A Report on the "Inferred Mineral Resource" at the Superior Graphite Property based on the 1999 Diamond Drill Program and prospecting during the year 2000

Slocan Mining Division, B.C.

NTS 82F/12

NAD 83 UTM 445361E, 5506798N

Prepared for:

Worldwide Graphite Producers Ltd.

By:

George G. Addie, P.Eng. (B.C.)
604 3rd St
Nelson, B.C.
Tel and Fax 250 352 2832
E-mail: ggaddie @ netidea.com

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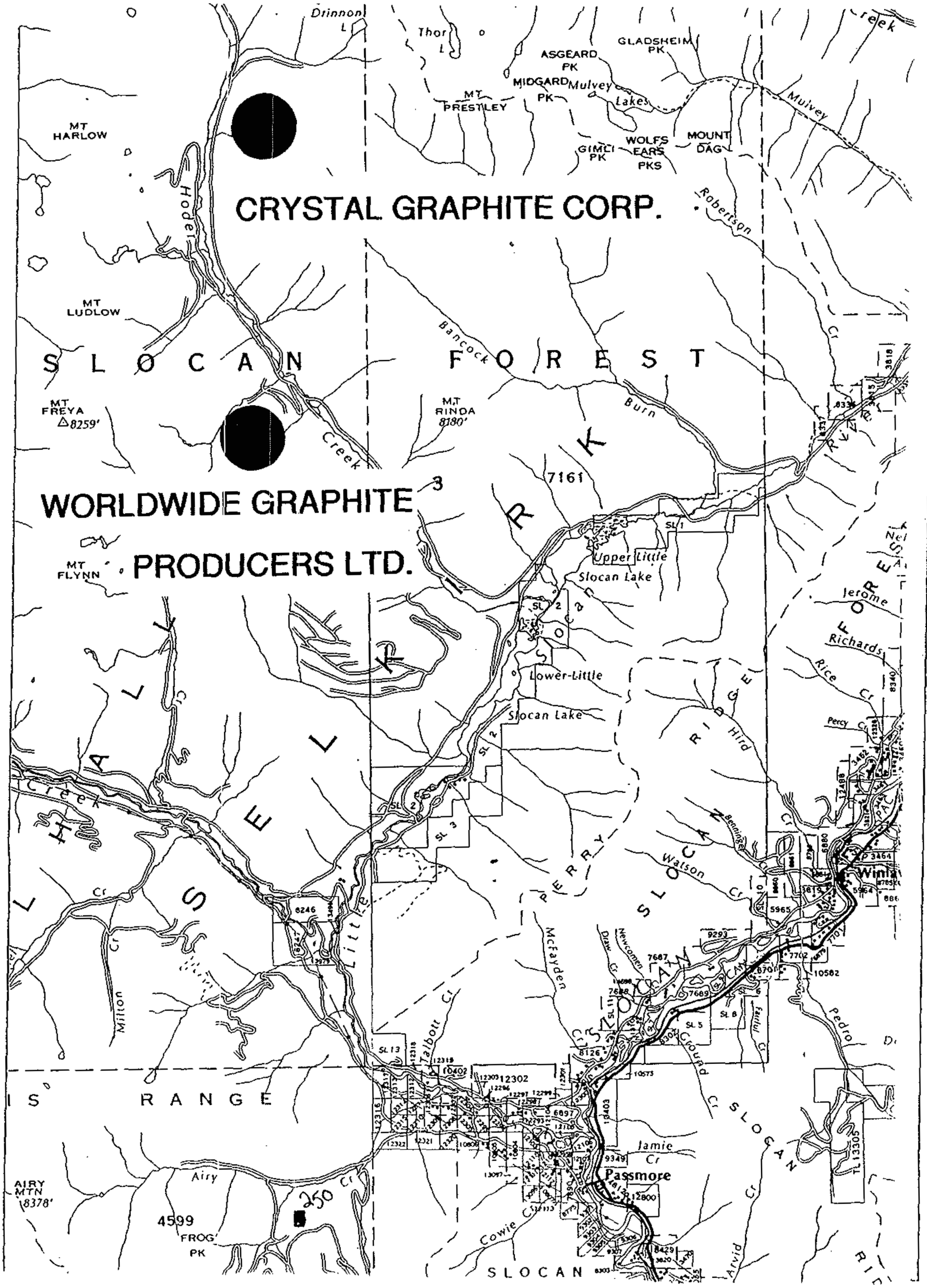

MAP 1 Location Map

Scale 1:125,000

Summary

A very large graphite mineral potential exists on the **"Worldwide Graphite Producers Ltd."** property. (Ref. Map 1 "Location Map") The known geological extent of the graphite covers an area of eight square miles (20.72 square kilometers). This euhedral crystal graphite is identical, occuring mostly in marble.

The following description of the graphite is from research done by Lakefield Research Ltd. (1998) from a report by Pearson, Hofman & Associates Ltd.:

Testwork indicated that upgrading by a combination of flotation and gravity separation could produce a good grade of graphite concentrate, with 45% to 50% of the graphite reporting to the plus 48 mesh fraction at a grade of over 95% C.

The regional structural geology is of a single monocline with crenulations. The general bearing is N-S with a 25 degree dip to the West. At the Superior Graphite property the general bearing is N22W with a dip of 25 degrees West. (Stereogram 1)

This paper uses six diamond drillholes drilled in 1999. By using strip logs and histograms, a new interpretation of the geology is presented. Thus it is proposed that a single graphite zone has been split into three by faulting. In certain areas such as diamond drillhole SG99-004 this faulting produces a stacking of the mineral zones. Too, the bearing of the graphite mineral zones at this location follows the contours to the south. An ideal exploration situation!

Using the information available, an estimate of the graphite resource can be made. It is 3.4 million tons at 1.4% Graphite. Within this resource it is expected that zones of 5% graphite can be found.

Further drilling is warranted.

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INTRODUCTION

Terms of Reference:

A fax was received on November 30, 2000 from Mr John Rapski of **Worldwide Graphite Producers Ltd.**, (A private company), for a report with an "Inferred Resource" estimate.

Definition of Inferred Mineral Resource: (CIM Standards on Mineral Resources and Reserves. August 20, 2000.)

An "Inferred Mineral Resource" is that part of a Mineral Resource for which quality and grade or quantity can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, working and drill holes.

Property Location and Access:

The **Superior Graphite** Property of Worldwide Graphite Producers Ltd. Is located thirty four kilometers from Passmore, B.C. (Ref: Map 1 Location Map). The Hoder Creek road is maintained by Slocan Forest Products, and Crystal Graphite Corp. It is the principal access road into the Drinnon Pass area of the Valhalla Provincial park located at the head of Hoder Creek valley.

The road up Freda Creek is a secondary Forestry road which has had low level deactivation and because of the water bars a four wheel drive is necessary.

Travel time from Nelson, B.C. to the main showing is two hours by vehicle.

Claim status:

At present the claims are all in good standing. (Ref: Table 1)

TABLE 1

Superior Graphite Property, Status, Sept 14, 2000 From Map Place

Owner	Claim Name	Tenure No	Units	Expiry Date
Worldwide Graphite	SUPERIOR IX	346875	6	2007 0612
Producers Ltd	SUPERIOR X	346876	3	2009 0612
"	SUPERIOR I	346877	1	2007 0612
"	SUPERIOR II	346878	1	"
"	SUPERIOR III	346879	1	"
"	SUPERIOR IV	346880	1	"
"	SUPERIOR V	346881	1	"
"	SUPERIOR VI	346882	1	"
"	SUPERIOR VII	346883	1	"
"	SUPERIOR VIII	346884	1	"
"	SUPERIOR XI	346885	1	2007 0613
"	SUPERIOR XII	346886	1	"
"	SUPERIOR XIII	346887	1	"
"	SUPERIOR XIV	346888	1	"
"	SUPERIOR XV	346889	1	"
"	SUPERIOR XVI	346890	1	"
"	SUPERIOR XVII	346891	1	"
"	SUPERIOR XVIII	346892	1	"
"	SUPERIOR XIX	346893	1	2007 0614
"	SUPERIOR XX	346894	1	"
International Mineral	SUPERIOR XXI	346895	1	2008 0614
Resources Ltd	SUPERIOR XXII	346896	1	"
"	SUPERIOR XXIII	346897	1	"
"	SUPERIOR XXV	346898	1	"
Worldwide Graphite	SUPERIOR XXV1	346899	1	"
Producers Ltd	SUPERIOR XXVII	346900	1	2007 0614
"	SUPERIOR XXVII	346901	1	2007 0616
"	SUPERIOR XXVIII	346902	1	"
"	SUPERIOR XXIX	346903	1	"
"	SUPERIOR XXX	347428	1	2007 0701
"	SUPERIOR XXXI	347429	1	"
"	SUPERIOR XXXII	347430	1	"
"	SUPERIOR XXXIII	360029	16	2008 1021
"	SUPERIOR XXXIV	360030	20	2007 1021
"	SUPERIOR XXXV	360031	16	2007 1024
"	SUPERIOR XXXVI	360032	18	2008 1024
"	MOTHER SUPERIOR	365015	16	2008 0809

Superior Graphite Property. New Claims Yr. 2000

Owner	Claim name	Tenure Number	Units	Expiry Date
Worldwide	Amar	381757	1	2001 10 20
Graphite	Gracia	381758	1	2001 10 20
Producers Ltd.	Nissim	381759	1	2001 10 20
"	Emile	381760	1	2001 10 20
"	Solange	381761	1	2001 10 20
"	Dady	381762	1	2001 10 20
"	Claude	381763	1	2001 10 21
"	Babette	381764	1	2001 10 21
"	Bradley	381765	1	2001 10 22
"	Stefni	381766	1	2001 10 22

Survey:

The map used in this report is from a report by **SNC-Lavalin Engineers and Constructors** dated June 15, 2000. This is a chain and compass survey at the scale of 1:2500. No contours are on the map.

The above information has been transposed onto a Forestry trim map which has a scale of 1:2500 and on the NAD 83 grid. Thus by taking GPS readings on ddh SG99-003 it was found that the above map fitted well. However, no ground check survey has been done. Now that the contours are available from the trim map new elevations are available for the ddh collars. (Ref: Table 2)

TABLE 2

SG99 Diamond Drill Hole Locations based on NAD83 and ddh SG99-003

Drill Hole	Easting	Northing	Elevation(m)	Original	Difference (m)
1	445245	5506960	1360	1400	40
2	445268	5506898	1397	1444	47
3	**445361**	**5506798**	**1420**	**1454**	**34**
4	445431	5506698	1447	1468	21
5	445156	5506975	1351	1400	49
6	445156	5506998	1351	1400	49
7	445156	5506998	1351	1400	49
8	445174	5507056	1335	1377	42
9	445174	5507056	1335	1377	42

GEOLOGY

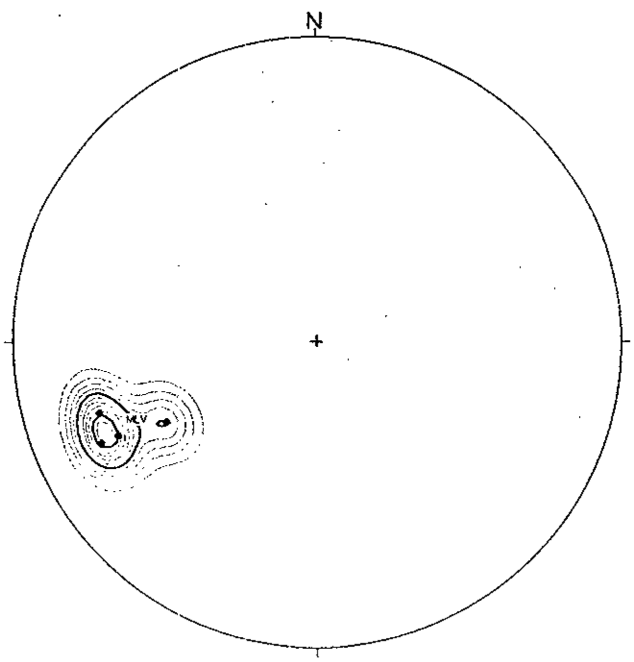
Regional:

The Superior Graphite deposit is within a large metamorphic complex called the "Valhalla Gneiss Complex". This has been described by Reesor (1965) in the Geological Survey of Canada Memoir 308. On his map 1176A a large zone of marble is shown crossing Hoder Creek and includes the Superior Graphite showings. The structural contours at Hoder Creek indicate a strike of N40E and dip of 21 degrees NW. This zone is probably a monocline with crenulations. This interpretation would account for both the Superior Graphite showings and those at the Crystal Graphite Corp property.

Property:

Structural Geology:

Three graphite rich zones have been found. The average strike and dip for these zones is N25W dipping 25 degrees to the SW. (Ref: Stereonet 1). Considering the Hoder Creek bearing mentioned above it is likely that a small anticline exists north of Freda Creek. This would have a bearing of N72W with a plunge of 19 degrees to the NW.



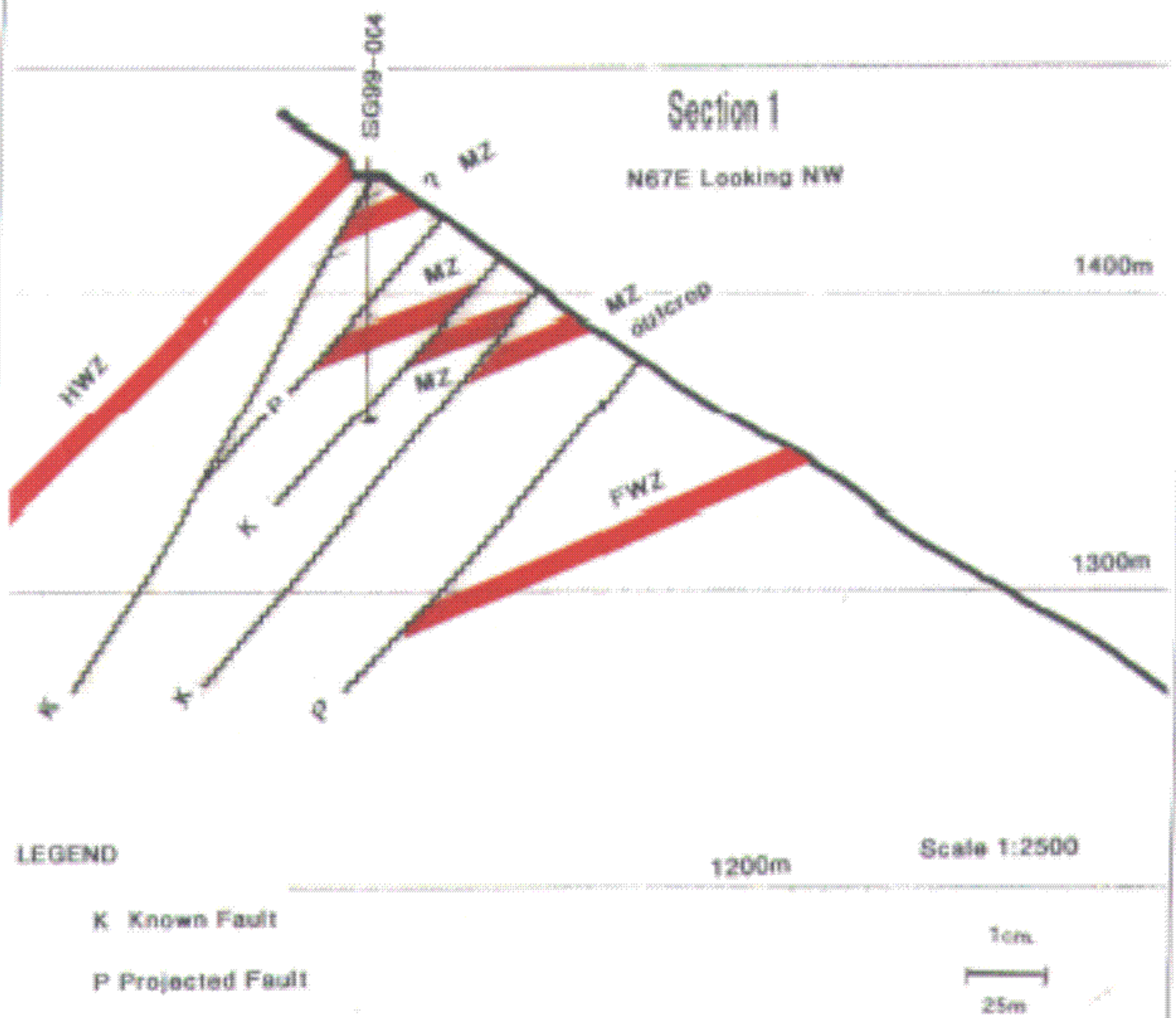
Projection	Schmidt (Equal Area)
Number of Sample Points	4
Mean Lineation Azimuth	246.2
Mean Lineation Plunge	29.4
Great Circle Azimuth	72.8
Great Circle Plunge	78.5
1st Eigenvalue	0.977
2nd Eigenvalue	0.021
3rd Eigenvalue	0.002
LN (E1 / E2)	3.861
LN (E2 / E3)	2.319
(LN(E1/E2)) / (LN(E2/E3))	1.665
Spherical variance	0.0114
Rbar	0.9886

Stereonet 1

Mineral Zone Poles

Structural Geology (continued)

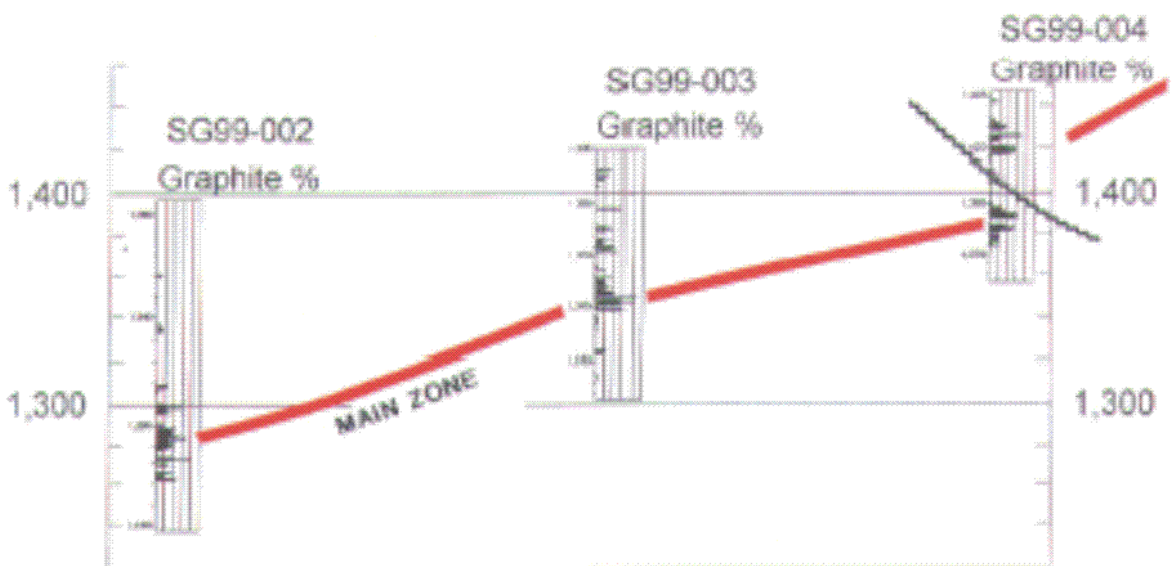
Excellent diamond drill hole (ddh) logs for the 1999 drilling have been made by **SNC-Lavalin Engineers and Constructors**. From them, strip logs and assay histograms have been made. (Appendix A). From this information a cross section along the drill holes can be made. (Ref. Section 2)



Structural Geology (continued)

Excellent diamond drill hole (ddh) logs for the 1999 drilling have been made by **SNC-Lavalin Engineers and Constructors**. From them, strip logs and assay histograms have been made. (Appendix A). From this information a cross section along the drill holes can be made. (Ref: Section 2)

SECTION 2



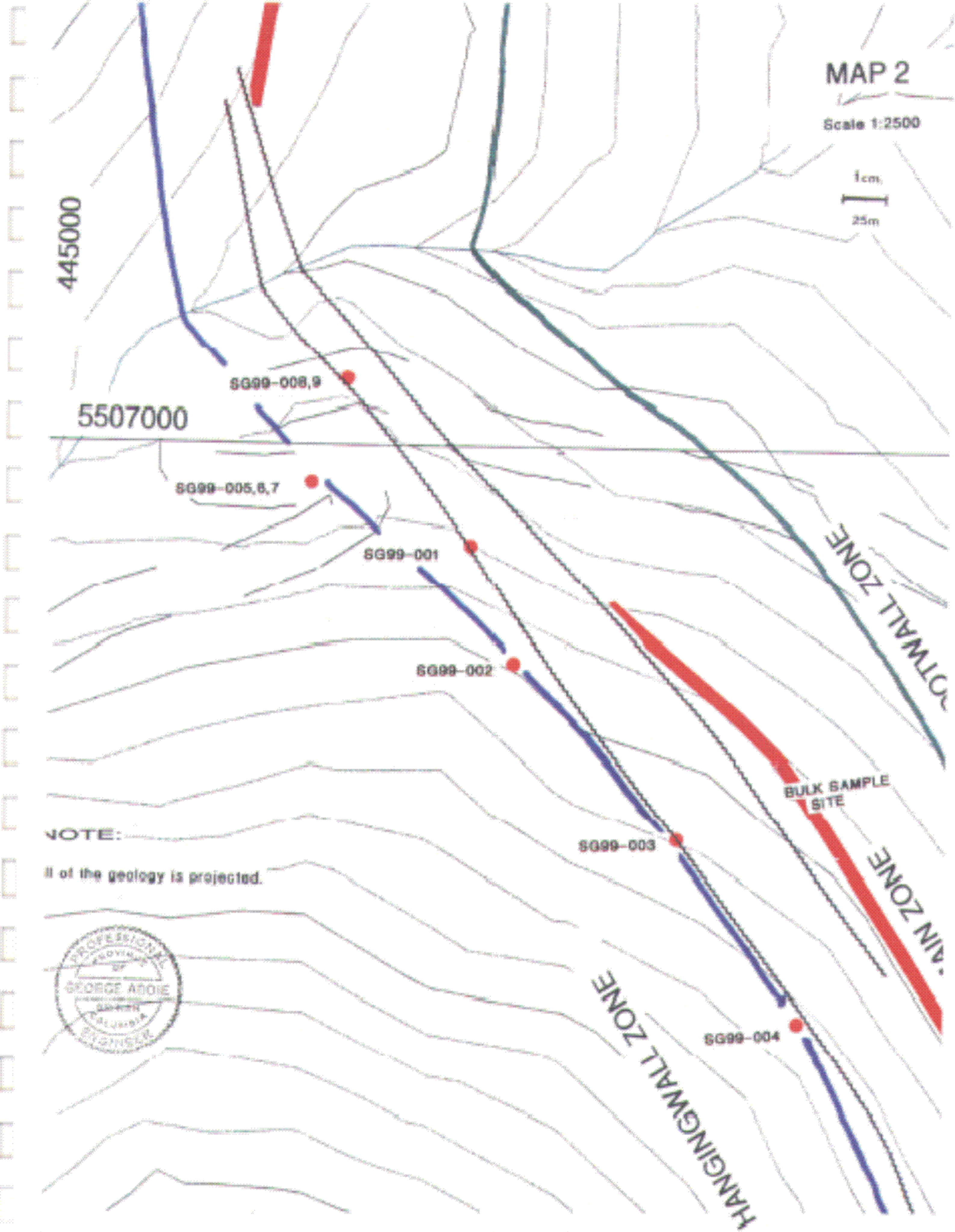
Vertical Scale 1:3636

Horizontal Scale 1:2341

Structural Geology (continued)

The surface geological map gives some indication of the complexity of finding mineral zones when a number of thrust faults occur. (Ref: Map 2). On this map only two faults are shown. These are parallel, striking N29W and dipping steeply to the SW. It is noted that a ground VLF-EM survey by **Quantec Consulting Inc.** has at least eight long anomalies at N30W. One interpretation of these anomalies is that they are faults. If so, the mineral zones may be repeated many more times.

