0.03	**0.97**	0.02	-0.15	-0.15	-0.03	0.27	-0.05	1.00	
Pb	-0.08	-0.05	-0.01	0.01	0.04	-0.03	0.04	0.02	0.15	-0.12	0.20	-0.16	0.14	-0.04	0.08	0.15	1.00

Correlation Coefficient (Pearson) for DG-1 Dacite XRF Analyses
- New Data -

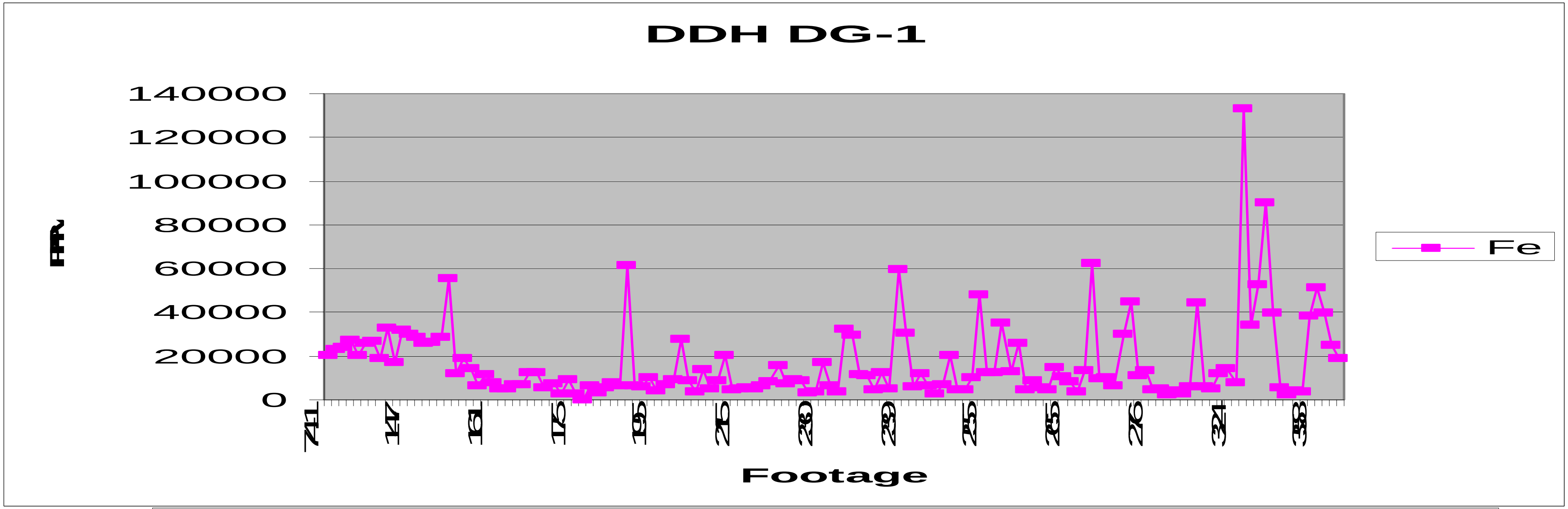
Dacite																
	Ti	*Mn*	*Fe*	*Co*	*Ni*	*Cu*	*Zn*	*As*	*Rb*	*Sr*	*Zr*	*Mo*	*Ag*	*Ba*	*Au*	*Pb*
Ti	1.00															
Mn	-0.07	1.00														
Fe	0.02	0.34	1.00													
Co	-0.07	0.25	**0.93**	1.00												
Ni	0.05	-0.02	-0.05	-0.06	1.00											
Cu	-0.07	-0.02	0.22	0.18	-0.02	1.00										
Zn	-0.01	0.09	0.08	0.10	-0.03	-0.03	1.00									
As	-0.04	0.15	0.26	0.40	-0.01	0.02	0.27	1.00								
Rb	0.18	-0.20	-0.09	-0.08	0.03	-0.10	-0.01	0.04	1.00							
Sr	0.19	0.12	-0.14	-0.16	-0.04	0.01	-0.06	-0.14	-0.23	1.00						
Zr	0.20	-0.32	-0.14	-0.14	-0.06	-0.10	-0.12	-0.13	**0.64**	-0.11	1.00					
Mo	-0.05	-0.02	0.00	0.00	-0.01	-0.02	0.02	-0.04	0.01	0.00	0.03	1.00				
Ag	-0.08	-0.04	0.08	0.07	-0.02	-0.03	-0.06	0.35	-0.05	-0.06	-0.03	-0.03	1.00			
Ba	-0.08	0.02	-0.04	0.01	-0.02	-0.03	-0.03	-0.05	0.24	0.19	0.07	-0.02	-0.03	1.00		
Au	-0.02	0.16	0.23	0.38	0.00	-0.05	0.23	**0.97**	0.04	-0.12	-0.16	-0.03	0.26	-0.05	1.00	
Pb	-0.09	-0.02	0.05	0.10	-0.02	0.14	0.05	0.15	-0.21	0.09	-0.18	0.17	-0.04	-0.04	0.17	1.00

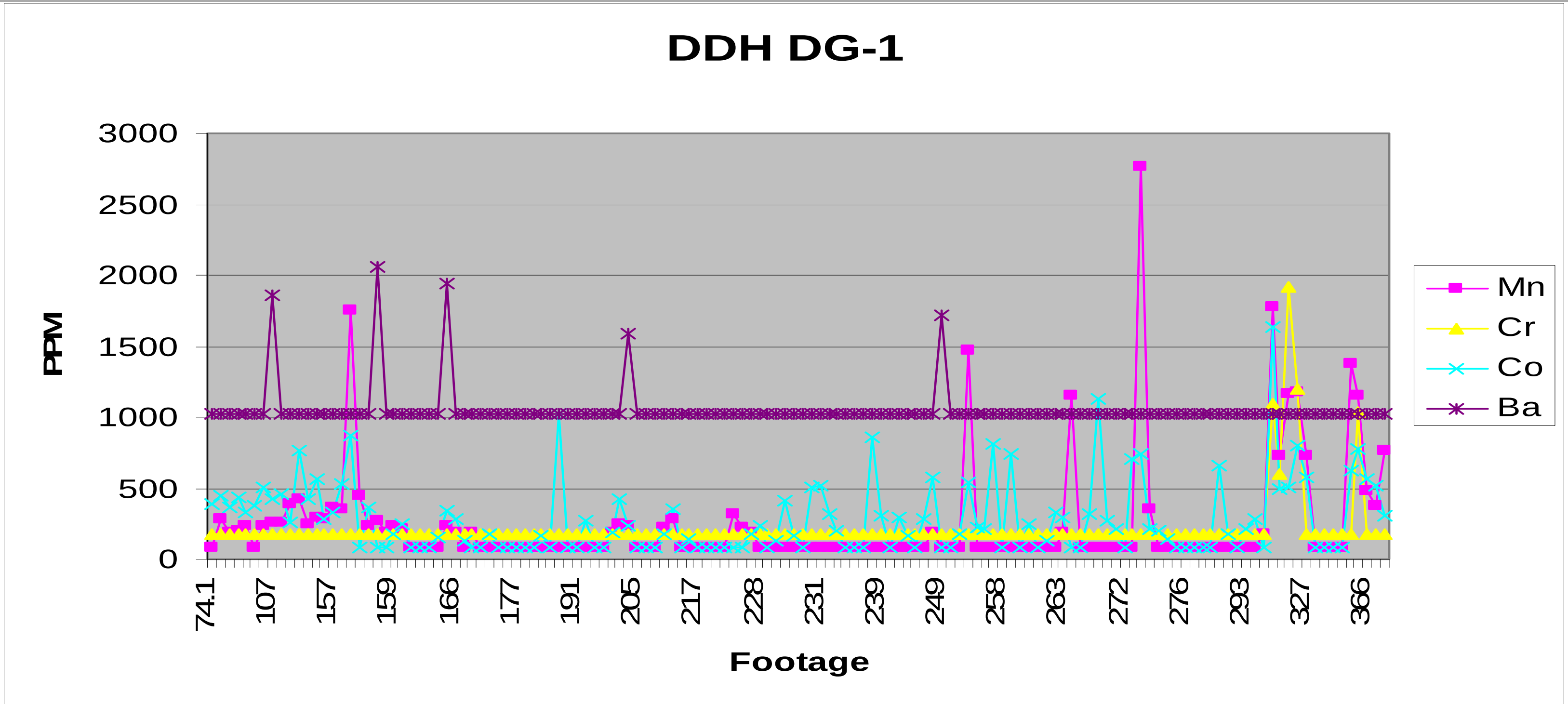
Portable XRF Analyses - New Data -



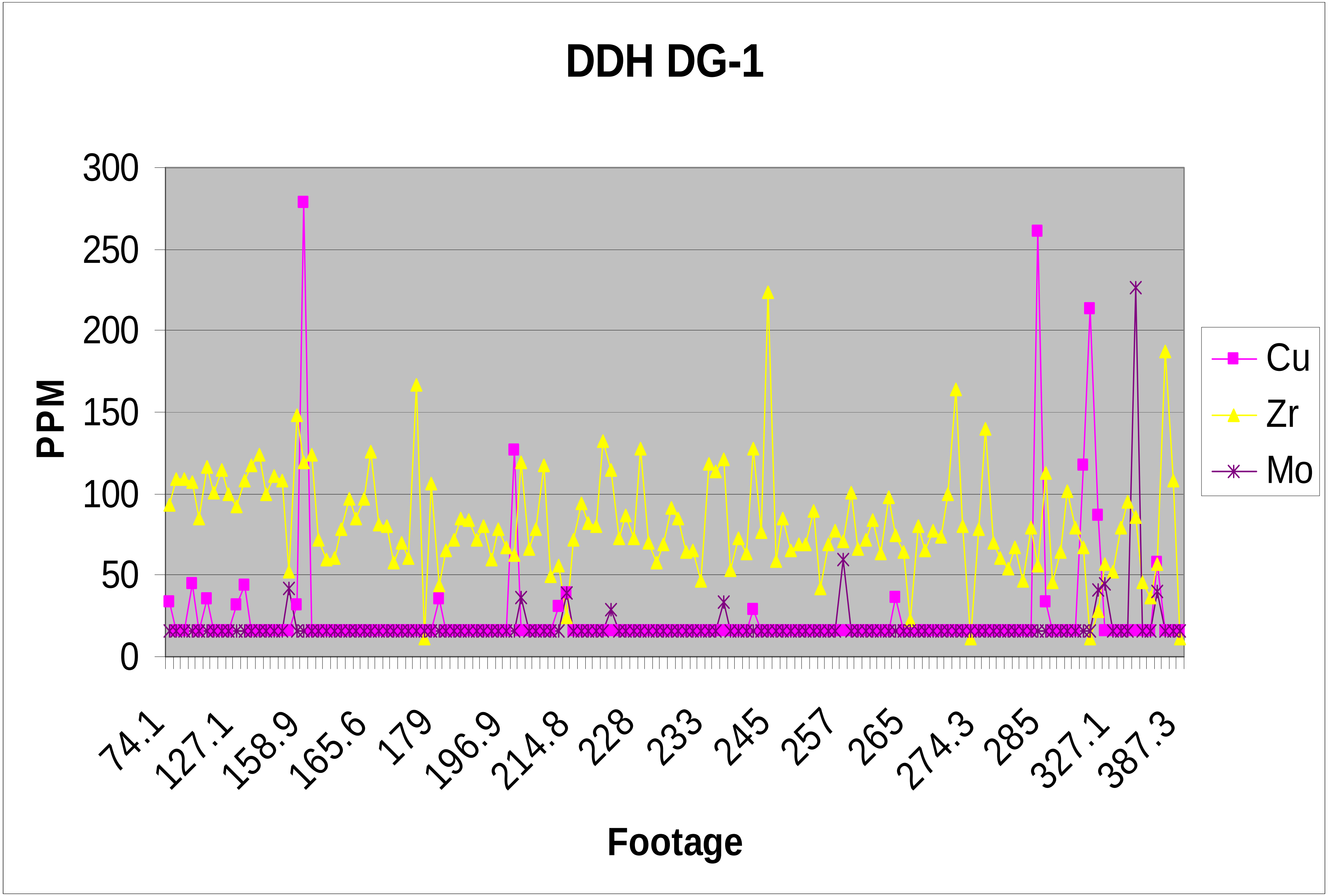
Yellow data points have associated elongate arsenopyrite

Portable XRF Analyses - New Data -





Portable XRF Analyses - New Data -



SECOND SET OF MICROROBE DATA

- **Microprobe detection limit for Au is about 200 ppm**
- **XRF data indicates microprobe could elucidate Au distribution in DDH DG-1**
- **Samples P368MW472a and P368MW472b were chosen because of high Au**
- **Done interactively to allow results as they come in to drive direction**