The surface trace of the mineral zones indicate that both North of Freda Creek, and South of ddh SG99-004, that the mineral zones follow the contours. This is an ideal situation for bench mining.


MAP 2
Scale 1:2500
1cm
25m
445000
5507000
SG99-008,9
SG99-005,6,7
SG99-001
SG99-002
SG99-003
SG99-004
BULK SAMPLE SITE
OTWALL ZONE
AIN ZONE
HANGINGWALL ZONE
OTE:
ll of the geology is projected.
GEORGE ADDIE

Statistics:

It is assumed that all the graphite assays have been done using the LECO method. Three labs are involved and except for **Lakefield Research** it is not known if quality control has been used. The latter reports that the limit of detection is 0.1%; precision +,- 5%; and accuracy at +,- 5%.

The histogram (Ref: Histogram 1) for all the assays from the 1999 drill program, except the check assays, indicates a log normal distribution with a Mean of 0.8% Carbon.

The histogram (Ref: Histogram 2) for all of the year 2000 assays including some core assays, shows an identical log normal distributrion with a Mean of 0.8% Carbon.

To date no one has been able to visually estimate the graphite content of a rock. All natural graphite contains some ash. In the Leco process this is eliminated to give a true carbon content. Thus it is suspected that the carbon assays will always underestimate the graphite.

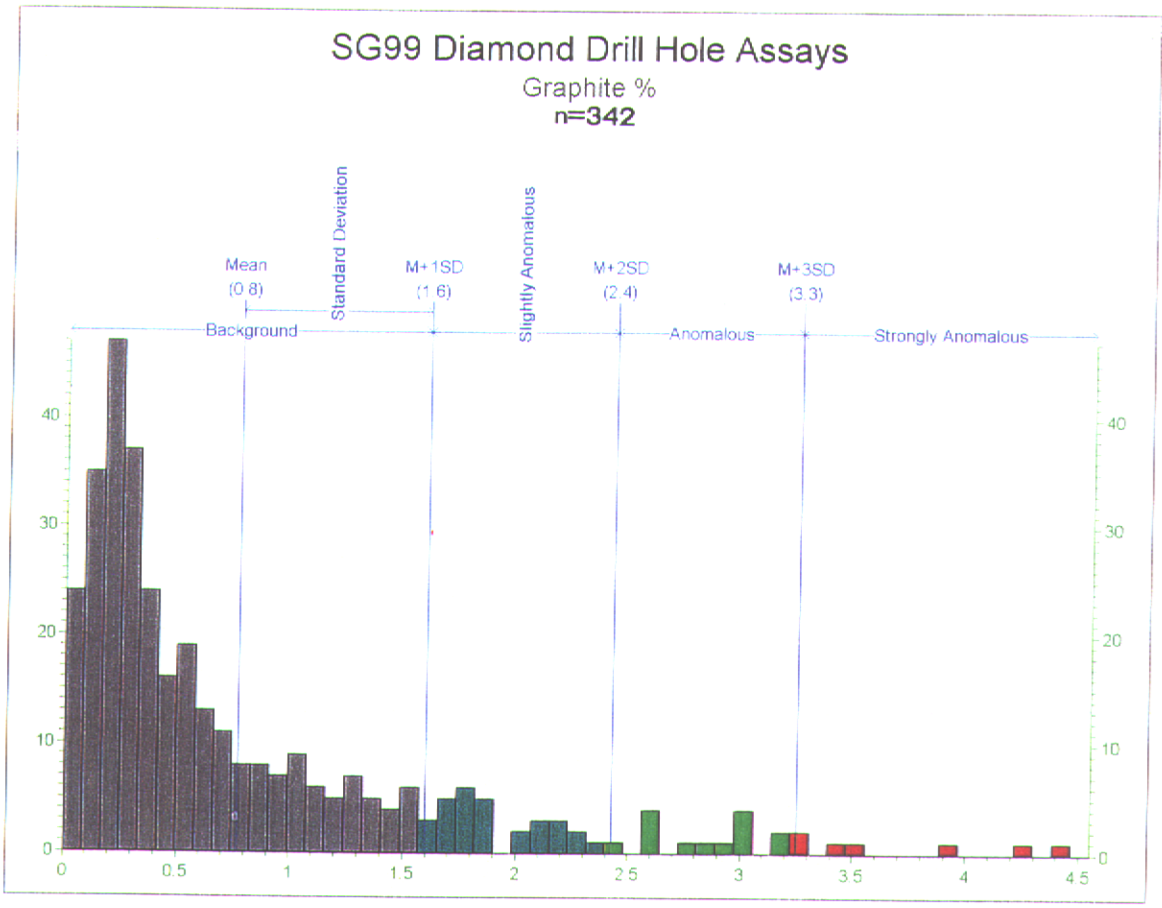
The only way to solve this dilemma is to use another process. This process would be to grind the sample, float the graphite, and then weigh it. This has the advantage of being close to a mill process.

In this report the carbon assays have been accepted as the graphite content.

Regression Analysis:

A comparison of the SG99 core assays with check assays indicates a high degree of correlation. However, when a graph is made (Graph 1) it is clear that at least four assays do not fit. One core assay is for 2.6% Carbon and its check assay is 0.27 % Carbon. It is thus clear that check assays must be part of the standard procedure.

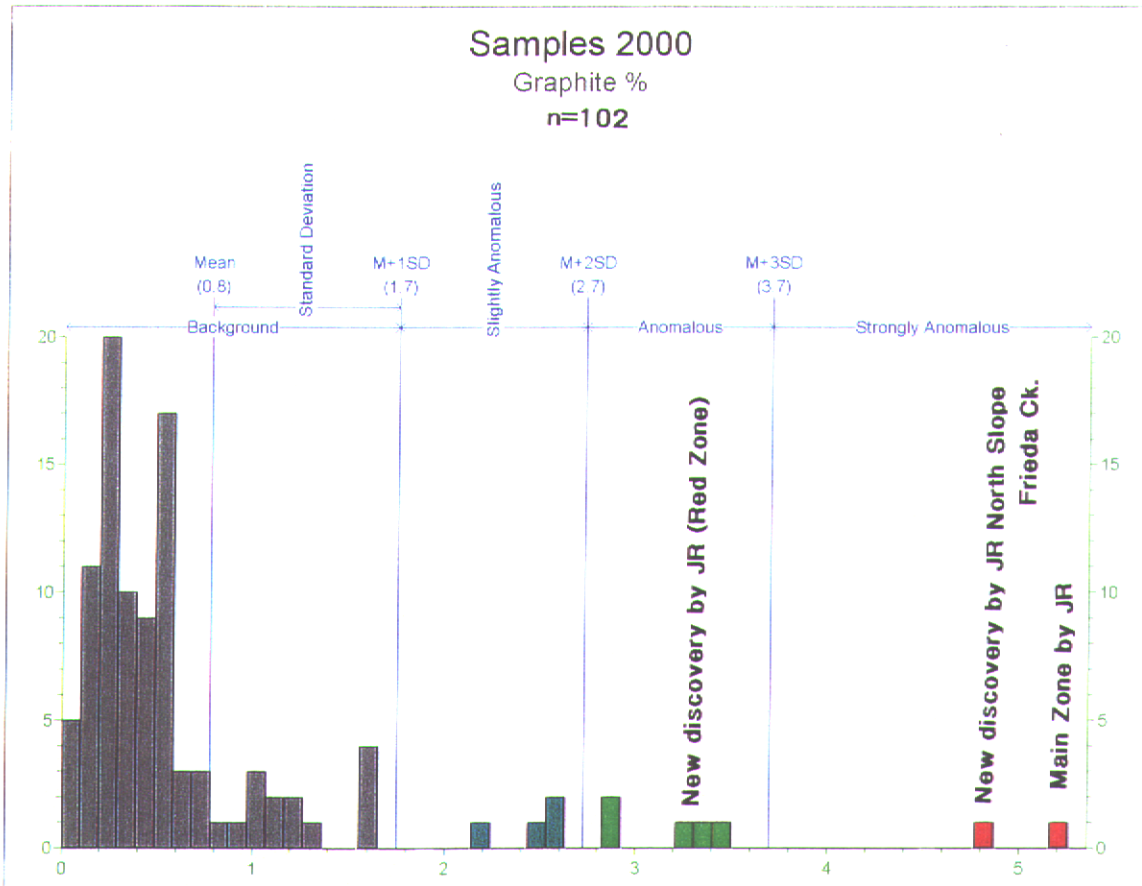
HISTOGRAM 1




```
Univariate Statistics:

  Population ........... 342
  Minimum Value ........ 0.02
  Maximum Value ........ 4.44
  Range ................ 4.42
  Mean ................. 0.770965
  Standard Deviation ... 0.826696
  Standard Error ....... 0.044703
  Median ............... 0.445
  Sum .................. 263.67
  Sum of Squares ....... 436.3287
  Variance ............. 0.683426
  Skewness ............. 1.791551
  Kurtosis ............. 3.13813
```

HISTOGRAM 2



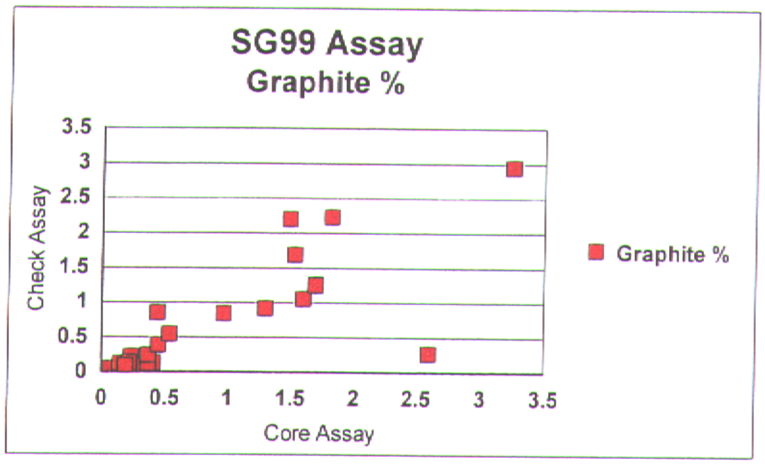
Univariate Statistics:

Population	103
Minimum Value	0.01
Maximum Value	5.23
Range	5.22
Mean	0.775146
Standard Deviation ...	0.973532
Standard Error	0.095925
Median	0.45
Sum	79.84
Sum of Squares	158.5596
Variance	0.947764
Skewness	2.477422
Kurtosis	6.360863

Comparison of SG99 Graphite Assays with Check Assays

SG99 Assay Graphite %	Check Assay Graphite %
0.24	0.14
0.24	0.23
0.17	0.08
0.07	0.05
0.44	0.85
0.26	0.09
1.53	1.69
0.41	0.13
0.15	0.12
0.37	0.12
1.6	1.05
1.49	2.21
0.22	0.1
0.22	0.13
2.6	0.27
1.7	1.27
0.37	0.24
1.3	0.92
3.25	2.95
1.7	1.25
0.19	0.09
1.82	2.23
0.97	0.84
0.45	0.39
0.54	0.55

Assay 1/2	Regression Output:	
Constant		0.0470966
Std Err of Y Est		0.4966515
R Squared		0.6404265
No. of Observations		25
Degrees of Freedom		23
X Coefficient(s)	0.7539276	
Std Err of Coef.	0.1177945	
99.9% Correlation Coefficient		



Statistics: (continued)

From the SG99 drilling logs nineteen samples were analyzed for the specific gravity of the marble. This is necessary for ore calculations. The mean of 2.74 has been used.

Specific Gravity SG99

Univariate Statistics:

```
Population ........... 19
Minimum Value ........ 2.64
Maximum Value ........ 2.86
Range ................ 0.22
Mean ................. 2.742105
Standard Deviation ... 0.055436
Standard Error ....... 0.012718
Median ............... 2.75
Sum .................. 52.1
Sum of Squares ....... 142.919
Variance ............. 0.003073
Skewness ............. -0.014069
Kurtosis ............. -0.647881
```

	Specific G
1	2.69
2	2.64
3	2.65
4	2.78
5	2.78
6	2.86
7	2.73
8	2.76
9	2.79
10	2.69
11	2.71
12	2.8
13	2.76
14	2.71
15	2.79
16	2.75
17	2.73
18	2.78
19	2.7

Statistics: (continued)

Three point calculations for strike and dip:

Surface bearings of beds or other linear structures can vary depending on the exact location. Using widely spaced elevations from diamond drill logs sometimes eliminates this problem, assuming no faults are involved.

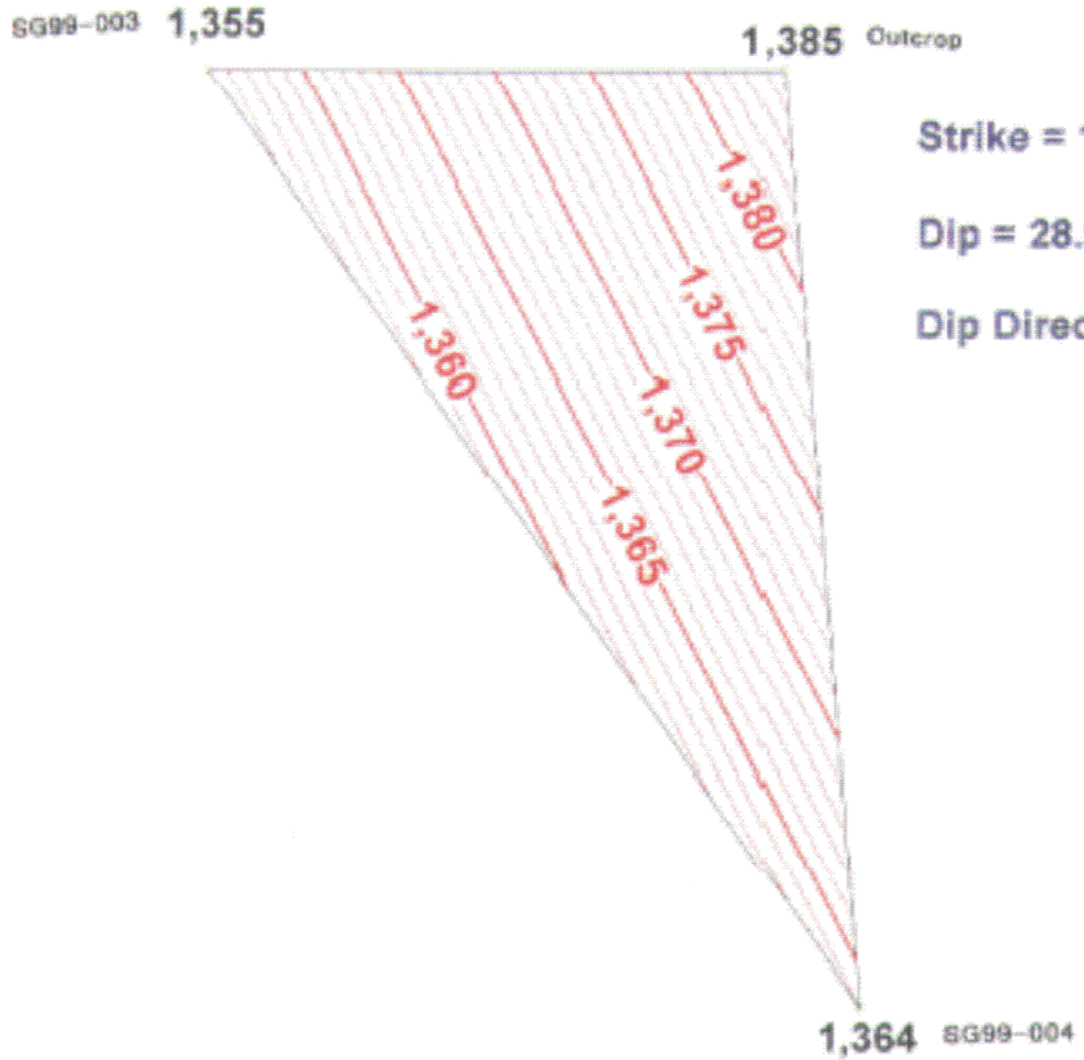
Diagram 1 is of the Main Zone and its intersection in two drill holes. Triangular diagrams can be used to calculate reserves. The extension of this triangle to the South and North becomes the key to future exploration.

Diagram 2 is based on faults observed in three diamond drill holes. The fault separates the Hanging Wall Zone from the Main Zone. As suggested in Section 2 there is a possibility that the two zones are the same.

Diagram 3 also is based on the diamond drill log. The fault is parallel to that in diagram 2 and also cuts the Main Zone. (Ref: Map 2)

The identification of faults in the diamond drill core is absolutely vital to deciphering the geology. This is why to a geologist the core is worth its weight in Gold. Some of the faults are obvious in the core. Some are only found by measuring the distance between the driller's wooden blocks in the core box. This has not yet been done. The core recovery is also based on these measurements. Sometimes a fault can be very thin line of gouge. That is why quartering of the core is not recommended as the result is gravel, and any hint of a fault is lost.

BEDDING – MAIN ZONE



Strike = 152.661 N27W

Dip = 28.971

Dip Direction = 242.661

Scale 1:789

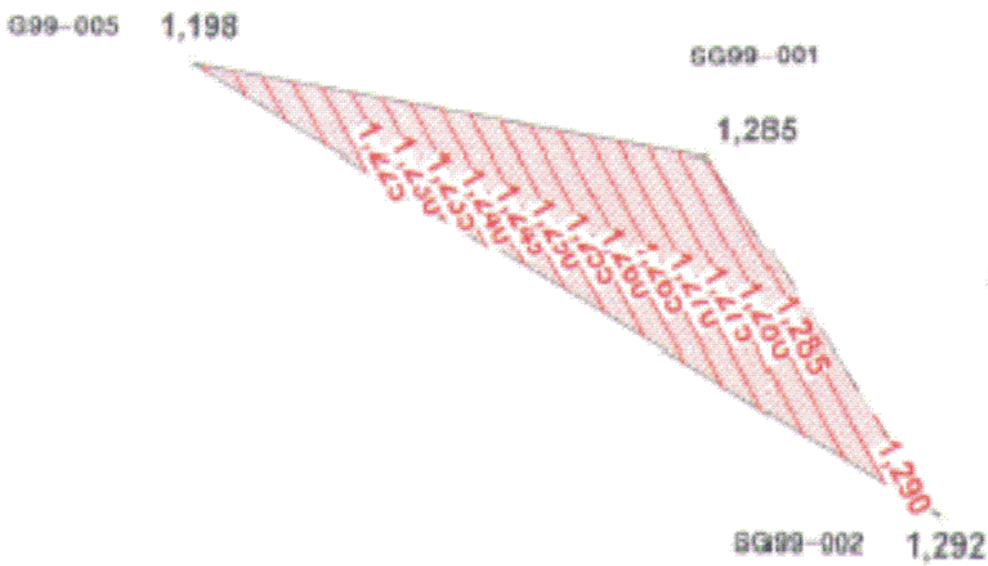
FAULT

Strike = 151.383 N29W

Dip = 61.466

Dip Direction = 241.383

Scale 1:1672



FAULT

Strike = 150.899 N29W

Dip = 50.993

Dip Direction = 240.899

Scale 1:1282

Tonnage and Grade Calculations:

The tonnage and grade are based on Map 2, Section 1, and the SG99 diamond drill logs.

It is assumed that split core gives the best sample because they are independent of bias which may occur with outcrop sampling. This is possible if the core recovery is very high. This is assumed in the SG99 drilling.

In the **SNC-Lavalin Engineers and Constructors** report of June 15, 2000, (p.26) the following is stated: "*The 1998 Metallurgical Test Sampling Program for the Superior Graphite Property, (AR25804) reports the average grade of the bulk sample collected from the MA was in excess of 7% graphite.*"

The horizontal lengths used in this report are from drillhole to drillhole. The down dip lengths have been measured from Section 1. The true widths have been calculated using the angles of intersection or core angle (CA) from the logs. The Specific Gravity used is the average value found in the SG99 logs. (P.15)

Thus with the information available an **estimate** of the grade is **3.4 million tons with a grade of 1.4% graphite**.