Procedures

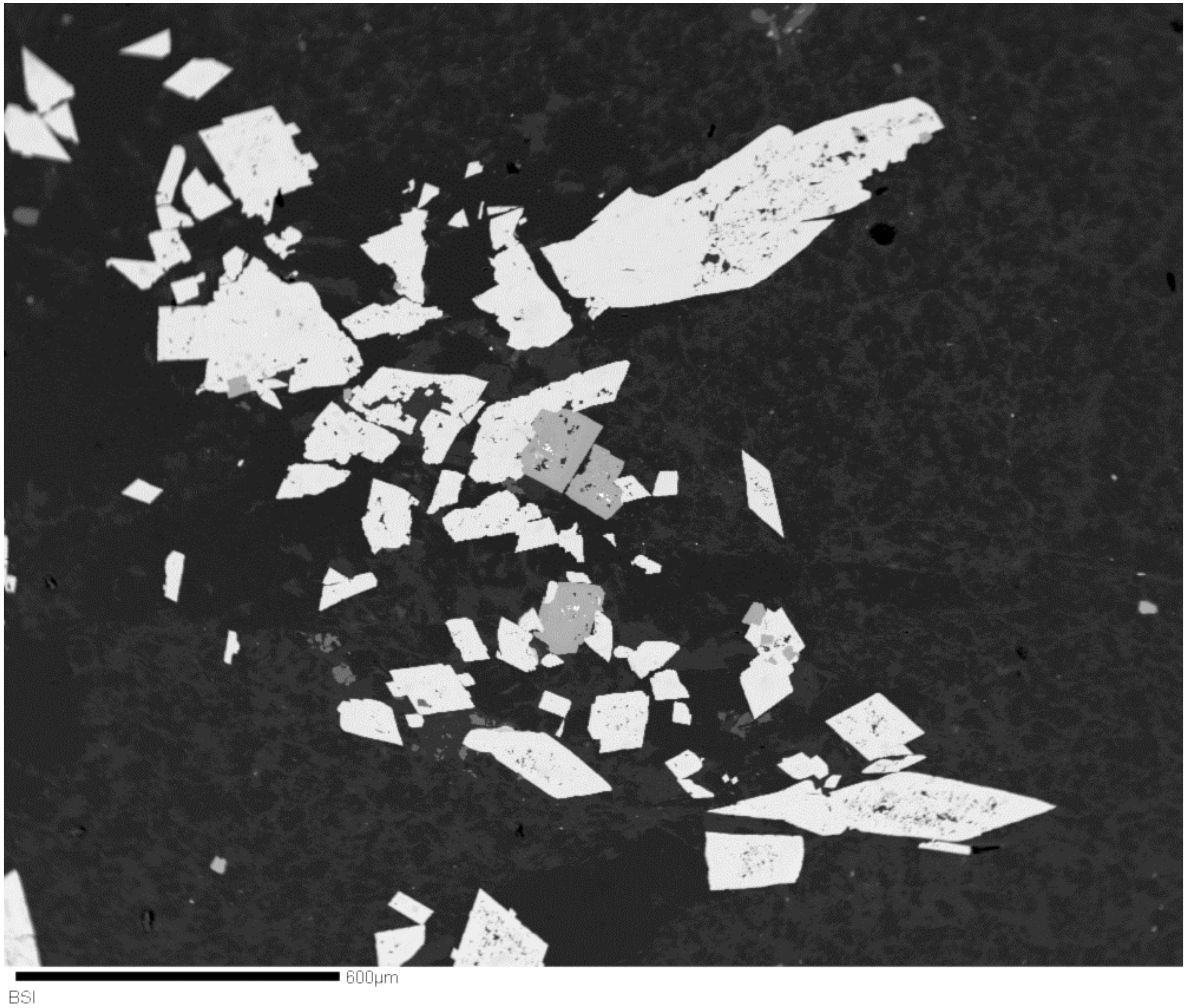
1. **Find highest atomic numbered phases by adjusting brightness and contrast of backscattered electron images**

2. **Use Energy Dispersive X-ray Spectroscopy (EDS) to separate Au phases from other high atomic number phases**

3. **Quantitative analyses of arsenopyrite and gold related phases, to get measurable gold concentrations**

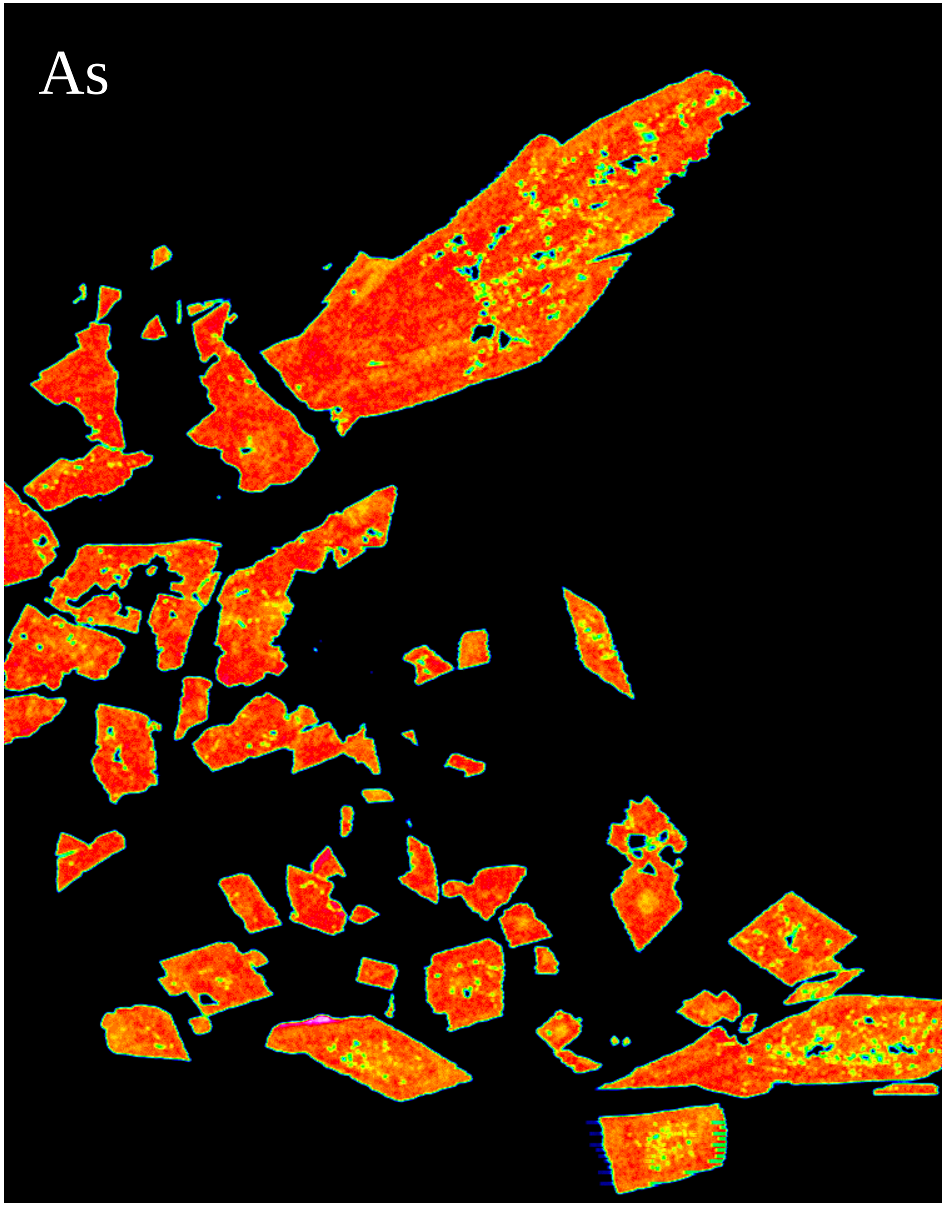
4. **Do element mapping for Au for phases with measurable concentration**