Tonnage and Grade Calculations: Yr.2000
From SG99 drill holes

TONNAGE

Zone	Down Dip See Sec 1	Horizontal Length (m)	True Width (m)	Specific Gravity	Tonnes	Tons *1.1
Main Zone	112.5	350	15.2	2.74	1639890	1803879
FW Zone	140	420	5.5	2.74	886116	974727.6
HW Zone	50	400	11.93	2.74	653764	719140.4
Total					3179770	3497747

GRADE

Zone	DDH	Weighted Graphite%	Average
Main	SG99-004	1.7	
	SG99-003	1.8	
	SG99-002	1.4	
			1.6
FW	SG99-002	1.2	
	SG99-005	0.9	
	SG99-001	1.4	
	SG99-006	1.7	
			1.3
HW	SG99-004	1.5	
	SG99-003	1	
			1.2

Average of all zones 1.4

Average Grade Calculations Yr-2000

Main Zone	DDH	Graphite %	From	To	Width (m)	True Width Sin 75	TW*G
	SG99-004	1.27	53.85	54.85	1	0.9659	1.226693
		1.53	54.85	56	1.15	1.110785	1.699501
		1.82	56	57	1	0.9659	1.757938
		3.18	57	58	1	0.9659	3.071562
		3.27	58	59	1	0.9659	3.158493
		0	59	59.3	0.3	0.28977	0
		3.18	59.3	59.74	0.44	0.424996	1.3514873
		0	59.74	62.5	2.76	2.665884	0
		1.76	62.5	63.5	1	0.9659	1.699984
		2.99	63.5	64.5	1	0.9659	2.888041
		2.62	64.5	65.5	1	0.9659	2.530658
		1.31	65.5	66.15	0.65	0.627835	0.8224639
						Sum	Sum
						11.88057	20.206821
							Average
							1.7008293
						Sin 65	
	SG99-003	1.22	62.65	63.65	1	0.906	1.10532
		1.09	63.65	64.85	1.2	1.0872	1.185048
		0	64.85	65.6	0.75	0.6795	0
		1.7	65.6	66.6	1	0.906	1.5402
		1.07	66.6	67.6	1	0.906	0.96942
		1.81	67.6	68.6	1	0.906	1.63986
		2.26	68.6	69.6	1	0.906	2.04756
		2.18	69.9	69.9	0	0	0
		0.55	69.9	70.5	0.6	0.5436	0.29898
		4.44	70.5	70.8	0.3	0.2718	1.206792
		0	70.8	71.65	0.85	0.7701	0
		2.89	71.65	72.6	0.95	0.8607	2.487423
		4.25	72.6	73.6	1	0.906	3.8505
		2.77	73.6	74.6	1	0.906	2.50962
		0.37	74.6	75.8	1.2	1.0872	0.402264
		3.23	75.8	77.1	1.3	1.1778	3.804294
						Sum	Sum
						12.8199	23.047281
							Average
							1.7977739
						Sin 80	
	SG99-002	1.11	97.2	98	0.8	0.78784	0.8745024
		3.05	98	99	1	0.9848	3.00364
		1.3	99	100	1	0.9848	1.28024
		0.81	100	101	1	0.9848	0.797688
		1.58	101	101.84	0.84	0.827232	1.3070266
		0	101.84	106.4	4.56	4.490688	0
		0.83	106.4	107.54	1.14	1.122672	0.9318178
		0.08	107.54	108	0.46	0.453008	0.0362406
		2.26	108	109	1	0.9848	2.225648
		1.71	109	110	1	0.9848	1.684008
		1.88	110	111	1	0.9848	1.851424
		1.77	111	112	1	0.9848	1.743096
		2.64	112	113	1	0.9848	2.599872
		3.46	113	114	1	0.9848	3.407408
		1.45	114	115	1	0.9848	1.42796
		2.22	115	116	1	0.9848	2.186256
		1.6	116	117	1	0.9848	1.57568
		2.05	117	118	1	0.9848	2.01884
		1.56	118	118.51	0.51	0.502248	0.7835069
						Sum	Sum
						20.986088	29.734854
							Average
							1.4168841

Average Grade Calculations Yr-2000

HW Zone	DDH	Graphite%	From	To	Width (m)	True Width Sin 65	TW*G
	SG99-004	1.85	16.5	17.5	1	0.906	1.6761
		1.59	17.5	18.4	0.9	0.8154	1.296486
		1.33	18.4	18.87	0.47	0.42582	0.5663406
		0	18.87	20.74	1.87	1.69422	0
		3.52	20.74	21.9	1.16	1.05096	3.6993792
		1.27	21.9	22.68	0.78	0.70668	0.8974836
		1.36	22.68	22.88	0.2	0.1812	0.246432
		0.63	22.88	24.28	1.4	1.2684	0.799092
		0.33	24.28	24.98	0.7	0.6342	0.209286
		0.07	24.98	25.98	1	0.906	0.06342
		3.03	25.98	27	1.02	0.92412	2.8000836
		1.82	27	28	1	0.906	1.64892
		2.96	28	29	1	0.906	2.68176
		2.48	29	30	1	0.906	2.24688
		1.7	30	30.37	0.37	0.33522	0.569874
						Sum	Sum
						12.56622	19.401537
							Average
							1.5439438
						Sin 60	
	SG99-003	1.25	35.36	36.7	1.34	1.16044	1.45055
		1.79	36.7	37.77	1.07	0.92662	1.6586498
		0.22	37.77	38.37	0.6	0.5196	0.114312
		0.94	38.37	39.12	0.75	0.6495	0.61053
		0	39.12	40.16	1.04	0.90064	0
		2.01	40.16	40.34	0.18	0.15588	0.3133188
		0	40.38	41.63	1.25	1.0825	0
		0.8	41.63	42.63	1	0.866	0.6928
		1.68	42.63	43	0.37	0.32042	0.5383056
		0.67	43	44	1	0.866	0.58022
		0.83	44	44.73	0.73	0.63218	0.5247094
		0.3	44.73	45.58	0.85	0.7361	0.22083
		2.19	45.58	46.63	1.05	0.9093	1.991367
		2.11	46.63	47.56	0.93	0.80538	1.6993518
		0	47.56	48.22	0.66	0.57156	0
		2.6	48.22	48.44	0.22	0.19052	0.495352
						Sum	Sum
						11.29264	10.890296
							Average
							0.9643712

Average Grade Calculations Yr-2000

FW Zone	DDH	Graphite %	From	To	Width (m)	True Width Sin 70	TW*G
	SG99-002	2.07	124.29	125.2	0.91	0.85449	1.7687943
		3.92	125.2	126	0.8	0.7512	2.944704
		0.13	126	127.09	1.09	1.02351	0.1330563
		0.13	127.09	127.32	0.23	0.21597	0.0280761
		1.49	127.32	128	0.68	0.63852	0.9513948
		1.53	128	129	1	0.939	1.43667
		0	129	131.4	2.4	2.2536	0
		1.74	131.4	132.4	1	0.939	1.63386
		0.53	132.4	133.4	1	0.939	0.49767
		1.02	133.4	134.4	1	0.939	0.95778
		2.32	134.4	135.9	1.5	1.4085	3.26772
						Sum	Sum
						10.90179	13.619725
							Average
							1.2493109
						Sin 60	
	SG99-005	1.68	138.31	139	0.69	0.59754	1.0038672
		0	139	140	1	0.866	0
		1.02	140	140.53	0.53	0.45898	0.4681596
		0.75	140.53	141.53	1	0.866	0.6495
		1.4	141.53	142.53	1	0.866	1.2124
						Sum	Sum
						3.65452	3.3339268
							Average
							0.9122749
						Sin 70	
	SG99-001	1.53	102.31	103.31	1	0.939	1.43667
		1.23	103.31	104.2	0.89	0.83571	1.0279233
		0.4	104.2	104.6	0.4	0.3756	0.15024
		2.58	104.6	105	0.4	0.3756	0.969048
						Sum	Sum
						2.52591	3.5838813
							Average
							1.4188476
						Sin 80	
	SG99-006	1.46	103.52	104.52	1	0.98	1.4308
		0.76	104.52	105.52	1	0.98	0.7448
		3.35	105.52	106.52	1	0.98	3.283
		1.39	106.52	107.52	1	0.98	1.3622
		1.53	107.52	108.52	1	0.98	1.4994
						Sum	Sum
						4.9	8.3202
							Average
							1.698

RECOMMENDATIONS

Priorities:

1. The model of mineral zone "stacking" needs to be proven.

2. Higher grade mineral areas within the known zones need to be found. At present the best exploration area is between ddh SG99-002 and SG99-004, and to the South.

3. The tonnage needs to be increased. Objective: 10 million tons. A drill program will be needed.

Task 1:

Clearly the model of stacking at ddh SG99-004 requires several new long diamond drill holes on Section 1.

Task 2:

Both VLF-Em 16 and Self Potential (SP) tests were conducted last Fall. While both responded to the Main Zone area the SP gave the most dramatic (off scale) results. It is recommended that two surveyed grids (with tie lines) be established over an area South of SG99-002 for 800 meters and another North of Freda Creek starting at the end of an old logging road (Ref: Location Map 1) for 1000 meters. A SP survey should be done in both of these areas.

Task 3:

New contour roads are needed to the above SP anomalies. This would be followed by new deep hole drilling with no less than BQ (45mm) core. Core racks and a core shed are needed.

CONCLUSION

A very large graphite mineral zone exists on the property of **Worldwide Producers Ltd.** The main mineralization is in marble. Discoveries this Fall indicate that some of the schists may also be economical. Three zones of mineralized marble are known. The best, the Main Zone, has graphite which is identical to that found at **Crystal Graphite Corp** approximately five miles (eight kilometers) to the North. This property is presently being explored. (Ref: Map 1 Location Map). Note: The area North of Freda creek to the Worldwide Producers Ltd. boundary has not been explored by diamond drilling.

The regional structure is of a single monocline with crenulations. The general bearing is N-S with a 25 degree dip to the West.

A new model developed from the 1999 drill program proposes that the three mineral zones may be actually one, cut by major faults. In the area of diamond drillhole SG99-004 this faulting produces a "stacking" of mineral zones. This is the kind of structure that is needed for an open pit mine model. Another type of mining would be simple single benching where the zone follows the contours. Two such areas are proposed. One is South of ddh SG99-004, the other is North of Freda Creek .

An estimate of the graphite resource has been made, (using a 1% cut-off grade.) to be 3.4 million tons at 1.4% Graphite. Within this resource it is expected that zones of 5% graphite can be found.

The property may be classified as being in a "prospect" stage.

Further drilling is warranted.

STATEMENT OF QUALIFICATIONS

I, GEORGE G. ADDIE, P.ENG., do hereby certify:

1. That I am a Professional Engineer of the Province of British Columbia residing at 604 3rd Street, Nelson, B.C., V1L 2P9.

2. That I am a graduate of Mount Allison University of Sackville, New Brunswick, and Washington State University, Pullman, Washington, having obrtained a Science Degree in Geology from each university.

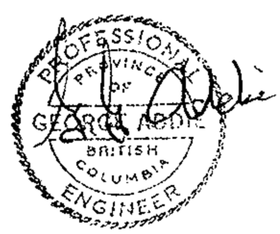
3. That I have practiced my profession in Geology since 1959 for Rio Algom Mines., (Elliot Lake, Ontario), Bralorne Pioneer Gold Mines, B.C. Phoenix Copper Mine, at Grand Forks, B.C., Pend Oreille Mines Ltd., Metaline Falls, Washington State, the Reeves MacDonald Mine, Remac, B.C. and at Cominco's Sullivan Mine, Kimberly, B.C.

4. That I have served as a Professional Geologist for J.C. Sproule and Associates of Calgary, Alberta, and Addie Consultants Ltd., of Calgary, Alberta.

5. That for fourteen years I was with the B.C. Department of Energy, Mines and Petroleum Resources as the District Geologist in Nelson, B.C., and that I am now retired from that position.

6. That I am a member of the Canadian Executive Services Overseas, (C.E.S.O.) And have served in Bolivia, and Colombia.

7. That I am a Fellow in good standing of the Geological Association of Canada.



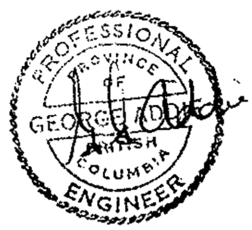
Dated at Nelson, British Columbia on the 15th day of December, 2000

DISCLAIMER

I, George G. Addie, P. Eng., 604 3rd St., Nelson, B.C., V1L2P9 State:

1. That I have worked nine days on the Superior Graphite property of Worldwide Graphite Producers Ltd., from September 13 to October 24, 2000.

2. That I have not received, nor do I expect to receive, any interest in the properties or securities of Worldwide Graphite Producers Ltd.



Dated at Nelson, British Columbia on the 15th day of December, 2000

CAVEAT

Terms of this report:

1. No part of this report may be copied, used for promotional purposes, or for news releases unless a copy in writing be delivered to the author for his approval and permission.

Dated at Nelson, British Columbia on the 15th day of December, 2000

Appendices

A Strip Logs, Histograms and Assays

SG99-001
SG99-002
SG99-003
SG99-004
SG99-005

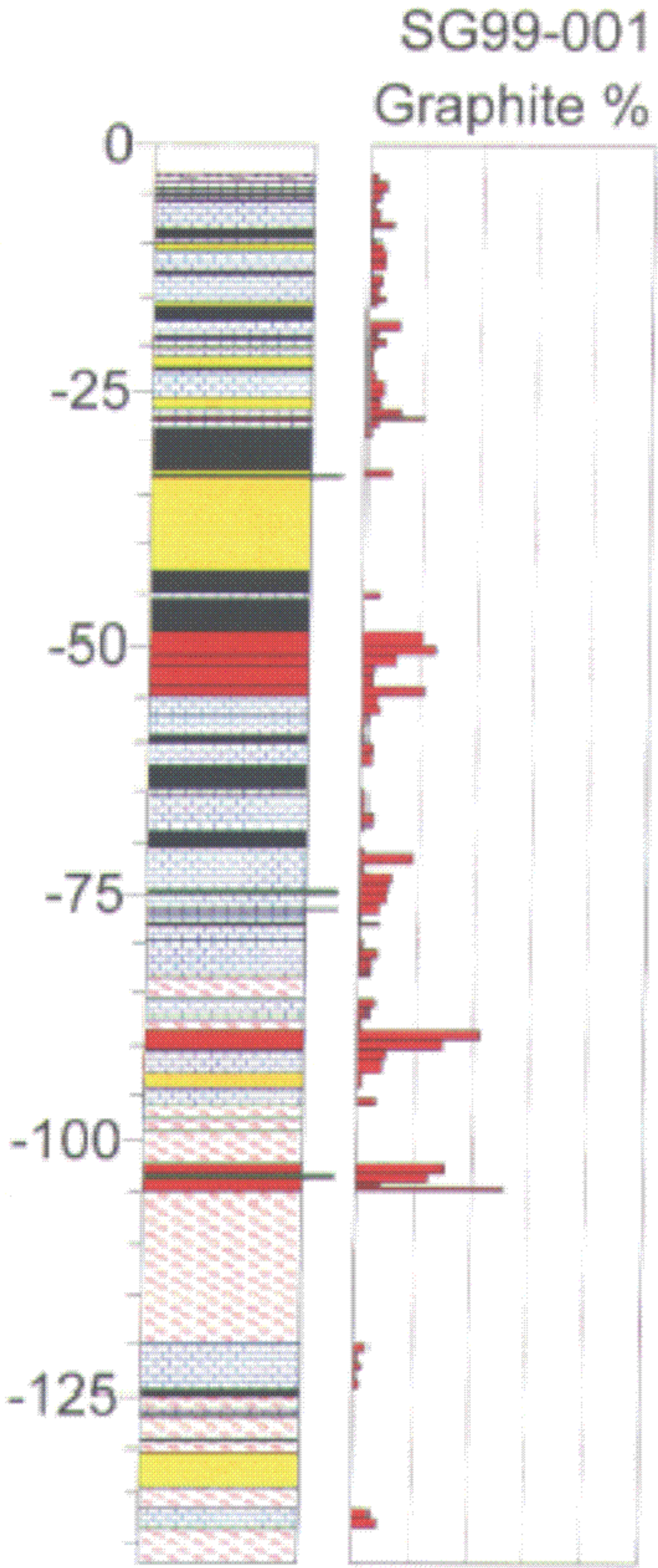
B Atlas of "Map Place" Maps

1. Intrusive Geology
2. Gold Geochemistry
3. Zinc Geochemistry
4. Lead Geochemistry
5. Copper Geochemistry

C Sample Location and the Year 2000 Assay Sheets

D Information:

1. IMP Change in name to Crystal Graphite Corp.
2. Capsule Geology of Black Crystal.
3. World Graphite Production to 1999
4. Graphite Prices to 1994
5. World Graphite Production and Prices to 1999



Scale 1:725

SG99-001

0.0	3.05	Casing
3.05	3.78	Overburden
3.78	4.48	Graphitic Marble
4.48	4.67	QFP
4.67	5	Graphitic Marble
5	5.06	QFP
5.06	5.15	Graphitic Marble
5.15	5.3	QFP
5.3	5.63	Graphitic Marble
5.63	5.8	QFP
5.8	8.52	Graphitic Marble
8.52	9.5	QFP
9.5	10.02	Graphitic Marble
10.02	10.7	B-Q-Gneiss
10.7	12.46	Graphitic Marble
12.46	12.96	QFP
12.96	15.62	Graphitic Marble
15.62	16.1	B-Q-Gneiss
16.1	17.54	QFP
17.54	19	Graphitic Marble
19	19.34	QFP
19.34	20.17	Graphitic Marble
20.17	20.29	QFP
20.29	21.6	Graphitic Marble
21.6	22.6	B-Q-Gneiss
22.6	23	QFP
23	25.7	Graphitic Marble
25.7	26.85	B-Q-Gneiss
26.85	27.6	Graphitic Marble
27.6	28	Mineralization 0.53%G/1.85m
28	28.7	Graphitic Marble
28.7	32.61	QFP
32.61	33	B-Q-Gneiss
33	33.32	Fault
33.32	42.7	Q-B-Gneiss
42.7	44.9	QFP
44.9	45.55	Graphitic Marble
45.55	48.85	QFP
48.85	50.85	Mineralization 1.14%G/2.0m
50.85	51.95	Mineralization 0.56%G/1.1m
51.95	54	Mineralization 0.16%G/2.05m
54	55	Mineralization 1.07%G/1.0m

55	56.85	Graphitic Marble	
56.85	59.34	Marble	
59.34	60.24	QFP	
60.24	62.43	Marble	
62.43	64.85	QFP	
64.85	65.3	Marble	
65.3	68.68	Graphitic Marble	
68.68	70.43	QFP	
70.43	74.55	Graphitic Marble	
74.55	75.05	Fault	
75.05	76.45	Graphitic Marble	
76.45	76.65	Fault	
76.65	77.1	Graphitic Marble	
77.1	78	Marble	
78	78.28	QFP	
78.28	79.7	Marble	
79.7	83.5	Graphitic Marble	
83.5	85.65	Q-B-G-Gneiss	
85.65	87.45	Graphitic Marble	
87.45	88.5	Q-B-G-Gneiss	
88.5	90.5	Mineralization 1.79%G/2.0m	
90.5	92.8	Graphitic Marble	
92.8	94.3	Q-B-Gneiss	
94.3	96.15	Graphitic Marble	
96.15	97.8	Q-B-G-Gneiss	
97.8	99.1	B-Q-G-Gneiss	
99.1	102.31	Q-B-G-Gneiss	
102.31	103.31	Mineralization	1.46%C/2.69m. Fault at 103.31
103.31	103.81	Fault	
103.81	105	Mineralization	
105	119.9	B-Q-G-Gneiss	
119.9	124.5	Graphitic Marble	
124.5	125	QFP	
125	126.3	B-Q-G-Gneiss	
126.3	126.7	Marble	
126.7	126.93	QFP	
126.93	129.14	B-Q-G-Gneiss	
129.14	129.37	Marble	
129.37	130.5	B-Q-G-Gneiss	
130.5	134.5	Q-B-Gneiss	
134.5	136.6	B-Q-G-Gneiss	
136.6	138.6	Graphitic Marble	
138.6	142.04	B-Q-G-Gneiss	

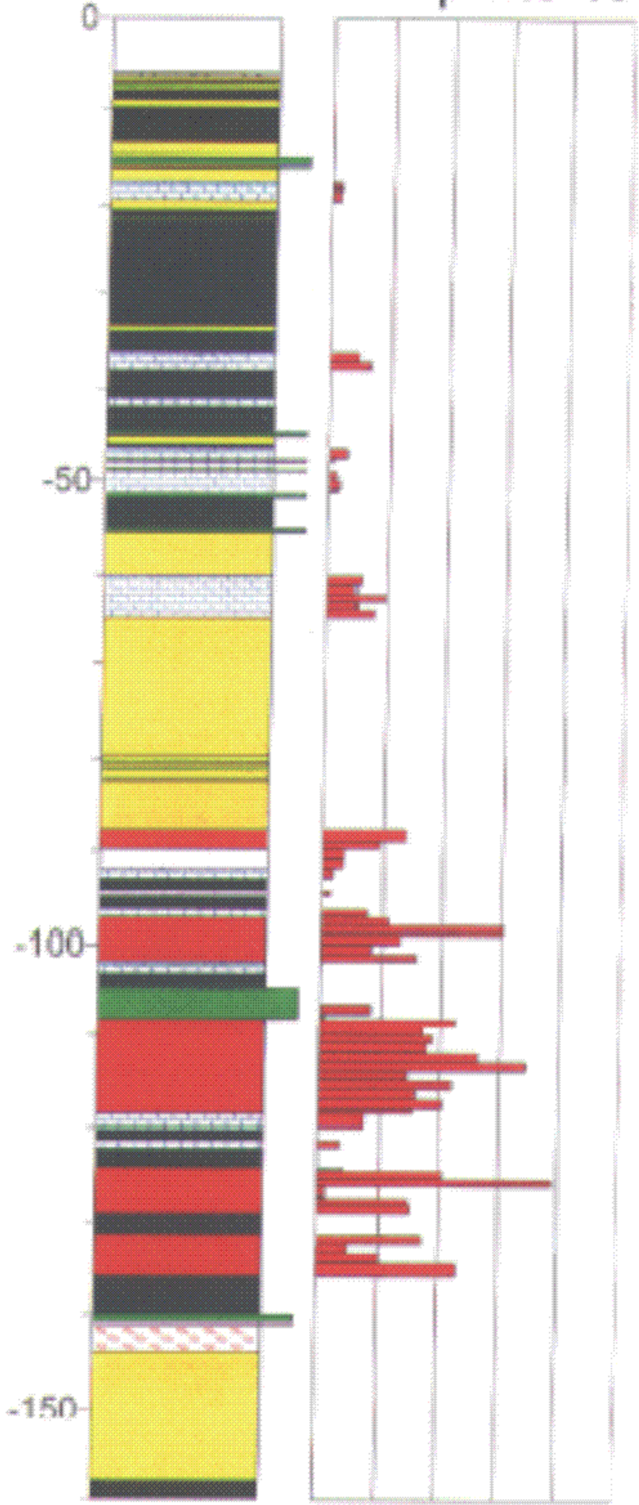
99-1.histogram

0.	3.05	0.
3.05	3.78	.13
3.78	4.9	.3
4.9	5.8	.19
5.8	6.7	.08
6.7	7.85	.17
7.85	8.52	.43
8.52	9.5	.04
9.5	9.62	.22
9.62	10.02	.09
10.02	10.7	.24
10.7	11.7	.3
11.7	12.46	.28
12.46	12.96	.04
12.96	14.02	.22
14.02	15.02	.17
15.02	15.62	.29
15.62	16.1	.15
16.1	17.54	0.0
17.54	18.54	.56
18.54	19.0	.17
19.0	19.34	.15
19.34	20.12	.32
20.12	21.00	.13
21.0	21.6	.08
21.6	22.6	.09
22.6	23.0	.06
23.0	24.0	.13
24.0	25.0	.28
25.0	25.7	.28
25.7	26.0	.2
26.0	26.85	.24
26.85	27.6	.59
27.6	28.0	1.00
28.0	28.7	.19
28.7	29.7	.06
29.7	32.61	0.0
32.61	33.32	.44
33.32	44.9	0.0
44.9	45.55	.26
45.55	48.85	0.0
48.85	49.85	1.02

49.85	50.85	1.26
50.85	51.95	.56
51.95	52.85	.17
52.85	54.0	.15
54.0	55.0	1.07
55.0	56.0	.24
56.0	56.85	.28
56.85	58.0	.08
58.0	59.45	.06
59.45	60.24	.09
60.24	61.26	.17
61.26	62.43	.15
62.43	64.85	0.0
64.85	65.3	.07
65.3	66.3	.09
66.3	67.3	.09
67.3	68.3	.2
68.3	68.68	.08
68.68	70.43	0.0
70.43	71.0	.09
71.0	72.0	.89
72.0	73.0	.08
73.0	74.0	.53
74.0	75.0	.46
75.0	76.0	.44
76.0	77.1	.31
77.1	78.0	.04
78.0	78.28	.33
78.28	79.3	.02
79.3	79.7	.02
79.7	80.7	.09
80.7	81.7	.29
81.7	82.9	.18
82.9	83.5	.17
83.5	85.65	0.0
85.65	86.65	.26
86.65	87.45	.17
87.45	88.5	.06
88.5	89.5	2.12
89.5	90.5	1.46
90.5	91.5	.46
91.5	92.8	.4
92.8	94.3	.1
94.3	95.3	.02
95.3	96.15	.3

96.15	102.31	0.0
102.31	103.31	1.53
103.31	104.2	1.23
104.2	104.6	.40
104.6	105.0	2.58
105.0	119.9	0.0
119.9	120.9	.21
120.9	121.9	.08
121.9	122.6	.15
122.6	123.6	.06
123.6	124.5	.12
124.5	136.6	0.0
136.6	137.6	.29
137.6	138.6	.41
138.6	142.04	0.0

SG99-002
Graphite %



Scale 1:819

SG99-002

0	6.1	Casing	
6.1	6.5	Overburden	
6.5	6.9	B-Q-Gneiss	
6.9	7.2	Pegmatite	
7.2	7.6	Q-B-Gneiss	
7.6	8	B-Q-Gneiss	
8	9.03	Pegmatite	
9.03	9.81	Q-B-Gneiss	
9.81	13.53	Pegmatite	
13.53	14.85	B-Q-Gneiss	
14.85	15.7	Fault	
15.7	16	B-Q-Gneiss	
16	16.15	Fault	
16.15	17.47	B-Q-Gneiss	
17.47	19.46	Graphitic Marble	
19.46	20.51	B-Q-Gneiss	
20.51	21.27	Pegmatite	
21.27	21.57	B-Q-Gneiss	
21.57	33.57	Pegmatite	
33.57	34.1	B-Q-Gneiss	
34.1	36.05	Pegmatite	
36.05	37.95	Graphitic Marble	
37.95	40.9	Pegmatite	
40.9	41.8	Marble	
41.8	44.6	Pegmatite	
44.6	45.1	Fault	
45.1	45.9	B-Q-Gneiss	
45.9	46.52	Pegmatite	
46.52	47.7	Graphitic Marble	
47.7	47.95	Fault	
47.95	48.8	Graphitic Marble	
48.8	49	Fault	
49	51.4	Graphitic Marble	
51.4	51.9	Fault	Lower contact at 80 degrees
51.9	55.22	Pegmatite	
55.22	55.7	Fault	
55.7	60.05	B-Q-Gneiss	
60.05	64.6	Marble	Mixed B-Q-Gneiss. 80 deg. A/I
64.6	79.6	Q-B-Gneiss	
79.6	80.3	B-Q-Gneiss	
80.3	80.63	Q-B-Gneiss	
80.63	81.15	B-Q-Gneiss	
81.15	82.06	B-Q-Gneiss	
82.06	82.42	B-Q-Gneiss	
82.42	87.57	Q-B-Gneiss	
87.57	89.77	Mineralizati	1.24%G/2.2m
89.77	92	Quartzite	A/I=20 degrees
92	93.13	Graphitic Marble	
93.13	94.4	Pegmatite	
94.4	95	Quartzite	
95	96.38	Pegmatite	
96.38	97.2	Marble	
97.2	101.84	Mineralizati	1.59%G/4.64m
101.84	103	Marble	
103	106.4	Pegmatite	

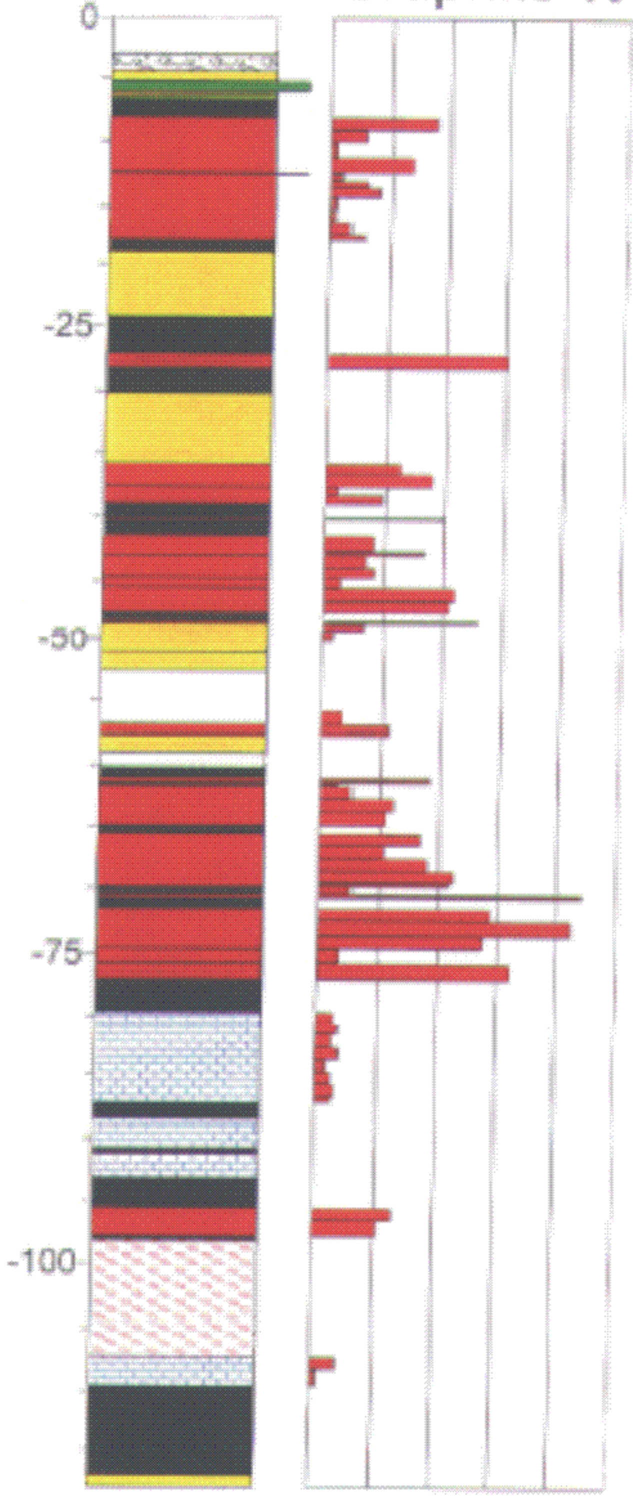
106.4	107.54	Graphitic Marble	
104.54	108	Fault	
108	118.51	Mineralizati	2.08%G/10.51m
118.51	120	Marble	0.73%G/1.01m
120	121.13	QFP	
121.13	122	Marble	
122	124.05	Pegmatite	
124.05	129	Mineralizati	1.58%G/4.95m
129	131.4	Pegmatite	
131.4	135.9	Mineralizati	1.5%G/4.5m
135.9	140	Pegmatite	
140	140.8	Fault	
140.8	143.7	B-Q-G-Gneiss	
143.7	158	B-Q-Gneiss	
158	160.01	Pegmatite	

99-2.histogram

0	17.47	0.0
17.47	18.0	.17
18.0	18.45	.19
18.45	19.64	.15
19.64	36.05	0.0
36.05	37.0	.45
37.0	37.95	.65
37.95	46.52	0.0
46.52	47.7	.34
47.7	48.0	.11
48.0	48.8	.02
48.8	49.0	.02
49.0	50.0	.15
50.0	51.0	.21
51.0	51.4	.17
51.4	60.05	0.0
60.05	61.0	.56
61.0	62.1	.48
62.1	62.89	.97
62.98	63.8	.5
63.8	64.6	.78
64.6	87.57	0.0
87.57	89.07	1.38
89.07	89.77	.93
89.77	91.0	.37
91.0	92.0	.36
92.0	93.13	.2
93.13	94.4	0.0
94.4	95.0	.15
95.0	96.38	0.0
96.38	97.2	.74
97.2	98.0	1.11
98.0	99.0	3.05
99.0	100.0	1.3
100.0	101.0	.81
101.0	101.84	1.58
101.84	106.4	0.0
106.4	107.54	.83
107.54	108.0	.08
108.0	109.0	2.26
109.0	110.0	1.71
110.0	111.0	1.88

111.0	112.0	1.77
112.0	113.0	2.64
113.0	114.0	3.46
114.0	115.0	1.45
115.0	116.0	2.22
116.0	117.0	1.6
117.0	118.0	2.05
118.0	118.51	1.56
118.51	120.0	.73
120.0	121.13	0.0
121.13	122.0	.38
122.0	124.05	0.0
124.05	124.29	.45
124.29	125.2	2.07
125.2	126.0	3.92
126.0	127.09	.13
127.09	127.32	.13
127.32	128.0	1.49
128.0	129.0	1.53
129.0	131.4	0.0
131.4	132.4	1.74
132.4	133.4	.53
133.4	134.4	1.02
134.4	135.9	2.32
135.9	160.01	0.0

SG99-003
Graphite %



Scale 1:607

SG99-003

0.0	3.05	Casing	
3.05	4.43	Overburden	
4.43	5.18	Q-B-Gneiss	
5.18	6.0	Fault	
6.0	6.27	Q-B-Gneiss	
6.27	6.57	B-Q-Gneiss	
6.57	8.10	Pegmatite	
8.10	12.33	Mineralization	0.98%G/4.23m
12.33	12.4	Fault	
12.4	17.73	Mineralization	0.35%G/5.33m
17.73	19.1	Pegmatite	
19.1	24.21	B-Q-Gneiss	
24.21	27.0	Pegmatite	
27.0	28.15	Mineralization	3.04%G/1.15m
28.15	30.16	Pegmatite	
30.16	35.87	Q-B-Gneiss	
35.87	37.77	Mineralization	1.55%G/1.9m
37.77	39.12	Mineralization	0.62%G/1.35m
39.12	40.16	Pegmatite	
40.16	40.38	Mineralization	2.01%G/0.22m
40.38	41.63	Pegmatite	
41.63	43.0	Mineralization	1.04%G/1.37m
43.0	44.73	Mineralization	0.74%G/1.73m
44.73	45.58	Mineralization	0.3%G/0.85m
45.58	47.56	Mineralization	2.15%G/1.98m
47.56	48.22	Pegmatite	
48.22	48.44	Mineralization	2.6%G/0.22m
48.44	51.12	B-Gneiss	
51.12	52.65	B-Q-Gneiss	
52.65	56.9	Quartzite	
56.9	57.72	Mineralization	1.13%G/0.82m
57.72	59.0	Q-B-Gneiss	
59.0	60.16	Quartzite	
60.16	61.0	Pegmatite	
61.0	61.4	Mineralization	1.85%G/0.4m
61.4	61.65	Pegmatite	
61.64	64.85	Mineralization	0.95%G/3.2m
64.85	65.6	Pegmatite	
65.6	69.9	Mineralization	1.74%G/4.3m
69.9	70.5	Pegmatite	
70.5	70.8	Mineralization	4.44%G/0.3m
70.8	71.65	Pegmatite	
71.65	74.6	Mineralization	3.31%G/2.95m

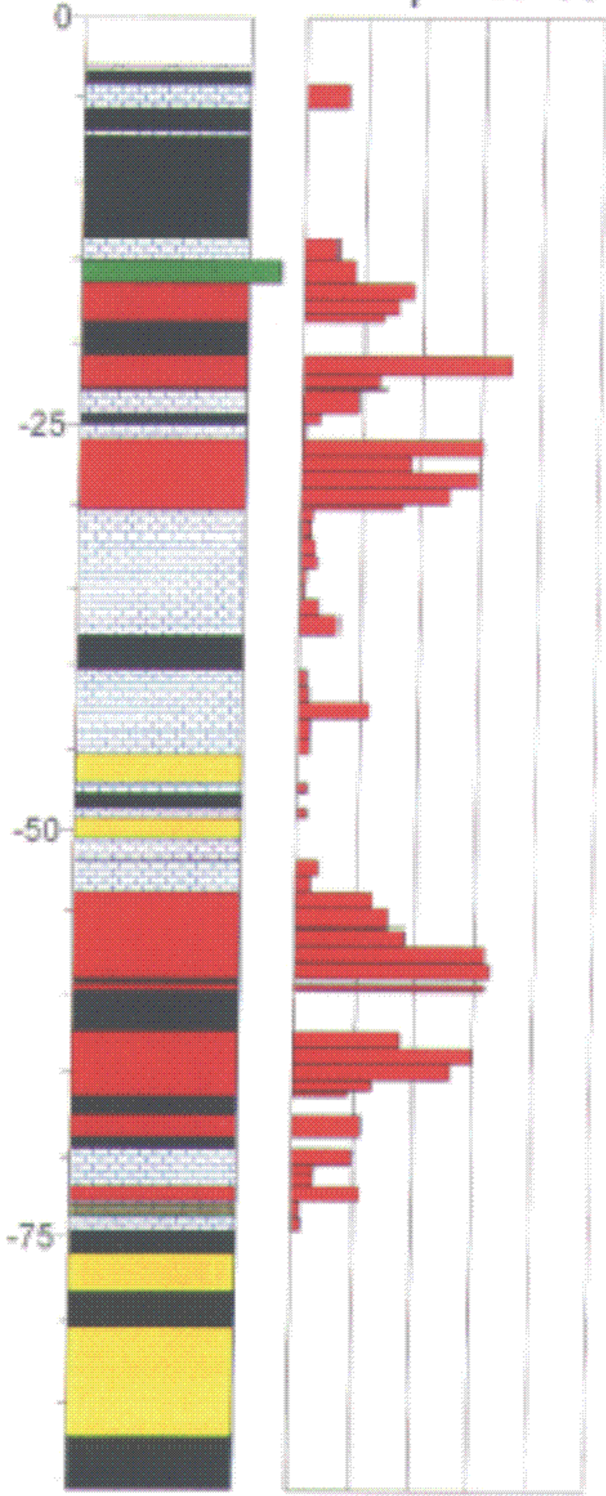
74.6	75.8	Mineralization	0.37%G/1.2m
75.8	77.1	Mineralization	3.23%G/1.3m
77.1	79.78	Pegmatite	
79.78	87.3	Graphitic Marble	
87.3	88.6	Pegmatite	
88.6	90.75	Graphitic Marble	
90.75	91.25	Pegmatite	
91.25	93.1	Marble	
93.1	95.54	Pegmatite	
95.54	97.89	Mineralization	1.15%G/2.35m
97.89	98.22	Pegmatite	
98.22	107.14	B-Q-G-Gneiss	
107.14	109.49	Graphitic Marble	
109.49	117.14	Pegmatite	
117.14	117.99	B-Q-Gneiss	

99-3.histogram

0.0	8.1	0.0
8.1	9.1	1.77
9.1	10.1	.57
10.1	11.1	.11
11.1	12.33	1.38
12.33	12.4	0.0
12.4	13.0	.22
13.0	13.48	.6
13.48	14.23	.83
14.23	15.3	.12
15.3	16.3	.1
16.3	17.3	.35
17.3	17.73	.58
17.73	27.0	0.0
27.0	28.15	3.04
28.15	35.87	0.0
35.87	36.7	1.25
36.7	37.77	1.79
37.77	38.37	.22
38.37	39.12	.94
39.12	40.16	0.0
40.16	40.38	2.01
40.38	41.63	0.0
41.63	42.63	.8
42.63	43.0	1.68
43.0	44.0	.67
44.0	44.73	.83
44.73	45.58	.3
45.58	46.63	2.19
46.63	47.56	2.11
47.56	48.22	0.0
48.22	48.44	2.6
48.44	49.18	.65
49.18	50.18	.19
50.18	55.85	0.0
55.85	56.9	.37
56.9	57.72	1.13
57.72	61.0	0.0
61.0	61.4	1.85
61.4	61.65	.31
61.65	62.65	.52
62.65	63.65	1.22

63.65	64.85	1.09
64.85	65.6	0.0
65.6	66.6	1.7
66.6	67.6	1.07
67.6	68.6	1.81
68.6	69.6	2.26
69.6	69.9	2.18
69.9	70.5	.55
70.5	70.8	4.44
70.8	71.65	0.0
71.65	72.6	2.89
72.6	73.6	4.25
73.6	74.6	2.77
74.6	75.8	.37
75.8	77.1	3.23
77.1	79.78	0.0
79.78	80.78	.3
80.78	81.78	.38
81.78	82.88	.28
82.88	83.88	.4
83.88	84.88	.19
84.88	85.88	.26
85.88	86.88	.33
86.88	87.3	.28
87.3	95.54	0.0
95.54	96.54	1.3
96.54	97.89	1.04
97.89	107.14	0.0
107.14	108.14	.44
108.14	109.46	.11
109.46	117.99	0.0

SG99-004
Graphite %



Scale 1:463

SG99-004

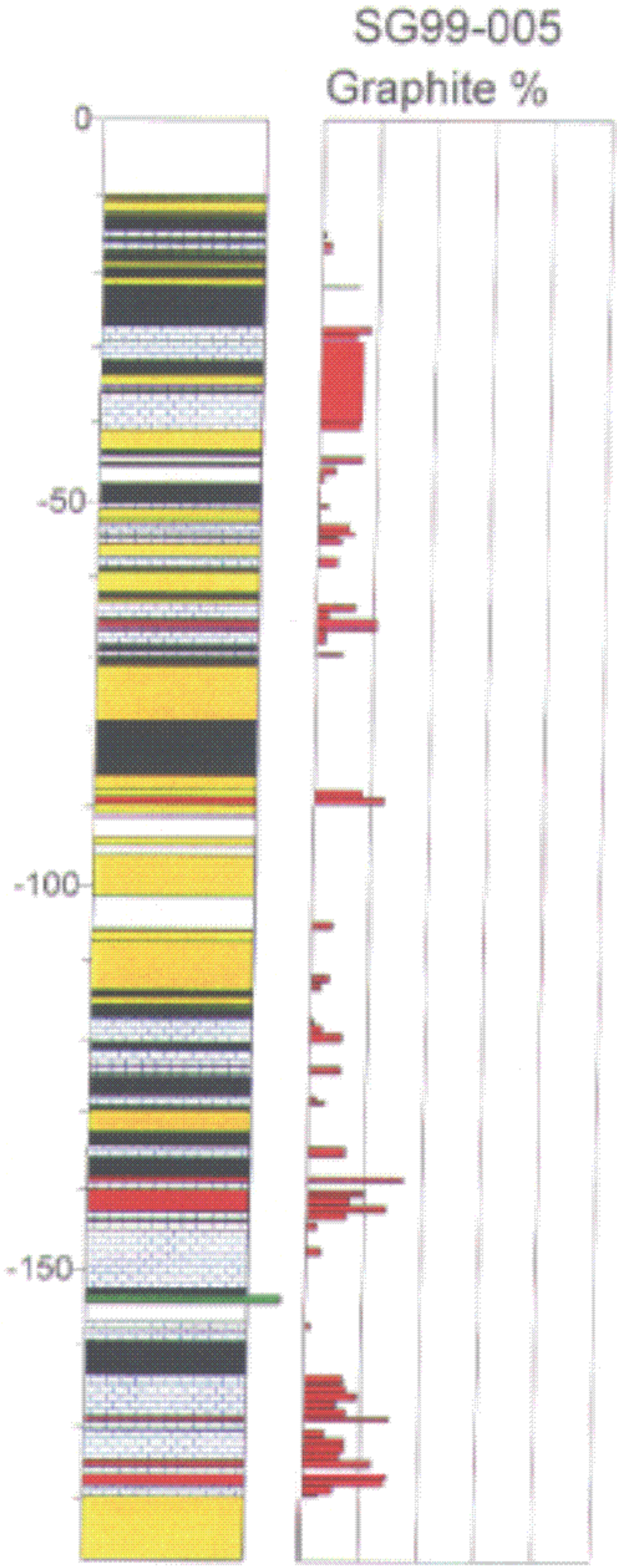
0.0	3.05	Casing	
3.05	3.4	Overburden	
3.4	4.18	QFP	
4.18	5.7	Graphitic Marble	
5.7	6.28	QFP	
6.28	7.08	QFP	
7.08	7.4	Marble	
7.4	13.7	QFP	
13.	15.08	Graphitic Marble	
15.08	16.5	Fault	
16.5	18.87	Mineralization	1.65%G/2.37m
18.87	20.74	QFP	
20.74	22.68	Mineralization	2.62%G/1.94m
22.68	22.88	Mineralization	1.39%G/0.2m
22.88	24.28	Graphitic Marble	
24.8	24.98	QFP	
24.98	25.98	Graphitic Marble	
25.98	30.37	Mineralization	2.5%G/4.39m
30.37	38.22	Graphitic Marble	
38.22	40.32	QFP	
40.32	45.3	Graphitic Marble	
45.3	47.0	Q-B-Gneiss	
47.0	47.66	Graphitic Marble	
47.66	48.55	QFP	
48.55	49.2	Graphitic Marble	
49.2	50.55	Q-B-Gneiss	
50.55	51.85	Marble	
51.85	53.85	Graphitic Marble	
53.85	59.0	Mineralization	2.19%G/5.15m
59.0	59.3	Pegmatite	
59.3	59.74	Mineralization	3.18%G/0.4m
59.74	62.5	QFP	
62.5	66.5	Mineralization	2.13%G/4.0m
66.5	67.6	Pegmatite	
67.6	68.8	Mineralization	1.12%G/1.2m
68.8	69.5	Pegmatite	
69.5	71.8	Graphitic Marble	
71.8	72.75	Mineralization	1.12%G/0.95m
72.75	72.95	Graphitic Marble	
72.95	73.15	B-Gneiss	
73.15	73.35	Graphitic Marble	
73.35	73.6	B-Gneiss	
73.6	74.65	Graphitic Marble	