Sample: 472a - Area 1



Arsenopyrite and As-rich pyrite

Sample: 472a - Area 1



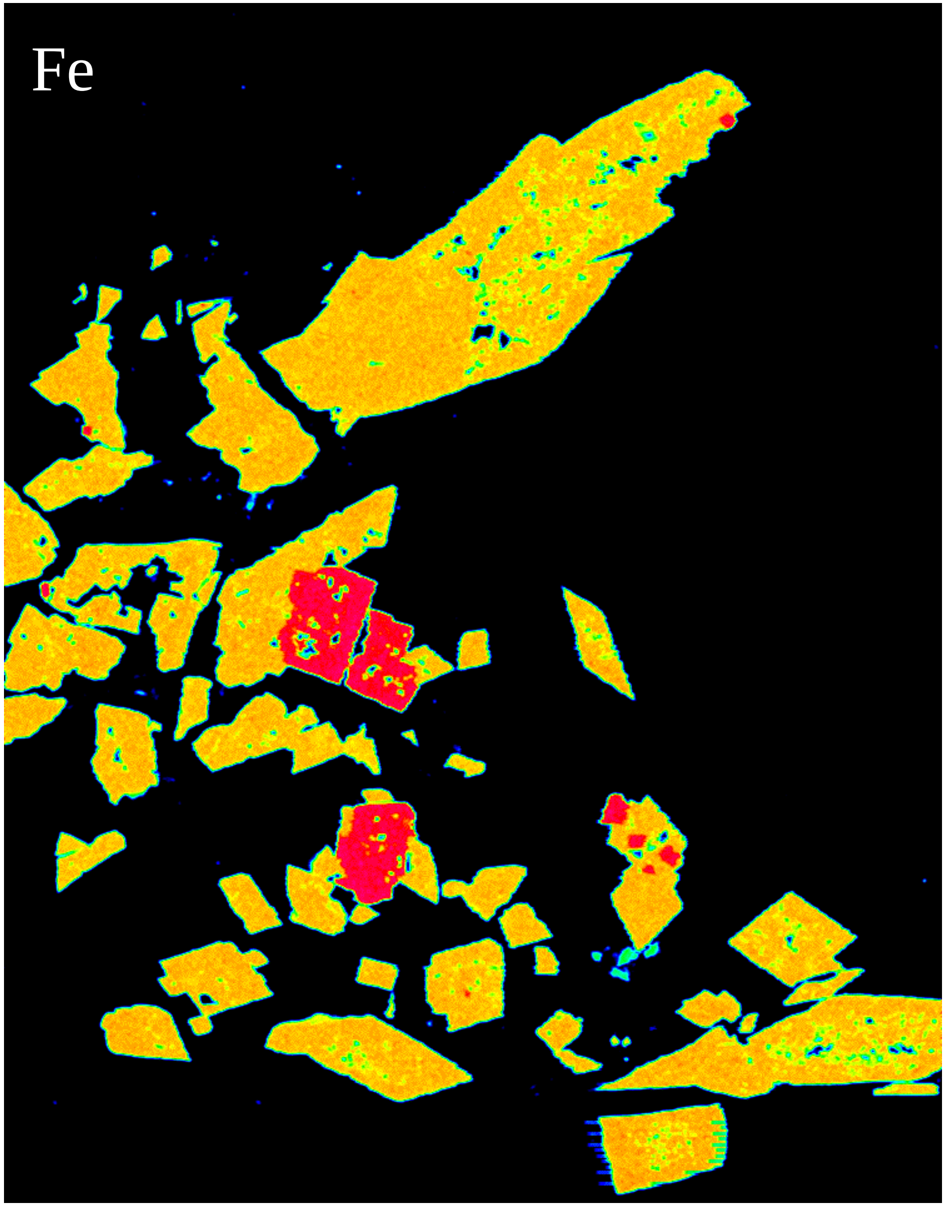


Image width: 1335 microns

Sample: 472a - Area 1

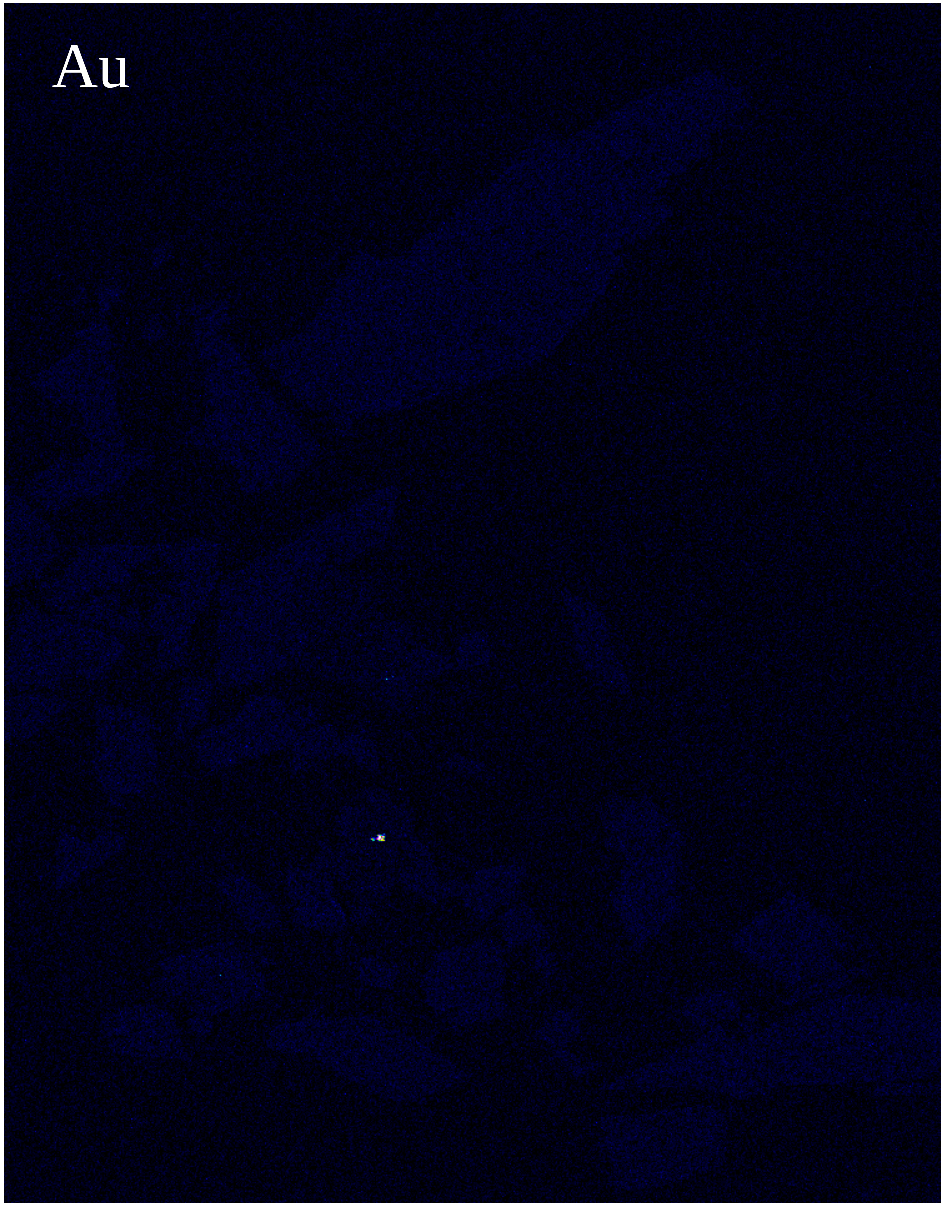


Image width: 1335 microns

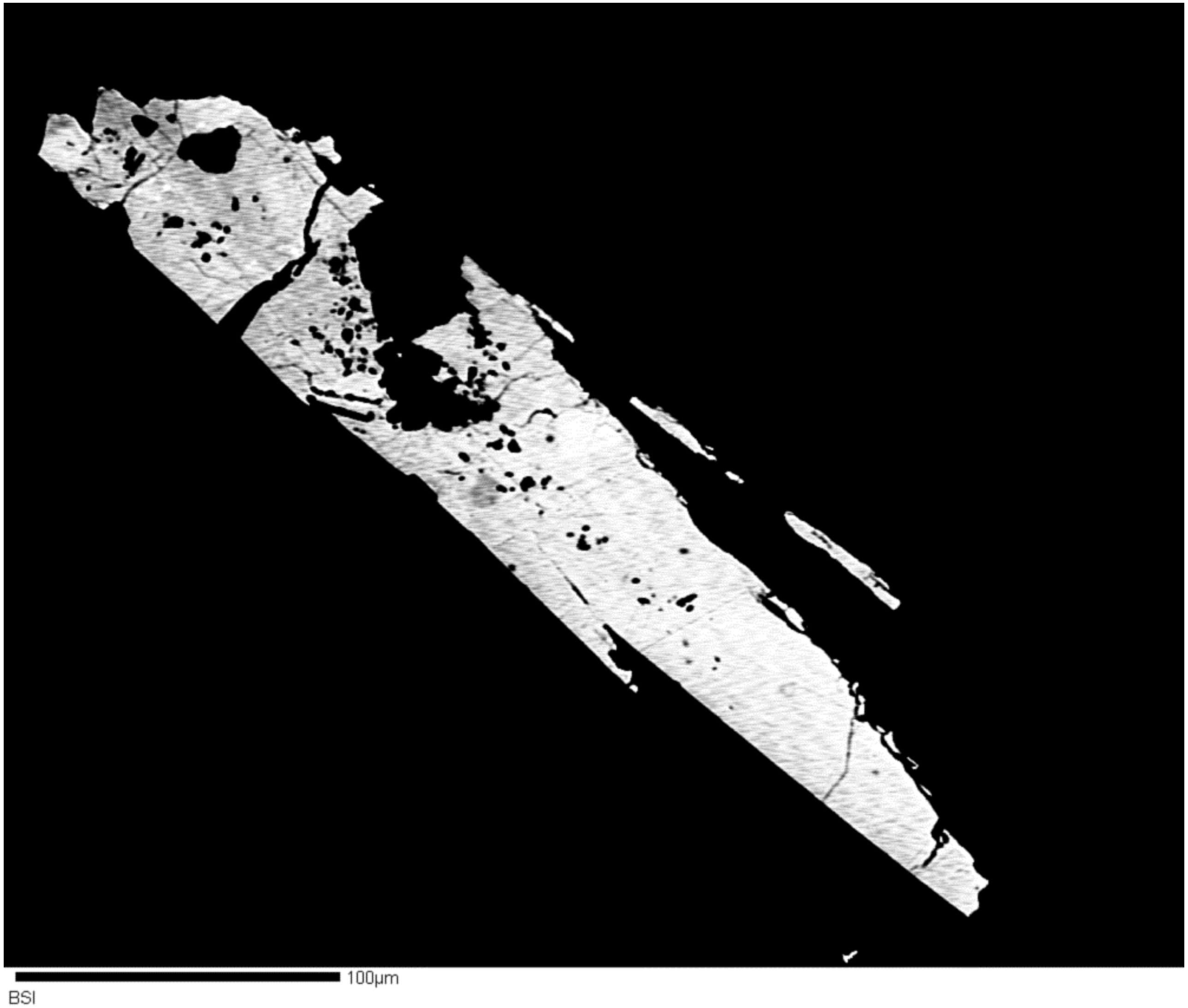
Pyrite Microprobe Analysis Data

			Weight Percent						
	Cu	Fe	As	S	Ag	Sb	Pb	Au	Total
	0.04	47.52	0.16	51.46	0.000	0.000	0.000	0.009	99.19
	0.00	45.70	3.97	49.52	0.000	0.000	0.000	0.044	99.23
	0.00	46.06	2.13	51.10	0.005	0.000	0.000	0.031	99.33
	0.01	45.72	3.88	49.50	0.000	0.000	0.000	0.016	99.13
Average	**0.01**	**46.25**	**2.54**	**50.40**	**0.001**	**0.000**	**0.000**	**0.025**	**99.22**

First Set of Arsenopyrite Microprobe Analysis Data

			Weight Percent					
Cu	Fe	As	S	Ag	Sb	Pb	Au (rpt)	Total
0.000	35.62	41.81	22.61	0.000	0.000	0.006	0.050	100.10
0.027	35.56	43.83	21.33	0.000	0.034	0.014	0.019	100.82
0.000	35.25	42.41	21.72	0.000	0.052	0.023	0.054	99.52
0.025	35.23	43.56	21.24	0.009	0.006	0.000	0.000	100.07
0.013	35.45	43.20	21.56	0.000	0.011	0.000	0.043	100.28
0.000	35.30	44.19	21.00	0.000	0.000	0.000	0.051	100.54
0.000	35.64	42.24	21.86	0.000	0.000	0.000	0.051	99.79
0.000	35.60	43.17	21.57	0.011	0.000	0.000	0.066	100.42
0.000	35.44	43.79	21.28	0.000	0.000	0.000	0.024	100.53
0.039	35.44	43.58	21.61	0.015	0.023	0.000	0.033	100.74
0.000	35.30	43.40	21.39	0.000	0.000	0.001	0.009	100.10
0.023	36.15	43.01	21.70	0.000	0.000	0.000	0.046	100.93
0.005	36.23	42.79	22.22	0.000	0.000	0.000	0.000	101.24
0.033	36.24	42.06	22.54	0.000	0.032	0.000	0.072	100.96
0.002	36.13	41.18	22.82	0.000	0.043	0.000	0.044	100.22
0.000	36.13	42.81	21.85	0.000	0.000	0.000	0.029	100.81
0.000	36.26	42.14	22.24	0.004	0.020	0.018	0.030	100.71
0.029	36.11	42.69	22.11	0.000	0.042	0.000	0.058	101.04
0.021	36.35	42.14	22.01	0.000	0.000	0.000	0.022	100.54
0.000	36.65	40.65	23.32	0.031	0.022	0.000	0.017	100.68
0.000	36.11	42.86	22.10	0.000	0.009	0.000	0.001	101.08
0.000	35.98	42.31	22.23	0.006	0.000	0.051	0.000	100.58
0.013	36.36	42.37	22.28	0.004	0.000	0.003	0.060	101.08