74.65	76.06	QFP
76.06	78.35	B-Q-Gneiss
78.35	80.33	QFP
80.33	87.35	B-Q-Gneiss
87.35	90.55	Pegmatite

99-4.histogram

0	4.18	0.0
4.18	5.7	.69
5.7	13.7	0.0
13.7	15.08	.56
15.08	16.5	.83
16.5	17.5	1.85
17.5	18.4	1.59
18.4	18.87	1.33
18.87	20.74	0.0
20.74	21.9	3.52
21.9	22.68	1.27
22.68	22.88	1.39
22.88	24.28	.93
24.28	24.98	.33
24.98	25.98	.07
25.98	27.0	3.03
27.0	28.0	1.82
28.0	29.0	2.96
29.0	30.0	2.48
30.0	30.37	1.7
30.37	31.0	.22
31.0	32.0	.19
32.0	33.0	.26
33.0	33.82	.3
33.82	34.82	.11
34.82	35.67	.09
35.67	36.67	.33
36.67	38.22	.65
38.22	40.32	0.0
40.32	41.32	.15
41.32	42.32	.19
42.32	43.32	1.17
43.32	44.32	.22
44.32	45.3	.22
45.3	47.0	0.0
47.0	47.66	.19
47.66	48.55	0.0
48.55	49.2	.19
49.2	51.85	0.0
51.85	52.85	.39
52.85	53.85	.26
53.85	54.85	1.27

54.85	56.0	1.53
56.0	57.0	1.82
57.0	58.0	3.18
58.0	59.0	3.27
59.0	59.3	0.0
59.3	59.74	3.18
59.74	62.5	0.0
62.5	63.5	1.76
63.5	64.5	2.99
64.5	65.5	2.62
65.5	66.15	1.31
66.15	66.5	.9
66.5	67.6	0.0
67.6	68.8	1.12
68.8	69.5	0.0
69.5	70.5	.97
70.5	71.0	.38
71.0	71.8	.37
71.8	72.75	1.12
72.75	73.75	.15
73.75	74.65	.19
74.65	90.55	0.0



Scale 1:943

SG99-005

0.0	10.0	Casing	
10.0	10.23	QFP	
10.23	10.56	B-Q-Gneiss	
10.56	11.03	Q-B-Gneiss	
11.03	12.38	B-Q-Gneiss	
12.38	12.7	Marble	With diopside
12.7	13.1	B-Q-Gneiss	
13.1	14.85	QFP	
14.85	15.7	Graphitic Marble	
15.7	16.14	QFP	
16.14	17.25	Graphitic Marble	
17.25	17.9	QFP	
17.9	18.14	B-Q-Gneiss	
18.14	18.44	Q-B-Gneiss	
18.44	19.23	B-Q-Gneiss	
19.23	20.58	QFP	
20.58	21.47	B-Q-Gneiss	
21.47	21.76	Graphitic Marble	
21.76	26.81	QFP	
26.81	28.65	Graphitic Marble	
28.65	31.9	Marble	
31.9	33.84	QFP	
33.84	35.22	B-Q-Gneiss	
35.22	35.77	Graphitic Marble	
35.77	36.21	QFP	
36.21	41.05	Graphitic Marble	
41.05	43.26	B-Q-Gneiss	
43.26	44.07	QFP	
44.07	44.94	Quartzite	Graphitic
44.94	45.4	QFP	
45.4	47.53	Quartzite	Graphitic
47.53	50.3	QFP	
50.3	50.91	Graphitic Marble	
50.91	51.1	Fault	
51.1	52.35	B-Q-Gneiss	
52.35	52.9	Q-B-Gneiss	
52.9	54.6	Graphitic Marble	
54.6	54.85	B-Q-Gneiss	
54.85	55.66	Graphitic marble	
55.66	57.37	B-Q-Gneiss	
57.37	58.61	Graphitic Marble	
58.61	58.88	B-Q-Gneiss	
58.88	59.38	QFP	

59.38	62.0	B-Q-Gneiss	
62.0	62.76	QFP	
62.76	63.4	B-Q-Gneiss	
63.4	65.3	Graphitic Marble	
65.3	65.6	QFP	
65.6	66.6	Mineralization	1.06%G/1.0m
66.6	68.25	Graphitic Marble	
68.25	69.3	QFP	
69.3	69.84	Graphitic Marble	
69.84	70.83	QFP	
70.83	71.1	B-Q-Gneiss	
71.1	78.52	Q-B-Gneiss	
78.52	86.07	QFP	
86.07	87.77	Q-B-Gneiss	
87.77	88.77	B-Q-Gneiss	Includes Graphitic Marble
88.77	89.73	Mineralization	1.24%G/0.96m
89.73	90.96	Q-B-Gneiss	
90.96	93.8	Calc Silicate	Brecciated
93.8	94.72	Q-B-Gneiss	
94.72	96.03	Calc Silicate	
96.03	101.38	Q-B-Gneiss	
101.38	105.85	Quartzite	
105.85	106.09	QFP	
106.09	107.47	Q-B-Gneiss	
107.47	113.8	B-Q-Gneiss	Mixed zone
113.8	114.78	QFP	
114.78	115.73	Q-B-Gneiss	
115.73	117.1	QFP	
117.1	120.2	Graphitic Marble	
120.2	121.22	QFP	
121.22	123.33	Marble	
123.33	124.39	Graphitic Marble	
124.39	124.79	Marble	
124.79	127.27	QFP	
127.27	129.07	Graphitic Marble	
129.07	129.8	QFP	
129.8	132.5	Q-B-Gneiss	
132.5	134.4	QFP	
134.4	135.86	Graphitic Marble	
135.86	138.31	QFP	
138.31	139.0	Mineralization	1.68%G/0.69m
139.0	140.0	Marble	
140.0	142.53	Mineralization	1.06%G/2.53m
142.53	143.51	Graphitic Marble	
143.51	143.87	QFP	

143.87	144.83	Graphitic Marble	
144.83	152.51	Marble	
152.51	153.44	QFP	
153.44	154.57		Fault A/I=30 degrees
154.57	157.0	Quartzite	
157.0	158.0	Graphitic Marble	
158.0	159.4	Marble	
159.4	159.6	B-Q-Gneiss	
159.6	163.72	QFP	
163.72	168.72	Graphitic Marble	
168.72	169.4	Mineralization	1.51%G/0.68m
169.4	170.4	Graphitic Marble	Assay missing
170.4	174.4	Graphitic Marble	
174.4	175.4	Mineralization	1.2%G/1.0m
175.4	176.4	Graphitic Marble	Assay missing
176.4	178.4	Mineralization	1.45%G/2.0m
178.4	179.82	Graphitic Marble	
179.82	188.10	B-Q-Gneiss	

99-5.histogram

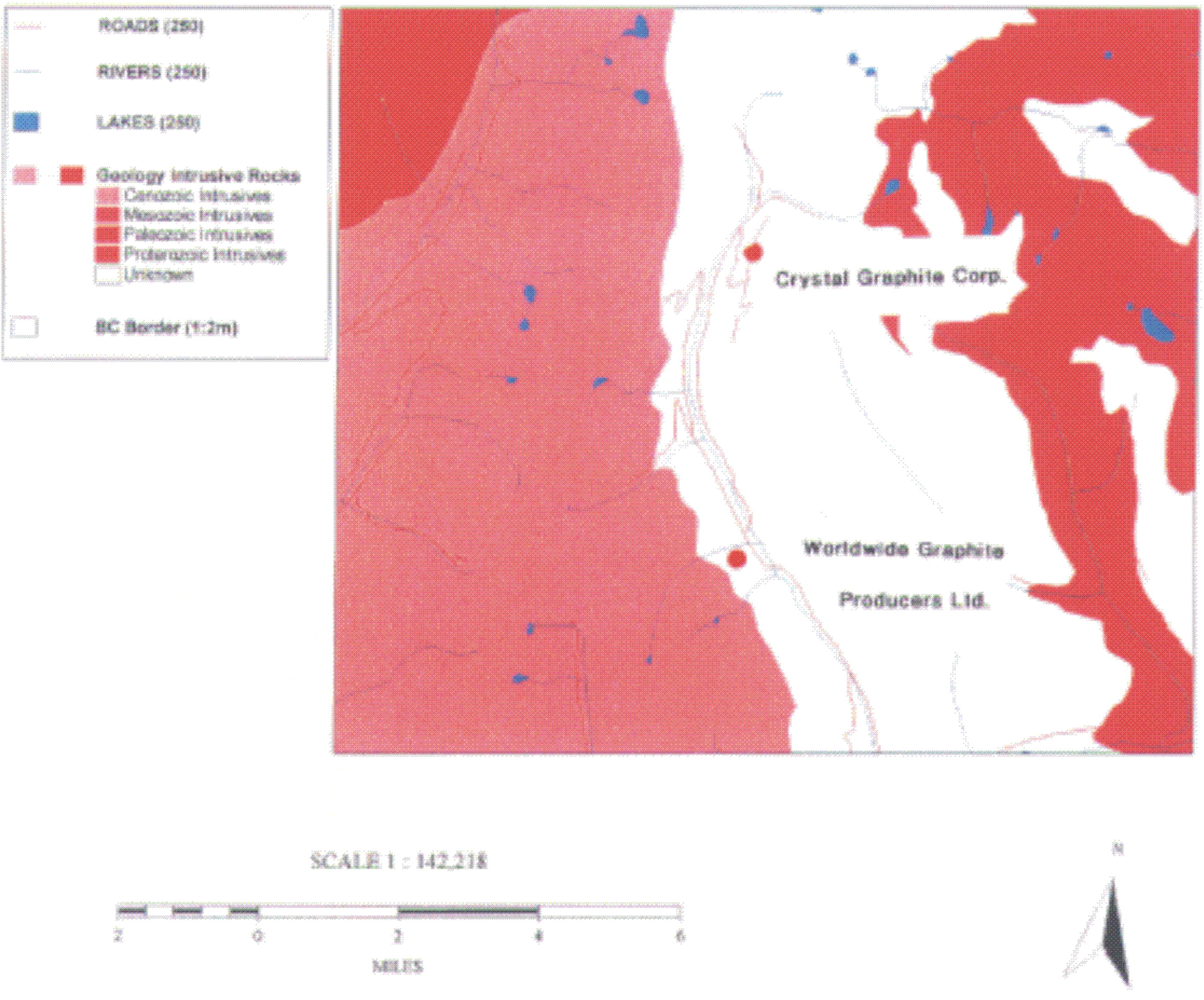
0	14.85	0.0
14.85	15.7	.08
15.7	16.14	0.0
16.14	17.25	.17
17.25	21.47	0.0
21.47	21.76	.67
21.76	26.81	0.0
26.81	27.81	.88
27.81	28.65	.64
28.65	35.22	0.0
35.22	35.77	.64
35.77	36.21	0.0
36.21	37.21	.49
37.21	38.21	.37
38.21	39.0	.3
29.0	40.0	.75
40.0	41.05	.71
41.05	44.07	0.0
44.07	44.94	.77
44.94	45.4	0.0
45.4	46.4	.29
46.4	47.53	.1
47.53	50.3	0.0
50.3	50.91	.19
50.91	52.9	0.0
52.9	53.9	.54
53.9	54.6	.65
54.6	54.85	.35
54.85	55.66	.42
55.66	57.37	0.0
57.37	58.61	.35
58.61	63.4	0.0
63.4	64.4	.68
64.4	65.3	.23
65.3	66.6	1.06
66.6	68.25	.17
68.25	69.3	0.0
69.3	69.84	.47
69.84	87.77	0.0
87.77	88.77	.85
88.77	89.73	1.24
89.73	104.85	0.0

104.85	105.85	.38
105.85	111.8	0.0
111.8	112.8	.34
112.8	113.8	.19
113.8	117.1	0.0
117.1	118.0	.08
118.0	119.0	.23
119.0	120.2	.57
120.2	123.33	0.0
123.33	124.39	.57
124.39	127.27	0.0
127.27	128.4	0.15
128.4	129.07	0.3
129.07	134.4	0.0
134.4	135.86	0.66
135.86	138.3	0.0
138.31	139.0	1.68
139.0	140.0	0.0
140.0	140.53	1.02
140.53	141.53	.75
141.53	142.53	1.40
142.53	143.51	0.70
143.51	143.87	0.0
143.87	144.83	0.19
144.83	147.06	0.0
147.06	148.16	0.27
148.16	157.0	0.0
157.0	158.0	0.11
158.0	163.72	0.0
163.72	164.72	0.67
164.72	165.72	0.75
165.72	166.72	0.94
166.72	167.72	0.57
167.72	168.72	0.75
168.72	169.4	1.51
169.4	170.4	0.0
170.4	171.4	0.38
171.4	172.4	0.72
172.4	173.4	0.72
173.4	174.4	0.64
174.4	175.4	1.2
175.4	176.4	0.0
176.4	177.4	1.48
177.4	178.4	1.42
178.4	179.4	0.53

179.4	179.82		0.3
179.82		188.1	0.0

APPENDIX B

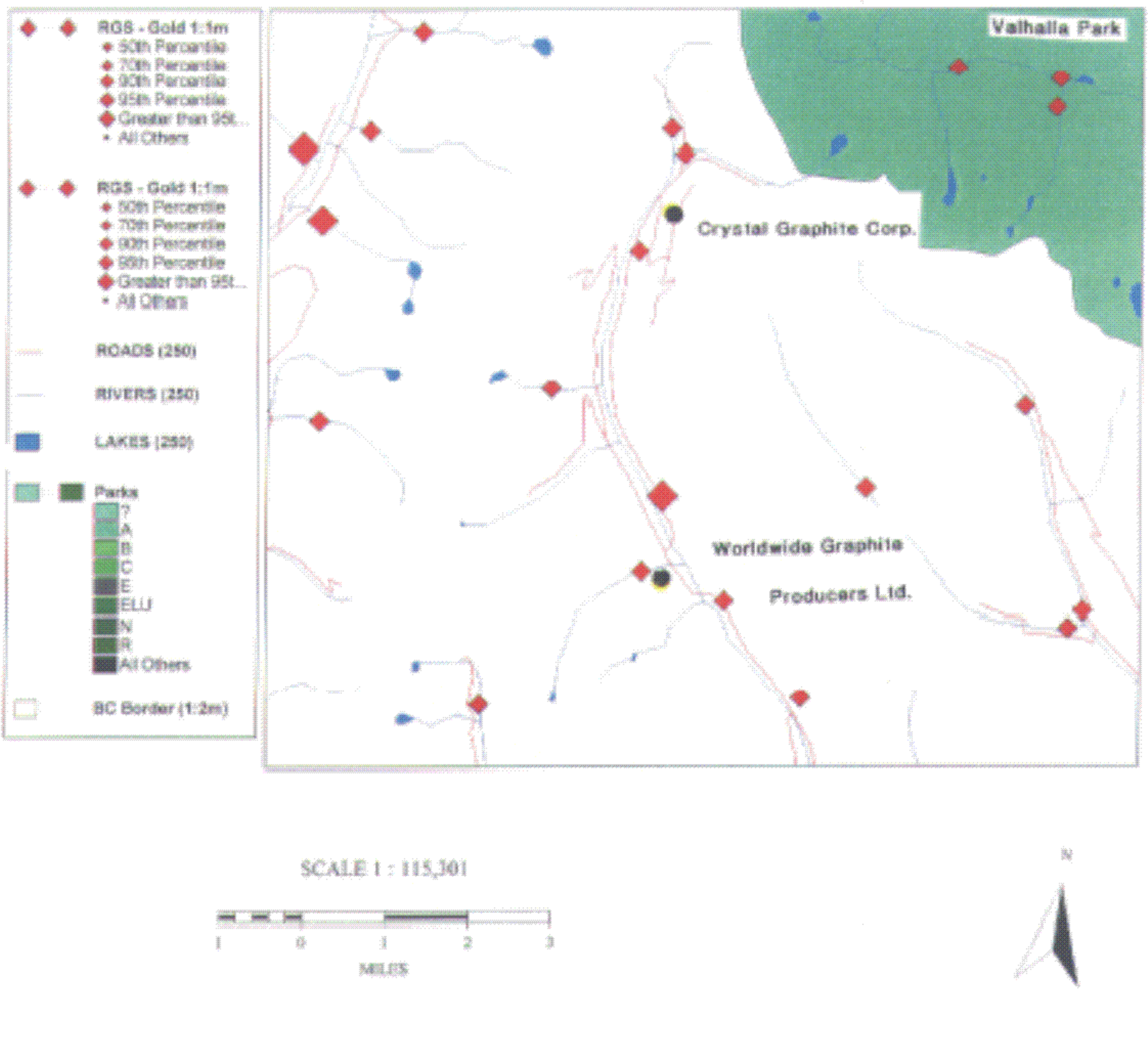
B.C. Ministry of Energy and Mines



http://webmap.ei.gov.bc.ca/minpot/map/pdac_lcc.mwf

Thursday, September 21, 2000 1:33 PM

B.C. Ministry of Energy and Mines



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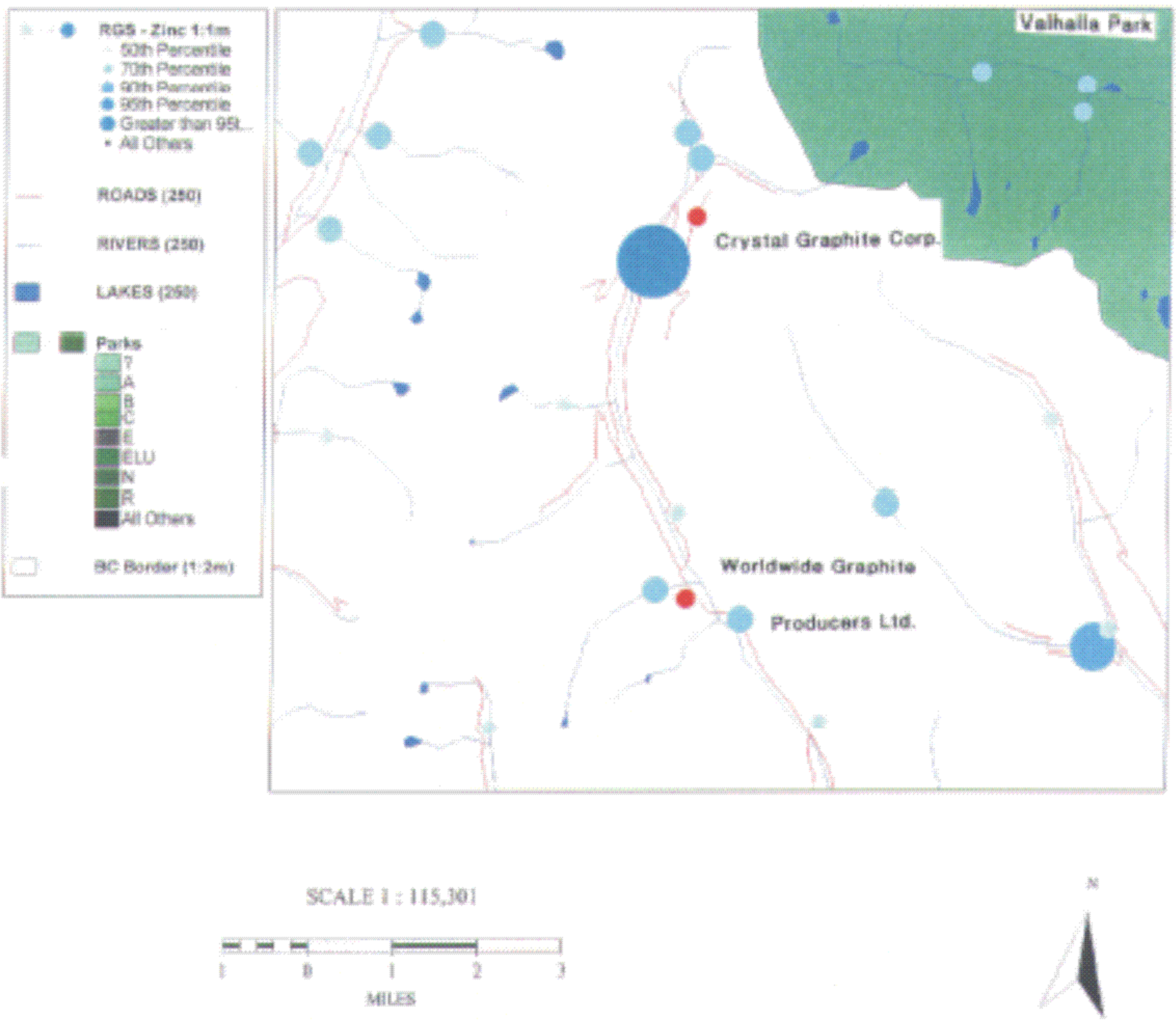
Thursday, September 21, 2000 10:14 AM

B.C. Ministry of Energy and Mines



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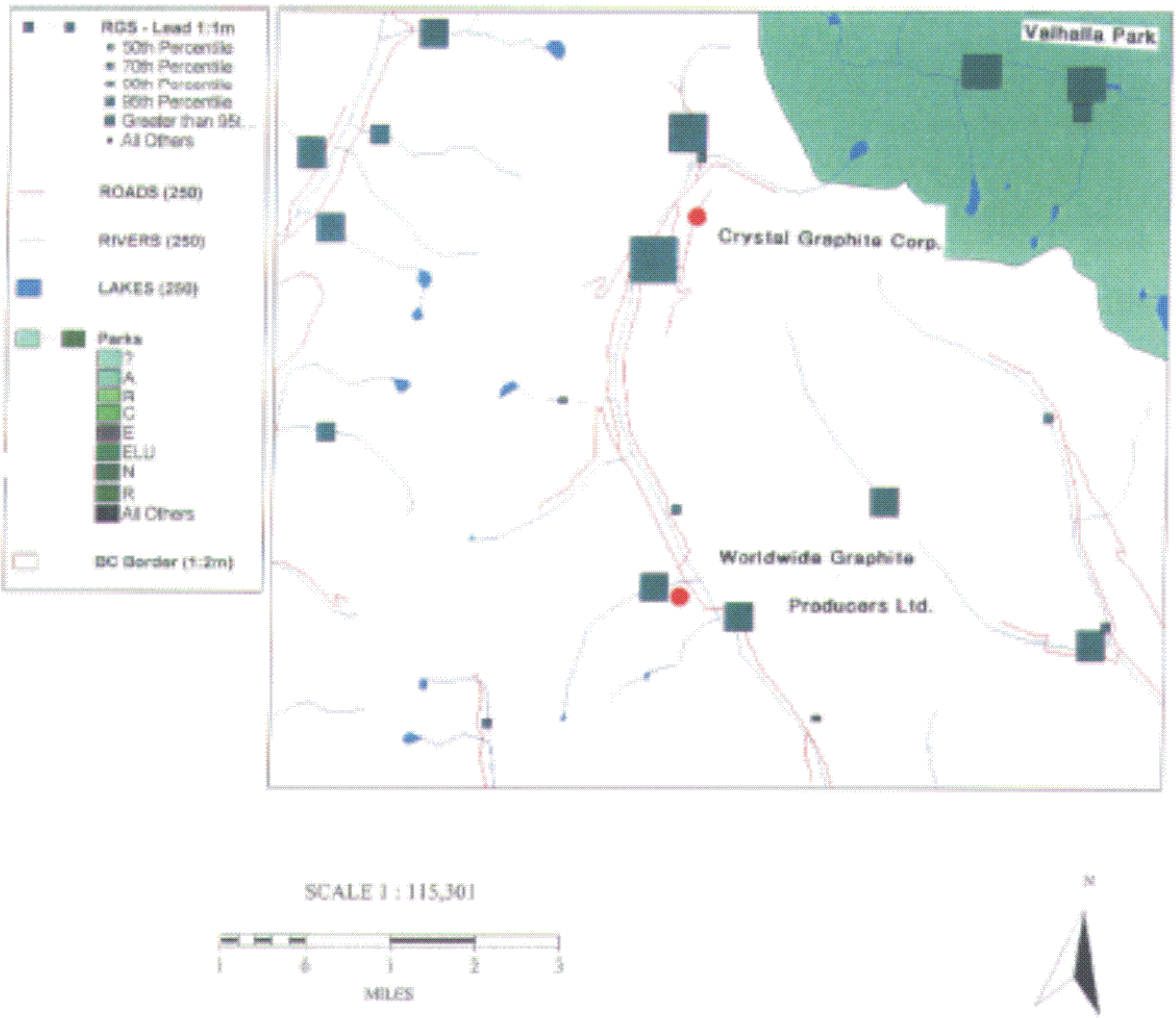
Thursday, September 21, 2000 10:30 AM

B.C. Ministry of Energy and Mines



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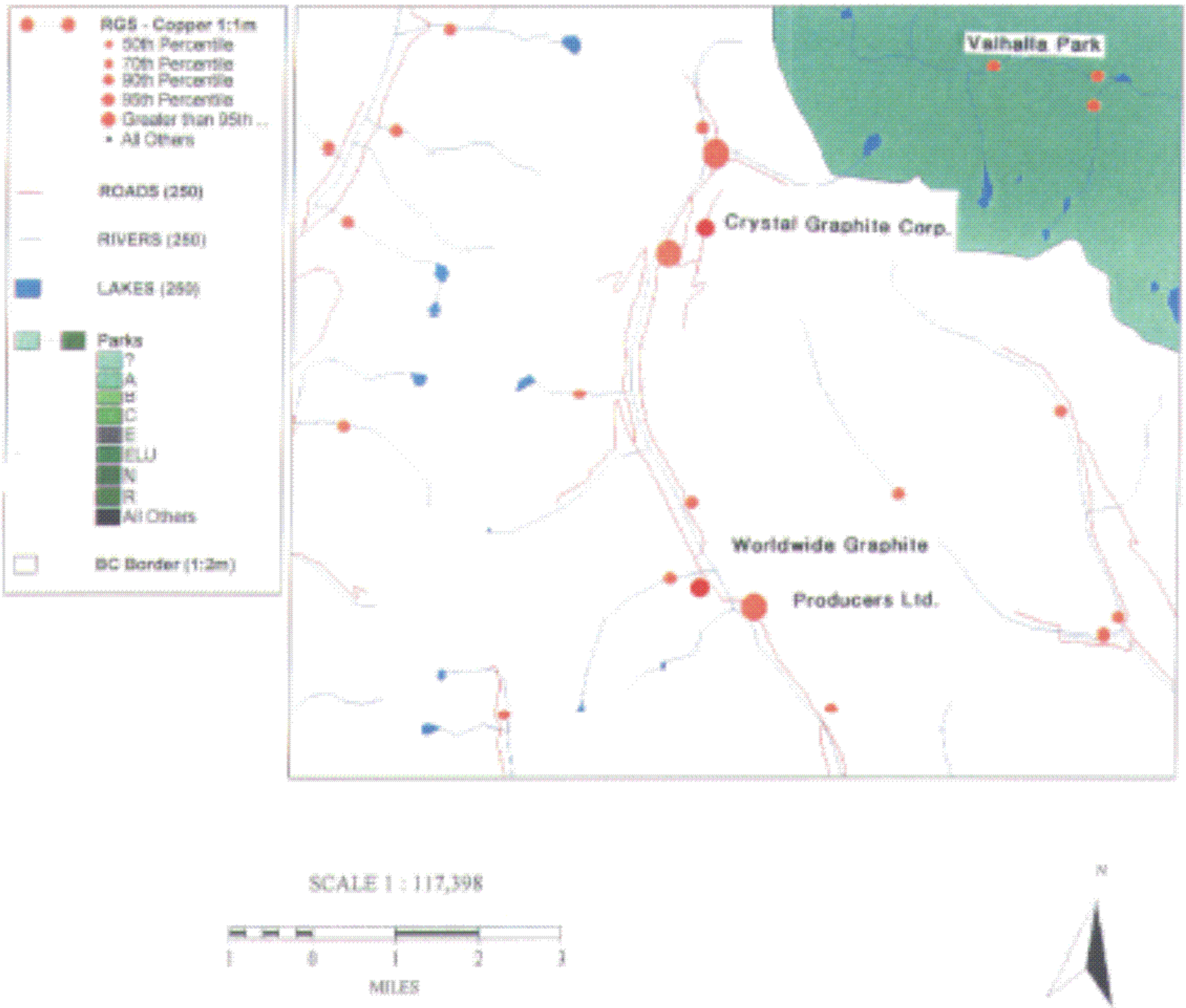
Thursday, September 21, 2000 10:26 AM

B.C. Ministry of Energy and Mines



http://webmap.ei.gov.bc.ca/minpot/map/pdac_lcc.mwf

Thursday, September 21, 2000 10:34 AM

SAMPLE LOCATIONS
Worldwide Graphite Producers Ltd.
Samples taken by George Addie, P.Eng.(B.C.)
Survey by Garmin GPSII+, NAD 27

Date Yr.2000	Sample #	Easting	Northing	El. (Ft.)	Error (el) +- Ft.	True Thickness	Rock Type	Visual Est. %	Assay	Check Assay	Special Comments
Oct 3	1	444797	5506550	4762	29	0.9	Mb	1			N45W-41SW
Oct 3	2	445416	5506632	4690	33	1.4	Mb	2			N10W-19W
Oct 3	3	445438	5506590	4666	48	1.6	Mb	3 to 5			N28W-43SW
Oct 3	4	445500	5506523	4717	34	0.5	Mb	<1			Green Diop.
Oct 3	5A	445561	5506418	4765	22	1.8	Sch	1			N5W-22W
Oct 3	5B	"	"	"	"	0.8	Mb				
Oct 3	5C	"	"	"	"	0.8	Mb				
Oct 3	6	445099	5506791	4532	38	1.5	Mb	<.5			N-S -45W
Oct 3	7	445111	5506806	4415	38	0.6	Mb	<.5			
Oct 6	1A(HW)	445261	5506835	4727	20	2.5	Sch				N25W-28SW
Oct 6	1B	"	"	"	"	1.5	Ca-Sil	2			
Oct 6	1C(FW)	"	"	"	"	1.5	Mb	3 to 5			
Oct 6	2A(FW)	445302	5506814		38	3	Siltss				N20W-17SW
Oct 6	2B	"	"		"	2	Mb				
Oct 6	2C(HW)	"	"		"	2	Mb	1			
Oct 6	3	445314	5506799		34	1.6	Mb				N15W-33SW
Oct 6	4	445339	5506794		27	2	Mb				N21E-20NW
Oct 10	1	445555	5506742	4333	20	3	Gneiss	<.1			N7E-37W
Oct 10	2	445548	5506744	4315	19	3	QFP	<.1			
Oct 10	3A	445540	5506748	4373	26	2.8	Mb	3 to 5			N18W-25W
		"	"	"	"		Fault				N56E-81SE
Oct 10	3B	"	"	"	"	1.7	Qtz+M	<1			

APPENDIX C

Samples taken by John Rapski, Sept-Oct, 2000
GPS Nad 27. Using a "Trimble" unit.

	Nad 27		Nad 83		
Sample	Easting	Northing	Easting	Northing	Description
A	447850	5508291	447769	5508500	Grey marble,10%G. Scree, Opposite Line 5511 on Bannock Rd
B	444885	5509583	444804	5509792	Below Road. West of Hoder Ck, White Marble 3%
C					Same as A. White crystaline with black graphite
D	444847	5509583	444766	5509792	Above Hoder Ck. East side near contact. White Brown Marble 2%G. On top of outcrop
E					Same location as D. 2 distinct gneiss samples at contact.
F	447553	5509044	447472	5509253	On top of mountain. Last flag North. 1%G.
G					Drill Site 10%
G-J					Marked as G on road above main zone the drill road. 195' North of hole 99-04 In place sugary marble large flake 1% Red quartzite zone on way up hill between Main Zone and drill road zone.
H					215' north of drill hole 99-04. Sugary large flake 1%.
I					200' From main road on drill road-May be boulder. Sugary, 1%
K	445155	550680	445074	550889	150' N of drill shack 2 Flags red. Go North to North side of Creek Freida-Boulder train uphill. Very hard. 1-2%, Large flake.
L					Above K. 20ft above an old road. 4 flags visible from above drillsite Outcrop - coarse 1-2%
M					Skree pile between 2 glaciers. Marked fine High G 3-4%
N					Top of pinacle. Low less 1% coarse
O					High G 3-4% 100' S of core boxes
P	445571	5506757	445490	5506966	Gneiss. Graphite and sulphides
Q					Gneiss. Graphite and sulphides
R	445357	5506912	445276	5507121	Frieda Ck. Large outcrop
S	445328	5506924	445247	5507133	4240' Frieda Ck. Large outcrop
T	445725	5507027	445644	5507236	Up Frieda from Hoder Rd. Bed Rock
U	443639	5509945	443558	5510154	Bed Rock
V	444702	5508176	444621	5508385	Above B 4290' Looks like bedrock
W					Top of Frieda Ck Mountain on north side. Bed Rock. No GPS
X	445023	5506825	444942	5507034	Up Frieda C. From Drill Location. Bed Rock
Y1	444618	5508142	444537	5508351	4470' Bed Rock above B. Float. lower 25'
Y2					Middle 75'
Y3					Upper 50'

Notes by Mark Goldenberg
Oct 24, 2000
Frieda Creek - All samples areas "Red Flagged".

K1 5005 feet asl. Bottome of zone "K". North slope Frieda Creek.

K2 5085 feet asl. Mid zone "K". North slope Frieda Creek.

K3 5161 feet asl. Upper zone "K". North slope Frieda Creek

K4 5200' asl. North slope Frieda Creek. Fine grained recrystalized limestone.
Fine grained graphite.

K5 5217' asl. West slope Hoder Crk. 444916E / 5507413N

K6 5426' asl. West slope Hoder Crk. 444805E / 5507481N. Timber boundary
To be cut.

Oct 25/00

Mature to clima(?) Forest. Overburden. No rock exposures. 30 degree slope.
No satellites in position.

443|8125E 5508993N 4810' asl. About half way up slope. 30 degree slope. Scree
1466 m slope. Very good graphite showing. No sample
taken here. 11:45AM.

443790E 5508926N 4910' asl. 28 degree dip. 342 strike. Where bedrock starts
42 degree slope.

443876E 5508672N 5186' asl. Second scree zone. 42 degree slope. 282 strike,
dip 22 degrees.

443939E 5508607N 5296' asl. Traversing rock cliffs. Strike 312. Dip 18 degrees.

443970E 5508412N 5622' asl. On top of small knoll. Graphitic Gneiss. Valhalla
Granite.

44108E 5508189N 5729' asl. Strike 292. Dip 28 degrees.

Sample "B1". First sample taken at this site. 444545E 5508094 4939' asl.
Strike 297. Dip 38 degrees. South of Crk. "B" Zone.

Sample "B2". Creek Zone. 44512E 5508094N 4708' asl.
Strike 286. Dip 48 degrees. 3:19PM

444828E 5508472N 3977 asl. Came out at road 4:05PM.

444141E 5509345N 4100' asl. At truck at other creek. 4:25PM. Day is done!!

Samples Sept. - Nov. 2000
Worldwide Graphite Producers Ltd

Sample ID	Location Comments
AB1	Bedrock 4455.15 55058.34 elevation 5130' 30 ft. Outcrop
AB2	445638 5506416
AB3	Red Zone 443499 5509785
Z1	Bottom of Falls 443445 5510117 4420 ft.
Z2	Top of Falls 443445 5510117 4420 ft.
B1	444545 5508070 4937 ft. Strike 297°Dip 38° Crk.zone
B2	444512 5508094 4708 ft. Strike 286° Dip 48°Crk.zone
AB4	443570 5509449
AB5	443531 5509902 4450 ft.
AB6	445525 5506755 4447 ft. Sand
AB7	445577 5505759
AB8	Above main zone 5000+ft.
K1	5005 ft.
K2	5085 ft. Lots of brown phosphate
K3	5161 ft.
K4	5200 ft. North slope frieda creek
K5	5217 ft. 444916 5507413 contains lots of brown phosphate
K6	5326 ft. 444805 5507481
X	200 ft. Above 195 metre mark on North Frieda Creek old rd.
P	445571 5506757 4250 ft.
G1	assay gold Berry Creek Rd.
G2	assay gold amorphous graphite and quartz Fortune 7
Above B	assay appatite
Upper K	assay appatite
Upper MZ	assay appatite above Main Zone sample kept

DRILL CORE HOLE 8

ASSAY MASTER

FROM:
TO:
SUBJECT:

DATE:

#	SAMPLE LENGTH	FROM	TO	REMARKS OLD SAMPLE
72251	1M	6.37	7.37	207028
72252	1M	7.37	8.37	207029
72254	1M	50.07	50.9	207034
72255	1.24M	139.29	140.53	207079
72257	1M	120.52	121.51	207063
72258	1M	121.52	122.52	207064
72259	1M	122.52	123.52	207065
72260	1M	123.52	124.52	207066
72261	1M	124.52	125.52	207067
72262	1M	125.52	126.52	207068
72263	1M	126.52	127.52	207069
72264	1M	127.52	128.52	207070
72265	1M	128.52	129.52	207071
72266	1M	132.33	133.33	207072
72267	1M	133.33	134.33	207073
72268	1M	134.33	135.33	207074
72269	1M	135.33	136.33	207075
72270	1M	136.33	137.33	207076
72271	1M	137.33	138.33	207077
72272	1M	138.33	139.33	207078
72273	1M	59.79	60.79	207038
72274	1M	60.79	61.79	207039
72275	1M	61.79	62.79	207040
72276	1M	62.79	6379	207041
72277	1M	63.79	64.79	207042
72278	1M	64.79	65.79	207043
72279	.53M	65.79	66.79	207044
72280	1M	77.08	78.08	207055 + 207056

Lakefield Research

METHOD#: 9-9-1
REV.#: 1.0
DATE: 05 June 00
PAGE: 1 of 1

METHOD SUMMARY

METHOD 9-9-1 Determination of Carbon and Sulfur in Rocks, Ores, Sludges and Metal Scraps by Combustion Followed by Infrared Detection Analysis

1. **Parameters measured, units:**
   Carbon, %; Sulfur, %

2. **Typical sample size:**
   0.1 g (pulps) to 0.5 g (metal scraps)

3. **Type of sample applicable (media):**
   Rocks, ores, sludges and metal scraps

4. **Sample preparation technique used:**
   Samples are crushed, pulverized and screened, or drilled. An appropriate amount is weighed, mixed with an accelerator, combusted and analysed.

5. **Method of analysis used:**
   Combustion followed by infrared detection analysis on LECO instrumentation.

6. **Data reduction by :**
   Computer, on line, data fed to the laboratory information management system with secure audit trail.

7. **Figures of Merit:**
   Limit of Detection: 0.01 %
   Precision: ± 5%
   Accuracy: ± 5%

LakefieldResearch

METHOD

METHOD #: 9-9-10
REV.#: 1.0
DATE: 28 Mar. 00
PAGE: 1 of 1

METHOD 9-9-10 Preparation for the Determination of Graphitic Carbon by Acid Leach Followed by IR Detection Analysis

1. **Parameters measured, units:**
   C(g), %

2. **Typical sample size:**
   0.2 g

3. **Type of sample applicable (media):**
   Rocks, ores and sludges

4. **Sample preparation technique used:**
   Samples are crushed, pulverized and screened. A 0.2g sample is weighed, mixed with dilute nitric acid, digested and filtered. The filtered residue is mixed with metal accelerators and placed in the Leco instrument where it is analyzed for total residual carbon. The residual carbon is taken as graphitic carbon.

5. **Method of analysis used:**
   Combustion followed by infrared detection analysis on LECO instrumentation.

6. **Data reduction by :**
   Computer, on line, data fed to the laboratory information management system with secure audit trail.

7. **Figures of Merit:**
   Limit of Detection: 0.01 %
   Precision: ± 5%
   Accuracy: ± 5%

LAKEFIELD RESEARCH LIMITED

Box 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0

Worldwide Graphite Producers Ltd.
357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Attn : Sandy Reid
Fax : 416-367-8334

Lakefield, October 30, 2000

Date Rec. : October 16, 2000
LR. Ref. : OCT9085.R00
Reference : N/A
Project : 2002894

CERTIFICATE OF ANALYSIS

No.	Sample ID	LOI @ 950°C %	Volatile @ 950°C %	C(t) %	C(g) %
1	NB "A"	12.2	3.97	7.81	2.83
2	NB "A-1"	20.9	5.32	7.45	2.22
3	"B"	31.1	2.82	8.23	0.32
4	NB "C" Skree Below Peak	22.9	3.45	5.85	0.01
5	"D" 444947 5509583	17.1	4.46	4.88	0.56
6	"E-1"	36.2	3.51	9.79	0.56
7	"E-2"	36.1	4.15	9.80	0.35
8	"F-1" 447553 5509044	2.92	3.00	1.23	0.44
9	"F-2"	40.9	6.43	11.2	1.02
10	"G" Drill Site Main Zone	25.2	6.24	10.6	5.23
11	"H"	34.5	4.95	9.09	0.31
12	"I"	29.9	6.99	7.60	0.15
13	"J"	47.4	5.78	9.77	0.11
14	"K"	38.8	5.48	10.4	0.22
15	Freida near "K-I in SSide	12.8	8.31	3.51	0.12
16	"L" Above "K" 20'	28.3	22.1	7.50	0.52
17	"M"	17.6	15.9	5.13	0.86
18	"N"	36.3	20.8	9.67	0.22
19	"O" 100' SORCORE	3.19	2.68	2.26	1.56
20	"P" 4455.71 55067.57	2.82	2.14	1.52	1.16
21	"Q" 5m S of STN 1280 SP S	2.70	2.80	0.72	0.62
-- Check --					
22	"Q" 5m S of STN 1280 SP S	2.65	2.52	0.71	0.66

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

LAKEFIELD RESEARCH LIMITED

Postal Bag 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0
Phone : 705-652-2038 FAX : 705-652-6441

Worldwide Graphite Producers Ltd.
357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Lakefield, October 31, 2000

Attn : Sandy Reid
Fax : 416-367-8334

Date Rec. : October 18, 2000
LR. Ref. : OCT9119.R00
Reference : N/A
Project : 2002968

CERTIFICATE OF ANALYSIS

No.	Sample ID	LOI @ 950°C %	Volatile @ 950°C %	C(t) %	C(g) %
1	1 444797/5506550	12.6	12.8	4.03	0.76
2	1A 445261/5506835	1.64	1.78	0.93	0.53
3	1B 445261/5506835 FW	1.01	1.11	0.72	0.34
4	1C 445261/5506935	1.98	2.11	1.35	0.77
5	2 445416/5506632	1.97	2.16	0.92	0.40
6	2A 35m South of #1	0.65	0.81	0.23	0.08
7	2B 35m South of #1	1.17	1.49	0.56	0.27
8	2C 35m South of #1 HW	2.10	2.25	0.70	0.14
9	3 445446/5506587	1.07	1.22	0.62	0.30
10	3 28.4m South of Samp.#1	1.30	1.54	0.15	0.06
11	4 445500/5506523	31.0	31.3	7.97	0.22
12	4 46.2m South of #2	0.66	1.01	0.26	0.15
13	5A 445561/5506418	28.7	28.9	7.67	0.44
14	5B 445561	16.6	17.3	6.16	2.53
15	5C 445561/5506418	17.8	18.2	6.42	2.60
16	6 445099/5506791	9.72	9.85	2.85	0.26
17	7 445111/5506806	32.8	33.0	8.98	0.26
18	"P1"	3.33	3.75	1.34	1.31
19	"R" 4451.57/55069.12	2.19	2.71	0.82	0.66
20	"S" 4453.08/55069.24	26.6	26.9	6.92	0.45
21	"T" 4457.23/55070.27	5.74	6.10	3.02	2.83
22	"U" 4436.69/55099.45	3.12	3.49	1.71	1.58
23	"V"	17.1	17.6	4.50	0.49
24	"W" OXOGES TOP OF FREIDA	32.8	33.0	8.73	0.49
25	"X" 4450.23/55068.25	9.73	10.0	2.82	0.29
26	"Y1" Higher Zone-Lower 25	6.42	6.94	2.40	0.91
27	"Y2" High Zone-Lower 75	24.7	25.1	6.20	0.20
28	"Y3" High Zine-Upper 50	11.8	12.0	3.06	< 0.01
-- Check --					
29	"S" 4453.08/55069.24	26.2	26.4	6.85	0.43

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

Accredited by the Standards Council of Canada in partnership with CAEAL to the ISO/IEC Guide 25 standard for specific registered tests.