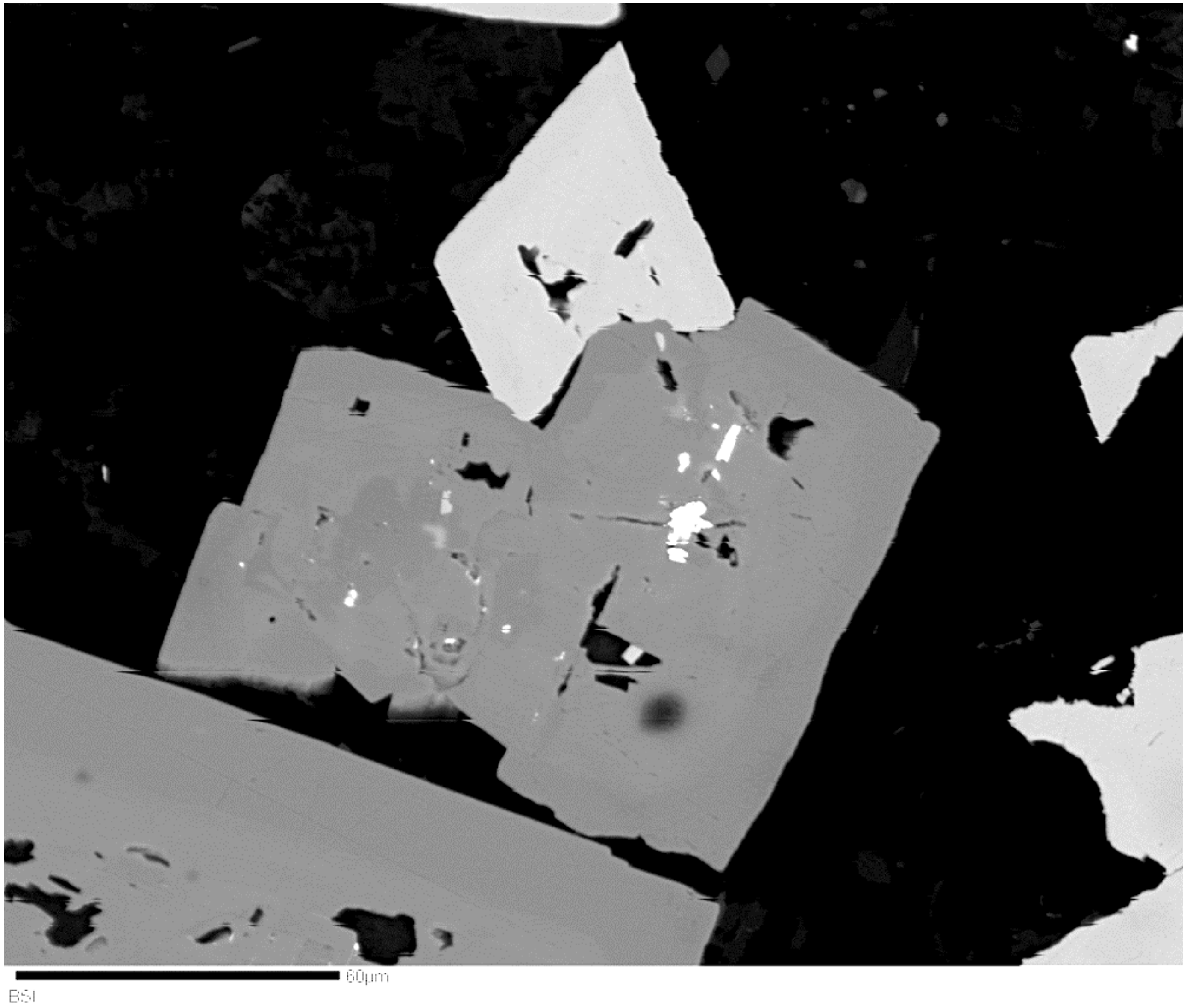
High-Au Arsenopyrite Grain



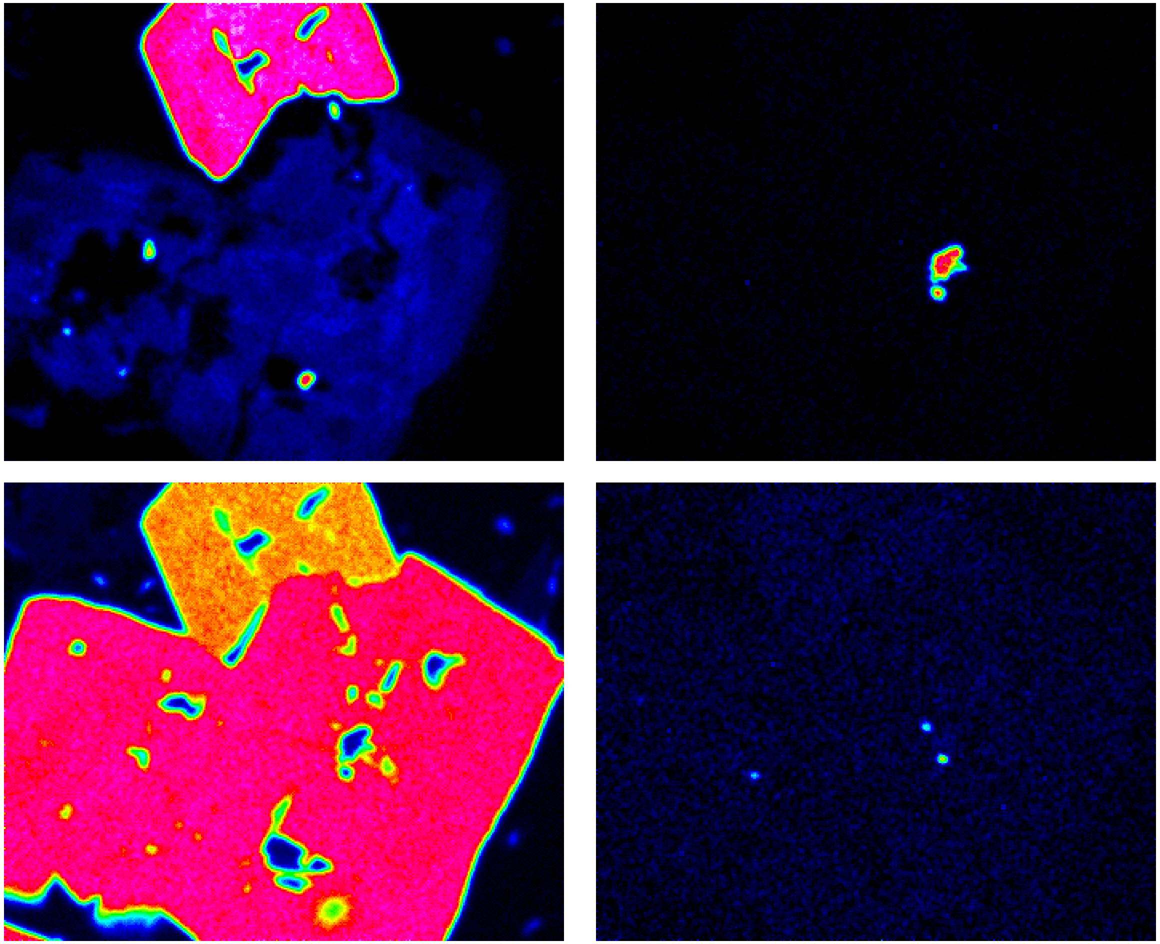
Second Set of Arsenopyrite Microprobe Analysis Data

	Weight Percent								
	Cu	Fe	As	S	Ag	Sb	Pb	Au (rpt)	Total
	0.004	36.13	41.48	22.56	0.000	0.021	0.000	0.014	100.20
	0.000	36.34	42.51	21.88	0.020	0.031	0.000	0.000	100.77
	0.017	36.43	41.78	22.58	0.000	0.032	0.015	0.010	100.86
	0.043	36.19	43.17	21.90	0.006	0.000	0.000	0.045	101.35
	0.000	36.24	43.10	21.48	0.000	0.000	0.000	0.030	100.84
	0.007	35.66	43.74	20.70	0.012	0.181	0.000	0.040	100.34
	0.000	36.14	43.35	21.45	0.000	0.014	0.000	0.015	100.97
	0.003	35.75	43.50	20.98	0.005	0.072	0.000	0.000	100.32
	0.000	36.12	43.25	21.47	0.027	0.000	0.000	0.000	100.86
	0.000	35.35	44.77	20.18	0.000	0.032	0.000	0.000	100.33
	0.007	35.82	44.04	20.81	0.010	0.010	0.000	0.009	100.70
	0.006	35.62	44.60	20.38	0.000	0.014	0.000	0.009	100.64
	0.022	33.34	38.46	19.66	0.000	0.060	0.000	0.000	91.54
	0.007	35.72	43.64	20.89	0.012	0.008	0.000	0.000	100.28
HiAu	0.015	35.29	43.77	20.87	0.000	0.022	0.029	0.332	100.32
HiAu	0.000	35.32	43.65	20.61	0.000	0.000	0.000	0.101	99.69
HiAu	0.011	35.29	43.92	20.32	0.000	0.033	0.022	0.118	99.71
HiAu	0.011	34.53	44.35	19.46	0.000	0.001	0.000	0.197	98.54
HiAu	0.007	34.94	43.94	20.59	0.000	0.000	0.000	0.134	99.60
HiAu	0.000	34.78	43.51	20.68	0.000	0.032	0.034	0.182	99.22
HiAu	0.000	35.49	43.86	20.58	0.000	0.005	0.000	0.277	100.21
	0.000	36.28	41.77	22.06	0.034	0.021	0.053	0.017	100.24
Average	0.009	35.72	42.94	21.48	0.005	0.020	0.006	0.051	100.23