LAKEFIELD RESEARCH LIMITED

Postal Bag 4300, 185 Concession St., Lakefield, Ontario, KOL 2HO
Phone : 705-652-2038 FAX : 705-652-6441

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357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Attn : Sandy Reid
Fax : 416-367-8334

Lakefield, October 31, 2000

Date Rec. : October 18, 2000
LR. Ref. : OCT9119.R00
Reference : N/A
Project : 2002968

CERTIFICATE OF ANALYSIS

No.	Sample ID	LOI @ 950°C %	Volatile @ 950°C %	C(t) %	C(g) %
1	1 444797/5506550	12.6	12.8	4.03	0.76
2	1A 445261/5506835	1.64	1.78	0.93	0.53
3	1B 445261/5506835 FW	1.01	1.11	0.72	0.34
4	1C 445261/5506935	1.98	2.11	1.35	0.77
5	2 445416/5506632	1.97	2.16	0.92	0.40
6	2A 35m South of #1	0.65	0.81	0.23	0.08
7	2B 35m South of #1	1.17	1.49	0.56	0.27
8	2C 35m South of #1 HW	2.10	2.25	0.70	0.14
9	3 445446/5506587	1.07	1.22	0.62	0.30
10	3 28.4m South of Samp.#1	1.30	1.54	0.15	0.06
11	4 445500/5506523	31.0	31.3	7.97	0.22
12	4 46.2m South of #2	0.66	1.01	0.26	0.15
13	5A 445561/5506418	28.7	28.9	7.67	0.44
14	5B 445561	16.6	17.3	6.16	2.53
15	5C 445561/5506418	17.8	18.2	6.42	2.60
16	6 445099/5506791	9.72	9.85	2.85	0.26
17	7 445111/5506806	32.8	33.0	8.98	0.26
18	"P1"	3.33	3.75	1.34	1.31
19	"R" 4453.57/55069.12	2.19	2.71	0.82	0.66
20	"S" 4453.28/55069.24	26.6	26.9	6.92	0.45
21	"T" 4457.25/55070.27	5.74	6.10	3.02	2.83
22	"U" 4436.69/55099.45	3.12	3.49	1.71	1.58
23	"V"	17.1	17.6	4.50	0.49
24	"W" OXOGPS TOP OF FREIDA	32.8	33.0	8.73	0.49
25	"X" 4450.23/55068.25	9.73	10.0	2.62	0.29
26	"Y1" Higher Zone-Lower 25	6.42	6.94	2.40	0.91
27	"Y2" High Zone-Lower 75	24.7	25.1	6.20	0.20
28	"Y3" High Zone-Upper 50	11.8	12.0	3.06	< 0.01
-- Check --					
29	"S" 4453.29/55069.24	26.2	26.4	6.85	0.43

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

LAKEFIELD RESEARCH LIMITED
P.O. Box 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0
Phone : 705-652-2038 FAX : 705-652-6441

Worldwide Graphite Producers Ltd.
357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Attn : Sandy Reid
Fax : 416-367-8334

Lakefield, October 30, 2000

Date Rec. : October 16, 2000
LR. Ref. : OCT9085.R00
Reference : N/A
Project : 2002894

CERTIFICATE OF ANALYSIS

No.	Sample ID	LOI @ 950°C %	Volatile @ 950°C %	C(t) %	C(g) %
1	NB "A"	12.2	3.97	7.81	2.83
2	NB "A-1"	20.9	5.32	7.45	2.22
3	"B"	31.1	2.82	8.23	0.32
4	NB "C" Scree Below Peak	22.9	3.45	5.85	0.01
5	"D" 444847 5509583	17.1	4.46	4.35	0.56
6	"E-1"	36.2	3.51	9.79	0.36
7	"E-2"	36.1	4.15	9.80	0.35
8	"F-1" 447553 5509044	2.92	3.00	1.23	0.44
9	"F-2"	40.9	6.43	11.2	1.02
10	"G" Drill Site Main Zone	25.2	6.24	10.6	5.23
11	"H"	34.5	4.95	9.09	0.31
12	"I"	29.9	6.99	7.60	0.15
13	"J"	47.4	5.78	9.77	0.11
14	"K"	38.8	5.48	10.4	0.22
15	Freida near "K-I in SSide	12.8	8.31	3.51	0.12
16	"L" Above "K" 20'	28.3	22.1	7.50	0.52
17	"M"	17.6	15.9	5.13	0.86
18	"N"	36.3	20.8	9.57	0.22
19	"O" 100' SORCORE	3.19	2.68	2.26	1.56
20	"P" 4455.71 55067.57	2.82	2.14	[illegible]	1.16
21	"Q" 5m S of STN 1280 SP S	2.70	2.80	0.72	0.62
-- Check --					
22	"Q" 5m S of STN 1280 SP S	2.65	2.52	0.71	0.66

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

LAKEFIELD RESEARCH LIMITED
Postal Bag 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0
Phone : 705-652-2038 FAX : 705-652-6441

Worldwide Graphite Producers Ltd
357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Attn : Sandy Reid
Fax : 416-367-8334

Lakefield, November 20, 2000

Date Rec. : November 13, 2000
LR. Ref. : NOV9082.R00
Reference : N/A
Project : 2003117

CERTIFICATE OF ANALYSIS

No.	Sample ID	C(t) %	C(g) %
1	Sample#1 445555-5566742	1.14	0.55
2	Sample#1 5510707-444230	5.88	0.20
3	Sample#1 446029-556509	3.95	0.27
4	Sample#2 445548-5506744	0.13	< 0.01
5	Sample#2 444230-5510707	5.01	0.10
6	Sample#3A 445540-5506748	0.90	0.54
7	Sample#3B 445540-5506748	1.78	1.56
8	AB1 Bed Rock	0.59	0.24
9	AB2	5.68	0.49
10	AB3 Red Zone	3.37	3.25
11	AB4 443570 5509449	3.41	3.37
12	AB5 443231 5509502 4450	1.51	1.57
13	AB6 445525 5506755 4447	3.76	2.59
14	AB7	0.75	0.43
15	AB8	1.74	0.39
16	"B1" Crk Zone	0.61	0.34
17	"B2" Crk Zone	0.31	0.28
18	K1 North Slope	6.47	4.80
19	K2	7.97	0.54
20	K3	6.04	0.28
21	K4	8.36	3.41
22	K5 West Slope	6.56	0.30
23	Hoder Crk	1.56	0.25
24	K6	1.22	1.20
25	B	1.28	1.26
26	Z1 bottom of falls	0.56	0.51
27	Z2 top of falls	0.80	0.75
28	X	1.84	0.82
29	8-72251	2.59	0.19
30	8-72252	3.66	0.22
31	8-72254	1.27	0.43
32	8-72255	7.41	0.26
33	8-72257	1.43	0.64
34	8-72258	1.40	< 0.01
35	8-72259	0.68	0.45
36	8-72260	1.61	0.36
37	8-72261	1.10	0.99

LAKEFIELD RESEARCH LIMITED

Postal Bag 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0
Phone : 705 652-2038 FAX : 705-652-6441

NOV9082.R00

No.	Sample ID	C(t) %	C(g) %
38	8-72262	1.31	0.57
39	8-72263	1.18	1.11
40	8-72264	1.46	0.24
41	8-72265	1.31	0.32
42	8-72266	2.43	0.28
43	8-72267	3.67	1.01
44	8-72268	4.81	0.26
45	8-72269	3.33	0.54
46	8-72270	3.88	0.41
47	8-72271	4.26	0.54
48	8-72272	4.23	0.36
49	8-72273	5.17	0.58
50	8-72274	6.08	0.48
51	8-72275	7.18	0.20
52	8-72276	4.88	0.17
53	8-72277	6.59	0.11
54	8-72278	6.88	0.53
55	8-72279	7.91	0.45
56	8-72280	6.92	0.20
-- Check --			
57	Sample#2 444230-55 3707	5.03	0.09
58	P	1.20	1.28
59	8-72269	3.30	0.55
--Prep Rep --			
60	8-72274	6.03	0.39

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

LAKEFIELD RESEARCH LIMITED

P.O. Box 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0
Phone: 705-652-2038 FAX: 705-652-6441

Worldwide Graphite Producers Ltd.
357 Bay Street, Suite 404
Toronto, Ontario, M5H 2T7 - Canada

Attn : Sandy Reid
Fax : 416-367-8334

Lakefield, November 20, 2000

Date Rec. : November 13, 2000
LR. Ref. : NOV9083.R00
Reference : N/A
Project : 2003117

CERTIFICATE OF ANALYSIS

No.	Sample ID	Au g/t
1	G1	0.17
2	G2	0.03
3	Above B	--
4	Upper K	--
5	Upper MZ	--
-- Check --		
6	Upper MZ	--

Partial Report

Roch Marion, B.Sc., C.Chem.
Assistant Manager, Analytical Services

Stockwatch

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Crystal Graphite Corp - New Listing

IMP Industrial changes name to Crystal Graphite Corp

Crystal Graphite Corp	CGH
Shares issued 21,532,937	1999-08-11 close $13.75
Thursday Nov 2 2000	New Listing

Also IMP Industrial Mineral Park Mining Corp (IME)

Pursuant to a special resolution passed by shareholders on Oct. 18, 2000, the company has changed its name from IMP Industrial Mineral Park Mining Corp. to Crystal Graphite Corp. There is no consolidation of capital.

Effective at the opening on Nov. 6, 2000, the common shares of Crystal Graphite will commence trading on the Canadian Venture Exchange and the common shares of IMP Industrial will be delisted. The company is classified as a non-metallic mineral mining and quarrying company.

Capitalization:	250 million shares with no par value of which 21,532,937 shares are issued and outstanding
Escrow:	Nil
Transfer agent:	Pacific Corporate Services Ltd.
Trading symbol:	CGH (new)
Cusip No:	229248 10 9 (new)

old url (better for printing)

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Capsule Geology and Bibliography

082FNW260 Production Report Inventory Report

Name	BLACK CRYSTAL	**Mining Division**	Nelson
Status	Developed Prospect	**NTS**	082F13W NAD 27
Latitude Longitude	49 46 30 N 117 46 00 W	**UTM**	11 5513678 444798
Commodities	Graphite	**Deposit Types**	P04 : Crystalline flake graphite.
Tectonic Belt	Omineca	**Terranes**	Undivided Metamorphic Assembl..

Capsule Geology

The Black Crystal property is a large graphite deposit located near the headwaters of Hoder Creek, approximately 74 kilometres north of the community of Trail. The prospect was discovered by a Castlegar prospector, Steve Paszty, around 1960.

The property is within the central portion of the Valhalla Complex comprised of high metamorphic grade paragneiss structurally overlain and interlayered with thick granitoid sheets. Graphite mineralization in the form of disseminated fine to coarse grained flakes is associated with a locally very coarse grained, friable, graphitic marble and/or siliceous metasedimentary rock. The graphite occurs along and parallel to the foliation planes and/or metamorphic compositional bands. The mineralized zone defined to date appears to cover an area 500 by 500 metres and have a minimum thickness of 80 to 100 metres. The geologic resource contained within this volume ranges from 50 to 62.5 million tonnes at an unknown grade (Assessment Report 23406).

Based on a total of 18 samples, 11 of which were three metre continuous channel samples, the average arithmetic grade of the deposit is 2.55 per cent graphite with a range of 0.39 to 6.95 per cent graphite. The 11 channel samples had a weighted average grade of 2.55 per cent; the high grade assay of 6.95 per cent is an average of four separate samples from the same sample location (Assessment Report 23406).

Industrial Mineral Park Mining Corporation (IMP) mined a 3000 to 4000 tonne bulk sample and shipped it to a nearby site, where a flotation mill for the recovery of crystalline graphite will soon be built; start-up is forecast for spring 1996 (Information Circular 1996-1, page 20).

Sampling and evaluation continued at Black Crystal in 1996. IMP estimates a resource of flake graphite of over 27 million tonnes. The company stockpiled graphite at the mill which is

	nearing completion (Information Circular 1997-1, page 23). In 1996, I.M.P. processed 5.5 tonnes (Information Circular 1997-1, page 23). In 1997, I.M.P. drilled 891 metres in 22 short, vertical core holes. In 1998, the company estimates 1,500,000 tonnes of graphite in an 1800 by 85 metre zone. A 362-kilogram bulk sample was taken in 1998. Results were 5.4 per cent crystalline graphite.

Bibliography	EM EXPL 1994-58; 1996-E4,A24; 1997-50 EM INF CIRC 1999-1, pp. 12, 14 EMPR ASS RPT *23406 EMPR INF CIRC 1995-9, p. 20; 1996-1, p. 20; 1997-1, p. 23; 1998-1, p. 24 EMPR PF (Report by D.A. Howard) GCNL #244(Dec.21), 1994; #48(Mar.9), #99(May24), #119(June 21), #161 (Aug.22), #168(Aug.31), 1995; #209(Oct.30), #239 (Dec.12), 1997; #214(Nov.6), #237(Dec.10), 1998

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GRAPHITE (NATURAL)

(Data in thousand metric tons, unless otherwise noted)

Domestic Production and Use: Natural graphite was not produced domestically in 1999. Natural graphite was consumed by approximately 200 firms primarily in the Northeastern and Great Lakes regions. The major uses of natural graphite did not significantly differ from those of 1998. Refractory applications, once again, led the way in use categories with 39%; brake linings was second with 14%; lubricants, 6%; dressings and molds in foundry operations, 5%; and other uses making up the remaining 36%.

Salient Statistics—United States:	1995	1996	1997	1998	1999[e]
Production, mine	—	—	—	—	—
Imports for consumption	61	53	58	62	60
Exports	37	26	40	28	32
Consumption, apparent	24	27	18	34	28
Price, imports (average dollars per ton at foreign ports):					
Flake	658	699	622	514	550
Lump and chip (Sri Lankan)	610	675	1,010	1,200	1,100
Amorphous (Mexican)	143	134	153	192	220
Stocks, yearend	NA	NA	NA	NA	NA
Net import reliance[1] as a percent of apparent consumption	100	100	100	100	100

Recycling: Refractory brick and linings, alumina-graphite refractories for continuous metal castings, magnesia-graphite refractory brick for basic oxygen and electric are furnaces, and insulation brick in particular led the way in recycling of graphite products. Primary recycling of refractory articles is growing with the recycled market being principally in less demanding service conditions, such as safety linings and thermal insulation.

Recent demonstrations of technical feasibility of recovering high-quality flake graphite from steelmaking kish, by the former U.S. Bureau of Mines research staff, may further boost graphite recycling efforts. The current low prices, however, stand in the way of increased recycling efforts. Information on the quantities and monetary value of recycled graphite is not available.

Import Sources (1995-98): Mexico, 28%; Canada, 27%; China, 27%; Madagascar, 8%; and other, 10%.

Tariff: Item	Number	Normal Trade Relations 12/31/99
Crystalline flake (not including flake dust)	2504.10.1000	Free.
Other	2504.90.0000	Free.

Depletion Allowance: 23% (Domestic lump and amorphous), 15% (Domestic flake), and 15% (Foreign).

Government Stockpile:

Stockpile Status—9-30-99[2]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 1999	Disposals FY 1999
Sri Lanka, amorphous lump	5	—	5	3	([3])
Madagascar, crystalline flake	7	4	7	—	3
Other than Sri Lanka and Madagascar crystalline	—	([3])	—	—	([3])

Prepared by Rustu S. Kalyoncu [(703) 648-7720, rkalyonc@usgs.gov, fax: (703) 648-7722]

GRAPHITE (NATURAL)

Events, Trends, and Issues: Graphite was near to supply-demand balance in 1999. Demand was met largely by imports of flake from Canada, China, and Madagascar; lump and chip from Sri Lanka; and amorphous graphite from China and Mexico. Graphite electrode consumption in steelmaking has been decreasing since the late 1980's because of increased efficiency by the iron and steel producers. Use of natural graphite in lubrication applications is also decreasing because of changes in requirements for lubricant compositions and in processing technologies.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	1998	1999[e]		
United States	—	—	—	1,000
Brazil	40	44	420	1,000
China	200	200	5,100	310,000
India	120	125	500	620
Madagascar	15	13	950	960
Mexico	40	48	3,100	3,100
Other countries	190	148	5,200	44,400
World total (may be rounded)	605	578	15,000	360,000

World Resources: Domestic resources are relatively small, although the rest of the world's inferred reserve base exceeds 800 million tons of recoverable graphite.

Substitutes: Manufactured graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Finely ground coke with olivine is a potential competitor in foundry facing operations. Molybdenum disulfide competes as a dry lubricant, but is more sensitive to oxidizing conditions.

[e]Estimated. NA Not available.

[1]Defined as imports - exports + adjustments for Government and industry stock changes. Data on changes in stocks were not available and were assumed to be zero in the calculations.

[2]See Appendix B for definitions.

[3]Less than ½ unit.

[4]See Appendix C for definitions.

Graphite

Michel A. Boucher

The author is with the Mining Sector,
Natural Resources Canada.
Telephone: (613) 992-3074

SUMMARY

In 1994, natural flake graphite was produced in Quebec by Stratmin Graphite Inc., and in Ontario mainly by Applied Carbon Technology Inc. (ACT, previously known as Cal Graphite Corporation). Although world demand for graphite was weak during the year, Canada's production increased from 22 808 t in 1993 to 27 000 t in 1994. Shipments also increased, rising from 21 937 t in 1993 to 25 919 t in 1994. At the end of 1994, Stratmin Graphite Inc. was the only producer of natural flake graphite in North America and, according to the company, is the largest producer and exporter in the world of natural flake graphite from a single mine. Stratmin Graphite Inc., also the dominant Canadian producer, shipped 20 219 t in 1994, up from 15 783 t in 1993. On June 14, 1994, ACT closed its mine and concentration plant near Kearney, Ontario. In November, Stratmin Inc., a shareholder of Stratmin Graphite Inc., purchased 18.1 million shares in ACT (representing 49.5% of its outstanding shares) from affiliates of the Pittsburgh-based Hillman Company. After several years of planning, Victoria Graphite Inc., with a deposit near Portland, Ontario, started production on June 1, 1994; mill capacity is 3000 t/y of concentrates. Prices for crystalline flake graphite continued to be soft due to very strong competition.

NATURAL GRAPHITE

Graphite is a natural form of carbon. Natural graphite is a lustrous black carbon mineral, crystallized in the hexagonal system with rhombohedral symmetry. Flake graphite is opaque, flexible and sectile, and exhibits perfect basal cleavage. Natural graphite is unctuous and relatively soft with a hardness of 1-2 on the Mohs scale. It has a black streak on glazed porcelain. Its specific gravity is 2.26 g/cm^3. Graphite is an excellent conductor of heat and electricity and has a high melting temperature of 3500°C. It is extremely resistant to acid, chemically inert, and highly refractory.

Natural graphite is widely distributed throughout the world and is of common occurrence in metamorphic rocks produced by regional or contact metamorphism. Commercially, natural graphite is classified as amorphous, crystalline lump (or vein), and flake. Amorphous graphite is a microcrystalline graphite formed by crystallization of the carbon from organic sediments. The graphite occurs as distorted seams of minute microcrystalline particles intermixed with ungraphitized materials. The graphite content may vary from 15-98%, depending on the degree of metamorphism and the original carbon content in the sediments. Crystalline lump graphite occurs in the form of massive vein or circular accumulations formed probably from hydrothermal origin. Deposits are found in fissures or other cavities in igneous or metamorphic rocks. The size of the particles varies from fine grains to large lumps. The vein deposits vary widely in width from 2 mm to more than 2 m. Flake graphite is found disseminated in metamorphosed siliceous or calcareous sediments such as marble, gneiss and schist. Flake is defined as thin flakes which are classified from coarse to fine and which are graded according to their graphitic carbon content.

OCCURRENCES

Graphite deposits of potentially commercial interest in Canada occur principally in rocks of the Grenville series of eastern Canada. The mineral is found in disseminated crystalline flake and vein forms. Most Canadian graphite deposits are associated with graphite gneiss and crystalline limestones that have been subjected to contact metamorphism associated with tectonic features such as folding, compression and fracturing, and with pegmatitic intrusions. The richest ore zones occur as a succession of veins or lenticular bodies that gradually merge into the adjacent non-graphitic host rock and that are bordered by lenses of lower-grade ore.

Fine-to-coarse flake graphite deposits have been reported mainly in Quebec and Ontario, but also in New Brunswick, Nova Scotia, Saskatchewan, Labrador, and British Columbia.

In Quebec, graphite deposits are located mainly along the Grenville series in several townships of western Quebec: Buckingham, Argenteuil, and Pontiac. The disseminated flake graphite variety is dominant in biotite gneiss and crystalline limestone associated with biotite quartzite, but the vein variety is also reported along the contact of intrusive rocks and crystalline limestone. Occurrences of graphite are associated with metasedimentary rocks that have been subjected to several deformations and where metamorphism has reached amphibolitic or granulitic phases.

Graphite also occurs in Esmanville Township, south of Fermont. Several graphite-rich schist zones, measuring 1-25 m in thickness, are found interlayered with quartz-feldspar gneiss. Some graphite zones locally contain more than 15% graphite in the form of fine and well-crystallized flakes.

In Ontario, graphite deposits are found in several townships of Eastern Ontario in rocks of the Grenville Geological Province. Flake graphite occurs disseminated in marble and gneiss. The occurrences of major interest are in semipelitic and pelitic gneiss units within paragneiss sequences. Graphite is present in amounts up to 10%. Accessory minerals consist of biotite, garnet and pyrite; trace elements in these graphitic rocks are nickel, cobalt, boron and vanadium.

CANADIAN PRODUCTION AND DEVELOPMENTS

In 1994, Canada's production of natural flake graphite came mainly from Stratmin Graphite Inc., which operates a mine and concentrator at Lac-des-Îles, Quebec. In Ontario, production came mainly from Applied Carbon Technology Inc., which operated until June a mine and a processing plant near Kearney.

The year was again marked by a decline in exploration and development activity in Canada.

Despite difficult market conditions, Stratmin Graphite Inc.'s mill produced 23 100 t in 1994 and operated at near its capacity of 24 000 t/y concentrates; the company sold 20 219 t of graphite concentrates in 1994. The company is "ISO 9003 certified," which is an internationally recognized standard of quality-product assurance.