Sample: 472a - Area 2



Sample: 472a - Area 2



As Au

Fe Cu

Width of image: 120 microns

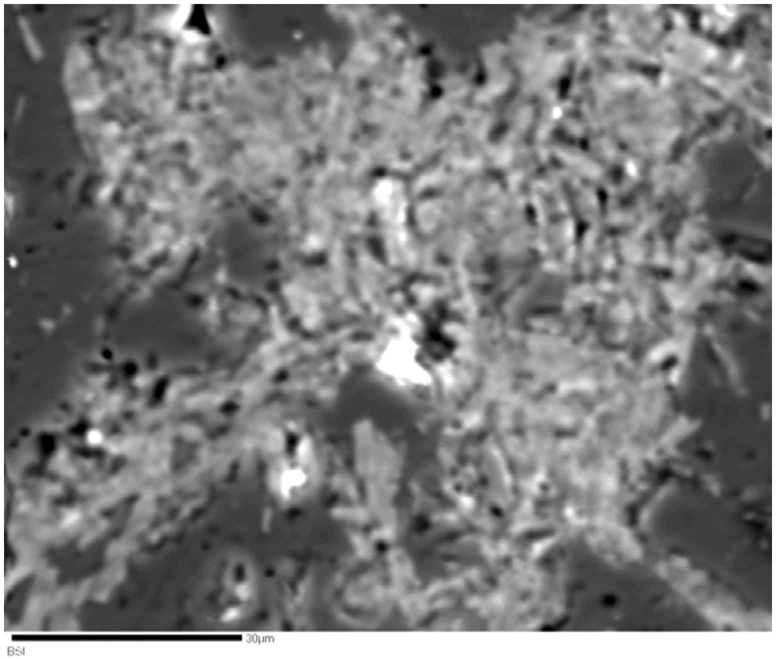
Gold Grain Microprobe Analysis Data

Sample: 472a - Area 2

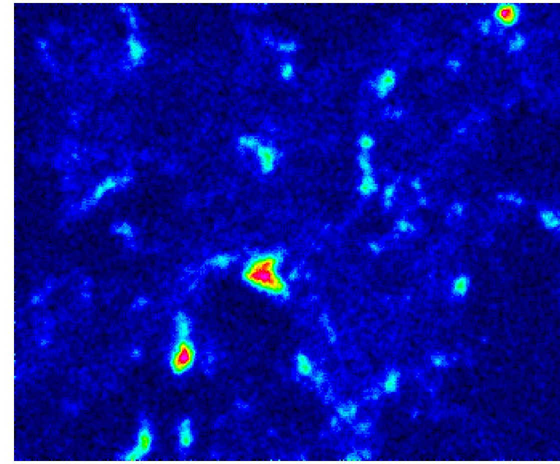
2 Grains within Pyrite

				Weight Percent					
	Cu	**Fe**	**As**	**S**	**Ag**	**Sb**	**Pb**	**Au**	**Total**
	0.04	4.30	0.31	1.02	22.20	0.00	0.00	68.97	96.84
	0.05	3.53	0.37	1.47	23.62	0.00	0.00	66.79	95.82
Average	**0.04**	**3.92**	**0.34**	**1.25**	**22.91**	**0.00**	**0.00**	**67.88**	**96.33**

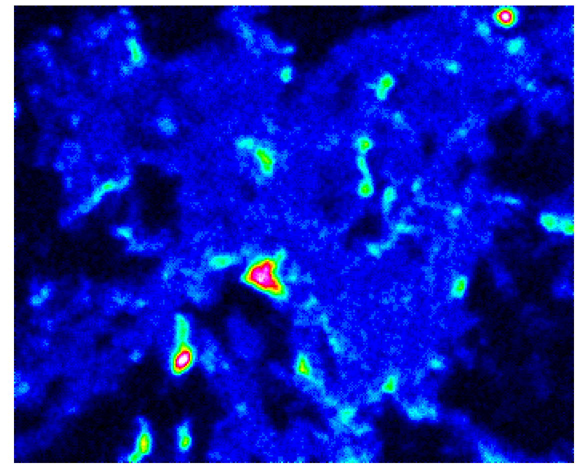
Sample 472a - Area 3



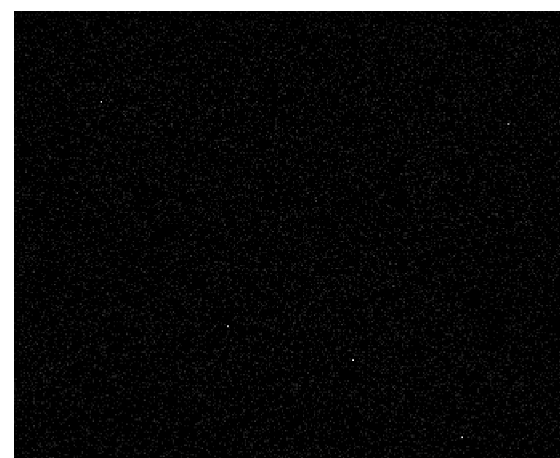
As



Fe



Au



Width of images: 100 microns

Silicate (Muscovite) Microprobe Analysis Data

	Weight Percent			
As	Ag	Au (rpt)	Fe	Cu
0.033	0.000	0.000	1.282	0.018
0.034	0.002	0.000	0.752	0.008
0.070	0.000	0.000	0.447	0.000
0.114	0.000	0.041	1.036	0.000
0.022	0.009	0.000	0.516	0.000
0.128	0.000	0.000	1.017	0.000
0.126	0.000	0.000	1.073	0.000
0.057	0.000	0.000	0.957	0.003
0.240	0.014	0.092	1.286	0.000
0.248	0.000	0.056	0.511	0.000
3.830	0.000	0.000	7.550	0.000
Average **0.446**	**0.002**	**0.017**	**1.493**	**0.003**

True Average gold:	0.007 wt%	
t-value:	0.588	
t Probability:	0.569	57% probability the average is actually zero)
True min dect limit:	0.025 wt.%	
(yellow)	anomalous values	

Chemical and Mineral Work Observations

- **Microprobe gold was observed in arsenopyrite, pyrite, and sericite**
- **Gold grains in pyrite was coarser (to 10 microns) than Au grains in arsenopyrite**
- **Gold grains in pyrite was finer that Au grains reported in quartz-carbonate veins in outcrops and core**
- **Gold positively correlates with potassium and negatively with sodium**
- **Dacite is the preferred host rock for gold mineralization**
- **Observed pyrite is zoned with higher arsenic rims.**

Chemical and Mineral Work Observations

- **Pyrite is locally enclosed within later arsenopyrite**

- **Largest gold values are related to elongate, arsenopyrite needles (low sulfidation conditions)**

- **“Invisible” gold is greatest in arsenopyrite**

- **Plots of previous Au analyses often have a single high Au bump, with smaller secondary bumps. As a general rule, the farther apart the secondary bumps are, the higher in magnitude they tend to be**

- **Arsenopyrite needles ore often broken with fragments variably displaced.**

Chemical and Mineral Work Observations

- **Pyrite and arsenopyrite with gold often have silicate, galena, and other inclusions**

- **Carbonate and organic carbon have negative correlation with gold**

- **Elongate arsenopyrite appear to be preferentially associated with fine-grained sericitic “fragments”, with less arsenopyrite in slightly coarser matrix.**

- **Silica chemistry is antipathetic to most other analyzed elements.**

- **Larger plagioclase phenocrysts have calcic cores, typically altered to chlorite, not epidote; with more sodic rims.**

Chemical and Mineral Work Observations

- **Strain shadows locally developed.**

- **Textures in dacite porphyry locally appear volcanic and fragmental, but fragments could also be alteration remnants.**

- **Fracturing and alteration within porphyry may be tectonic, but it often has an irregular appearance or orientation, and may represent cooling fractures (tectonically reactivated?).**

Chemical and Mineral Work Conclusions

- **Plots of previous DDH analyses may indicate that closer fracture spacing (and greater number of fractures for the same footage) tend to have lower Au values; as if secondary remobilization processes simply redistribute Au (and related alteration?) according to the number of secondary fractures. This says nothing of total amount of Au at a given place or within a given drill hole. Differences in the rheologic properties of the dacite bodies (thickness?, country rock?, silicification?) during deformation may explain this.**

- **More equigranular arsenopyrite (super-saturation with respect to sulfur) in other locations may be associated later remobilization.**

Chemical and Mineral Work Conclusions

- **Visible gold associated in quartz-carbonate veins may also be later remobilization.**

- **Primary sodium phase, plagioclase, appears to be altered/replaced by the major potassium phase, sericite.**

- **This altering of Na plagioclase to sericite appears to be related to Au and As mineralization.**

- **More uniform Na plagioclase phenocrysts kept starting to form beside overcoating the earlier phenocrysts with calcic cores.**

Chemical and Mineral Work Conclusions

▪ **Antipathetic nature of silica chemistry to many other analyzed elements, may indicate quartz-flooding or replacement (adding silica, diluting these other elements).**

▪ **Broken nature of arsenopyrite needles indicate early formation age relative to deformation.**

▪ **Serictic “fragments” origin is probably altered (non-zoned?) sodic plagioclase phenocrysts, with a lesser probability of them being filled amygdales, altered glass or pumice.**

▪ **Are galena, rutile, zircon, monazite inclusions (zoned distribution in pyrite and arsenopyrite) indicative of immiscible components?**

▪ **Dacite may be a mixture of volcanic and intrusive, and evolved**

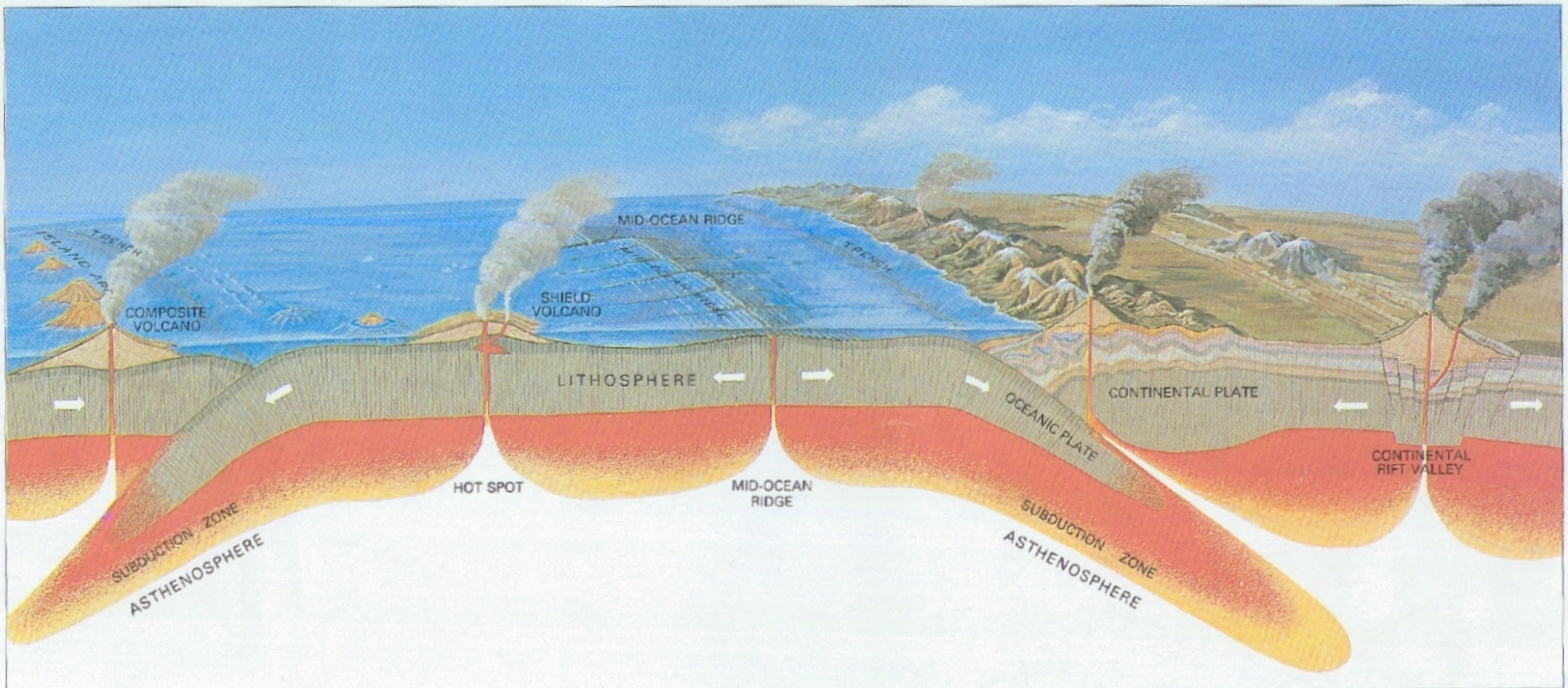
Chemical and Mineral Work Conclusions

- Dacite may be a mixture of volcanic and intrusive, and evolved volatile components (and primary gold?) may be volcanic related.

- Pyrite, arsenopyrite, carbonate, and plagioclase can all be zoned. Are there implications for them undergoing the same set of varying physical/chemical conditions? Or does timing preclude this.

- If mineralization has an important volcanic component, do original volcanic forms and stratigraphy influence metal distribution beyond fault and vein related alteration/mineralization?

With this, it's time to contemplate the past. . . .



Artwork by James Caldwell

Schematic cross section illustrating plate tectonics processes