Blaming soft graphite prices and financing difficulties, Applied Carbon announced on June 14, 1994, that it was closing its mine and concentration plant near Kearney, Ontario. The concentrator has a design capacity of 25 000-30 000 t/y of graphite concentrates. About half of the production was sold to the refractory industry for which graphite prices were weak. In November, Stratmin Inc. purchased 18.1 million shares in the capital of Applied Carbon, representing 49.5% of the outstanding shares from affiliates of The Hillman Company. A new board of directors has since been appointed. The plant will remain closed until the graphite market regains its strength. Ways to increase the viability of the plant will be studied, and the annual milling capacity of the blending plant located in Brocton, New York, will be increased to 7000 t in 1995 and to 9000 t in 1996.

After several years of planning, Victoria Graphite Inc. started producing flake graphite on June 1, 1994. The mine, which is located at Portland half way between Ottawa and Kingston, has a production capacity of 3000 t/y of graphite concentrates. Its average ore grade is 6% carbon, and the concentrates grade 80-85% graphite. Using physical and chemical methods, the company intends to upgrade the graphite concentrate to +95% carbon, with very low ash and relatively low sulphur content. Research has indicated that Portland graphite is suitable for the production of exfoliated graphite, a product which is used in the manufacture of graphite foil. Graphite foil is a high-value product and demand is increasing, so the company plans to produce graphite salt, exfoliated graphite, and eventually graphite foil.

Mazarin Mining Exploration Inc. of Québec City has updated a feasibility study to develop a graphite deposit near Fermont in northern Quebec. The study, prepared by Cambior inc. in 1991, proposed an open-pit mining operation for six months of the year, which would supply enough ore to feed a 400-t/d concentrator on a year-round basis for an annual production of 23 000 t of graphite concentrate. The total capital cost of the project was estimated by Cambior at $30.6 million. Geological reserves are 8.1 Mt averaging 16.7% carbon. The 20-year mining reserves total 2.5 Mt grading 17.4% carbon after dilution, and they are mineable by open pit with a waste-to-ore ratio of 1.0:1.0. The graphite from the deposit is suitable for all major applications without chemical upgrading. The project is ready for construction and could be in production in about one year.

Indresco Canada Inc. (previously known as Graphicor Resources Inc.), which faced a declining world market and low recoveries from its Diotte orebody, suspended its operations and mothballed its Lac-des-Îles beneficiation plant in December 1991. The company reports that the plant would re-open only if markets improve substantially, which it claims is not expected to happen in the short-to-medium term.

Mart Mining and Exploration Limited indicated it is seeking a partner to facilitate further exploration drilling and beneficiation testing on its deposit in Labrador, which the company reports has probable reserves of 10.5 Mt of ore grading 21.9% carbon and a stripping ratio of 0.9:1.0. Preliminary beneficiation work on the ore has produced a concentrate grading up to 83% carbon with flake size varying from -150 to +71 microns. The deposit is 7 km from a main highway, which is 15 km from the mining towns of Labrador City and Wabush.

Quinto Mining Corporation holds a 100% interest in a sericite (mica)-graphite-gold deposit near Lumby, British Columbia. The graphite-sericite combination consists of grains that vary in size between 0.3 and 100 microns. Laboratory work has indicated that it will be difficult to separate the graphite from the mica because they are so fine-grained, so the company hopes to sell a mica-graphite final product. Credits can be obtained from gold contained in the deposit. Reserves remain to be determined, but the deposit is reported to be large.

CANADIAN CONSUMPTION AND TRADE

Reported consumption of natural flake graphite in 1993, the latest year for which data are available, amounted to 5089 t. Graphite was used mainly in foundries, but also in the metallurgy and refractory industries.

In 1994, imports of natural graphite were 6427 t and exports were 21 711 t. Most of Canada's trade is with the United States. Crude graphite is used mainly in Ontario (70%) and Quebec (15%).

USES AND SPECIFICATIONS

The uses of natural graphite flow from its physical and chemical properties. It has a high melting temperature, high thermal and electrical conductivity, is chemically inert (resistant to slags), is thermal shock-resistant, has a low coefficient of friction, and has a low absorption coefficient for X rays and electrons.

The principal use for graphite is in the manufacturing of refractory products. This is followed by foundries, lubricants, brake linings, crucibles, and pencils. All of the aforementioned together account for 80% of total usage. Most of the remaining 20% is accounted for by uses such as carbon brushes, batteries, and expandable graphite for the production of graphite foil, for example. It is reported that in Europe refractory producers still use graphite that has a carbon content under 90%. In the United States, most producers use graphite that contains a minimum of 94% carbon. In Japan, the average is 95-99%. In the United States, flake graphite is used mainly in refractories, followed by lubricants, pencils, brake linings, powdered metals, crucibles, and foundries, in decreasing order.

The graphite content of magnesia-carbon refractory bricks, which are large users of flake graphite, varies between 15% and 25% with an average carbon content of 87-90%, and an average flake size of 0.15-0.71 mm. Mag-carbon bricks are used in high-temperature and corrosion-prone applications such as in steel furnace lining, ladles, slag-lines, hotpots, nozzles, and blast furnaces. Graphite is used because of its thermal conductivity and thermal and chemical resistance.

Graphite crucibles are used in steel-making and in the production of nonferrous and precious metals. Here, flake graphite is preferred to microcrystalline graphite because it burns more slowly, has a high attrition resistance, and imparts structural strength through the orientation of the flakes. Average carbon content is 80-90% and average flake size is 0.15 mm.

Lubricants for industrial usage are also made from graphite because of its softness, low friction, inertness, and heat resistance. High-carbon (between 98% and 99%) graphite, 53-106 microns in size, is used.

In the manufacture of lead pencils, natural graphite is used because of its marking properties. The degree of hardness of a pencil is determined by the clay-to-graphite ratio of its lead; softer pencils use more graphite. High-quality pencils use crystalline graphite, while cheaper grades use amorphous graphite. The lead is a mixture of kaolin and bentonite mixed with graphite, and baked.

The use of graphite in brake linings reduces the wear rate. High-carbon crystalline graphite, below 75 microns, is used with a minimum carbon content of 98%, although a concentrate of 90% can be used if abrasive impurities such as silica are at a low level.

Graphite has traditionally been used in dry-cell zinc-carbon batteries due to its electrical conductivity. Fine-grained carbon, 85% below 75 microns, or microcrystalline graphite with a minimum carbon content of 88%, is required. Alkaline batteries require a purer natural graphite, very fine-grain size, with a carbon content of at least 98% or a synthetic grade. Carbon material should be free of metallic impurities such as copper, cobalt, arsenic or antimony.

Electric motor components use a wide variety of graphite, natural or synthetic. Powdered graphite, 150 microns, with a minimum carbon content of 95-99% is required. Lump graphite, low-silica microcrystalline graphite and synthetic graphite are usually suitable.

In powder metallurgy, where steel is reinforced by the absorption of carbon, high-purity graphite is required for the sintering. It also acts as a lubricant and as a source of carbon. Dry powder graphite should be of an average particle size of 5 microns and must have a carbon content of between 96% and 99%.

In paint manufacture, graphite is used to protect metal surfaces exposed to a corrosive environment and to eliminate the accumulation of static electricity in floor coatings. Microcrystalline graphite of low carbon content, 50-55%, is usually required.

For foundry applications such as mould coating, graphite prevents the adhesion of metals. Foundry facings are usually made of microcrystalline graphite, between 53 and 75 microns, with a low carbon content of 40-70%.

Iron foundries use microcrystalline graphite as a recarburizer for raising the carbon content of iron melted in electrical furnaces from charges containing large proportions of scrap. A wide variety of material, such as synthetic graphite and coke, may serve as a substitute.

Other uses for natural graphite include paints and polishes, anti-knock compounds, electrical and electronic products, and rubber.

GROWTH AREAS

Growing markets include: (a) exfoliated "expanded" flake graphite rolled into sheet (grafoil, also called flexible graphite foil) for the manufacture of gaskets and seals used in the automotive industry, heat exchangers, and other products; (b) high-alumina and magnesia-graphite bricks for the refractory industry, although growth has been considerably reduced in recent years; (c) zirconia-graphite coatings; (d) flake graphite-silicon carbide refractories; and (e) friction materials. Other growing markets are very high-purity graphite for specialty applications, metal powders, and motor brushes.

FLEXIBLE GRAPHITE

World consumption of grafoil products is estimated at 8000-10 000 t in 1994 (Source: Stratmin); this compares with about 5500 t in 1990 and 5700 t in 1992. In 1994, the grafoil market required some 10 500-14 000 t of flake graphite raw material due to losses in the production processes, i.e., production of high-purity graphite from graphite concentrates using acids and bases to remove impurities, followed by graphite salt ("intercalated graphite"), expanded (exfoliated) graphite, and calendering and rolling graphite into foil. Natural flake graphite normally used to manufacture flexible graphite comes from mines located in Canada, China, Madagascar and Zimbabwe. China is the largest producer of high-purity graphite necessary for the production of graphite salt, and Japan is the largest producer and exporter of graphite salt. Graphite salt is shipped to the producer of grafoil where graphite is expanded, calendered and rolled into foil. The flake quality and, consequently, the prices are dependent upon the flake size distribution, fines content, carbon content, and ash content and distribution. Ash is defined as those elements present other than graphite. The size of ash particles as well as the content has an effect on the quality of the finished flexible graphite product. The ash normally consists of varying amounts of trace elements plus larger quantities of silica, sulphur, iron, aluminum and magnesium. The quality of the graphite raw material is also dependent on the quality and process control of the beneficiation process at the mine site, and must be closely monitored by the flexible graphite producer.

The markets for flexible graphite by use and geographic regions were as follows in 1992:

FLEXIBLE GRAPHITE MARKETS, 1992

Region	Industrial	Automotive
	(t/y)	
North America	500	2 600
Japan	100	1 700
Europe	400	250
Other	100	50
Total	1 100	4 600

Source: UCAR Carbon Company Inc.

World producers of grafoil are, in decreasing order: UCAR Carbon Company Inc., United States; SIGRI GmbH, Germany; Polycarbon Inc. (owned by SIGRI), United States; Hitachi Chemical, Japan; Nippon Carbon, Japan; and Le Carbone Lorraine, France. There are also producers in China and the former Soviet Union. The largest market for grafoil is the automotive industry. The industrial market can be divided as follows: petrochemical, which is the largest; chemical; and nuclear, which is the smallest, but is the one that requires the highest-purity grafoil and, consequently, is the most expensive. It is reported by industry that markets for grafoil in the automotive industry are growing worldwide, and that markets for the chemical industry are growing mainly in Southeast Asia and the Middle East. Prices for flexible graphite varied between US$12 and $22/kg in 1993.

WORLD PRODUCTION, TRADE AND CONSUMPTION

Preliminary figures for 1993 indicated that world production of natural graphite was 741 000 t. According to Stratmin Graphite Inc., approximately 200 000 t was flake graphite. The major producers of graphite were: China, with an estimated 310 000 t; South Korea, 80 000 t; Mexico, 49 000 t; Ukraine, 40 000 t; North Korea, 38 000 t; and Brazil, 29 000 t.

The major producing countries, by type of graphite and by decreasing order of importance, are as follows:

- **Flakes**: China, Ukraine, Brazil, Canada, Madagascar, Zimbabwe and Norway;

- **Microcrystalline (amorphous):** China, South Korea, Mexico, Czechoslovakia, Austria, North Korea, Russia, and Zimbabwe; and
- **Lump:** Sri Lanka.

A summary of the largest exporter and importer countries of graphite in recent years is as follows:

MAJOR EXPORTER AND IMPORTER COUNTRIES OF GRAPHITE, IN RECENT YEARS

Country	Exports	Country	Imports
	(000 t/y)		(000 t/y)
China	100-130	Japan	90-95
South Korea	35-45	United States	40-45
Mexico	20	Germany	35-40
Canada	20	United Kingdom	23-25
Madagascar	15	Taiwan	12-15
Zimbabwe	15	Italy	7
Brazil	15	France	6
Austria	7-10	Austria	5
Norway	3		
Germany[1]	2		

[1] Excludes re-exports.

The largest consumers of graphite are the largest producers of steel, base metals and precious metals. Together they consume about 50% of all graphite and are the largest users of flake graphite. Consequently, the largest consumer countries are the former Soviet Union, Japan, the United States, China, Germany, the United Kingdom, Italy, France and Brazil.

PRICES

Published prices for natural graphite provide only a range and do not represent real market prices, which are contracted prices negotiated between suppliers or distributors and consumers. Generally speaking, the prices for flake graphite concentrates are higher than those for microcrystalline (amorphous) graphite, and prices for flake graphite concentrates vary depending on the carbon content, the size of the flakes and their distribution, and the ash content. Published prices of crystalline flake graphite in Europe remained unchanged from the previous year, but amorphous powder continued to decline. Prices in Europe were reported by the industry to be lower than in the United States. The average price of graphite concentrates shipped from Canada in 1994 decreased by nearly 10%.

SUBSTITUTES

Molybdenum disulfide competes with natural graphite as a dry lubricant, but is more sensitive to oxidizing conditions. Finely ground coke mixed with olivine is a potential competitor in foundry-facing applications. Kish, a residue from steel-making, can be transformed into synthetic flake graphite and could become a substitute for flake graphite; however, the technology developed by the U.S. Bureau of Mines in cooperation with the steel industry and Asbury Carbons is still too expensive under the prices paid for natural graphite.

OUTLOOK

Natural graphite has excellent physical and chemical properties, its resource base is large, and it is readily available from several countries. Prices have declined substantially during the past four years and this should restrain the entry of new producers, encourage consumption, and prevent the development of substitutes. For these reasons, growth in consumption should continue. Canadian deposits are of the flake type, relatively easy to upgrade to +90% carbon; many contain graphite that is expandable. Products made from expandable graphite command high prices and the outlook for growth for these products is good. World supply of natural graphite will continue to be abundant. However, requirements by consumers for consistent and high-quality natural flake graphite will continue to increase.

Notes: (1) For definitions and valuation of mineral production, shipment and trade, please refer to Chapter 60. (2) Information in this review was current as of January 14, 1995.

PRICES

"Industrial Minerals"[1] pricing quotation, c.i.f., United Kingdom port, US$ per tonne

		1990 Dec.	1991 Dec.	1992 Dec.	1993 Dec.	1994 Dec.
Crystalline lump	92-95% C	750 – 1 500	750 – 1 500	750 – 1 500	650 – 850	650 – 850
Crystalline large flake	85-90% C	820 – 1 300	650 – 1 200	400 – 800	400 – 600	400 – 600
Crystalline medium flake	85-90% C	770 – 1 120	450 – 1 000	350 – 750	300 – 500	300 – 500
Crystalline small flake	80-95% C	540 – 900	400 – 600	300 – 550	250 – 500	250 – 500
Amorphous powder	80-85% C	220 – 440	220 – 440	220 – 440	220 – 440	220 – 300
Synthetic (Swiss border per kg)	99.95% C				2.23	2.23

c.i.f. Cost, insurance and freight; C Carbon.
[1] "Industrial Minerals," December 1990, December 1991, December 1992, December 1993 and December 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
25.04	Natural graphite				
2504.10.10	In powder	8.6%	6%	Free	Free
2504.10.20	In flakes	3.7%	2.5%	Free	Free
2504.90	Other	Free	Free	Free	Free
69.02	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths				
6902.90.10	Other, containing by weight 85% or more of carbon or graphite	6.3%	4.5%	2.0%	Free
6902.90.90	Other	Free	Free	Free	1.4%
69.03	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meals or of similar siliceous earths				
6903.10	Containing by weight more than 50% of graphite or other forms of carbon or of a mixture of these products				
6903.10.10	Crucibles and covers therefor	6.3%	Free	2.0%	1.4%
6903.10.91	Other, containing by weight 85% or more of graphite or other forms of carbon	6.8%	4.5%	2.7%	1.4%
6903.10.99	Other	Free	Free	Free	1.4%
8545.20	Carbon or graphite brushes	9.5%	6.5%	3.0%	1.1%[a]

Sources: Customs Tariff, effective January 1995, Revenue Canada; Harmonized Tariff Schedule of the United States, 1995.
[a] Equipment, originating in Canada, intended for use in the repair or maintenance of certain motor vehicles is subject to accelerated rate reductions.

TABLE 1. IMPORTS[1] OF CRUDE GRAPHITE AND GRAPHITE-RELATED PRODUCTS, 1993 AND 1994

Item No.		1993		1994p	
		(tonnes)	($000)	(tonnes)	($000)
2504.10	Natural graphite in powder or flake				
	United States	1 985	2 323	2 287	2 690
	Switzerland	17	38	163	541
	China, People's Republic of	102	69	212	138
	Mexico	–	–	112	92
	Sri Lanka	44	55	79	58
	Other countries	48	77	51	94
	Total	2 196	2 564	2 904	3 615
2504.90	Natural graphite, n.e.s.				
	United States	4 339	828	3 325	799
	China, People's Republic of	–	–	23	63
	Germany	–	–	174	27
	Mexico	–	–	1	2
	United Kingdom	64	24	–	–
	Total	4 403	853	3 523	894
6902.90	Refractory bricks, etc., n.e.s. (containing by weight more than 50% carbon or graphite)				
	United States	12 675	9 174	27 651	12 263
	Japan	1 940	4 751	670	2 032
	United Kingdom	1 853	1 474	1 391	1 475
	Belgium	202	266	715	1 216
	France	136	395	438	848
	Germany	222	515	471	225
	Brazil	–	–	18	54
	Denmark	–	–	50	37
	Switzerland	–	–	4	19
	Hungary	–	–	27	15
	Sweden	42	23	4	11
	Spain	–	–	3	10
	Other countries	385	531	–	–
	Total	17 455	17 132	31 442	18 213
6903.10	Refractory ceramic goods, n.e.s., more than 50% of graphite or other forms of carbon, etc. (including crucibles)				
	United States	..	1 222	14	1 516
	France	..	523	3	310
	Germany	..	583	3	284
	Japan	..	360	6	278
	United Kingdom	..	536	1	131
	Belgium	–	–	1	75
	Other countries	..	228	...	5
	Total	..	3 455	28	2 602
8545.20	Carbon or graphite brushes				
	United States	247	6 695	217	5 874
	Japan	7	176	19	403
	Germany	5	248	7	385
	Brazil	8	117	11	236
	France	...	22	4	115
	United Kingdom	...	41	...	66
	Taiwan	2	26	...	20
	Sweden	1	16	...	20
	Mexico	–	–	...	17
	Switzerland	...	10	...	13
	Other countries	...	19	1	22
	Total	270	7 374	261	7 178

Sources: Natural Resources Canada; Statistics Canada.
– Nil; .. Not available; ... Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] Imports from "other countries" may include re-imports from Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. EXPORTS OF NATURAL GRAPHITE, 1993 AND 1994

Item No.		1993		1994p	
		(tonnes)	($000)	(tonnes)	($000)
2504.10	Natural graphite in powder or flake	20 482	16 518	21 054	17 035
2504.90	Natural graphite, n.e.s.	1 019	561	657	362

Source: Statistics Canada.
n.e.s. Not elsewhere specified; p Preliminary.

TABLE 3. REPORTED CONSUMPTION[1] OF GRAPHITE IN CANADA, 1988-93

	1988a	1989	1990	1991	1992	1993p
			(tonnes)			
Natural graphite						
Foundry facing	2 729r	1 723	1 892	1 603	2 366	3 036
Refractories	673	643	415	274	97	75
Other uses[2]	1 522	1 625	2 876	2 186	2 188	1 978
Synthetic graphite						
Foundry facing	3 898r	3 782r	2 680	1 267	1 893	1 730
Other uses[3]	7 002	5 634r	4 287	918	929	442
Total	15 824r	13 407	12 150	6 248	7 473	7 261

Source: Natural Resources Canada.
p Preliminary; r Revised.
a Increase in number of companies being surveyed.
1 Reported from NRCan survey on the consumption of nonmetallic minerals by Canadian manufacturing plants.
2 Includes brake linings, chemicals, abrasives, primary steel and other end uses. 3 Includes abrasives, batteries, bearings and brake linings, cement, chemicals, primary steel and other uses.

TABLE 4. WORLD GRAPHITE PRODUCTION, BY COUNTRY[1]

Country	1989	1990	1991	1992	1993[e]
			(tonnes)		
Argentina[e]	100[a]	100	100	90	100
Austria	15 307	22 705[r]	19 750[r]	19 547	19 500
Brazil (marketable)[2]	31 650	28 890	26 965	29 414[r]	29 000
Burma (Myanmar)[3]	–	45	36[r]	–	–
Canada (exports of natural graphite)	6 000	10 200	6 200	17 400	18 800
China[e]	490 000[r]	455 000[r]	289 000[r]	300 000[r]	310 000
Czech Republic[4]	–	–	–	–	20 000
Czechoslovakia[5]	66 000[r]	39 000[r]	47 000[r]	20 000[r,e]	–
Germany	15 800[r,e]	19 314[r]	15 807[r]	11 963[r]	10 000
India (run-of-mine)[6]	58 000	61 000	69 922	70 000[e]	64 000
Korea, North[e]	35 000	35 000	35 000	38 000	38 000
Korea, Republic of					
Amorphous	100 282	98 987	75 239	75 000[e]	72 000
Crystalline flake	1 186	703	1 552	8 412[r]	8 000
Madagascar	15 863	18 036	14 079	8 910[r]	8 000
Mexico					
Amorphous	38 304	22 553	35 315	47 053[r]	49 440
Crystalline flake	1 942	2 365	1 943	985[r]	1 000
Namibia[e]	–	–	200	200	200
Norway	1 800	5 000[e]	6 930	5 000[r,e]	5 000
Romania	10 000	6 000[r,e]	6 000[r,e]	2 300	2 000
Russia	–	–	–	15 000[e]	10 000
Sri Lanka	4 163	5 469	6 381	3 307[r]	4 000
Turkey (run-of-mine)[7]	11 873	18 712	25 867	20 978[r]	20 000
Ukraine	–	–	–	50 000[e]	40 000
U.S.S.R.[e,8]	84 000	80 000	75 000	–	–
United States	w	–	–	–	–
Zimbabwe	18 147	16 383	12 903	12 346[r]	12 000
Total	1 005 417[r]	945 462[r]	771 189[r]	775 905[r]	741 040

Source: U.S. Bureau of Mines.
– Nil; [e] Estimated; [r] Revised; w Withheld to avoid disclosing company proprietary data.
[a] Reported figure.
[1] Table includes data available through May 31, 1994. [2] Does not include the following quantities sold directly without beneficiation, in metric tonnes: 1989, 13 005 t (revised); 1990, 8400 t revised); 1991, 7298 t (revised); 1992, 8957 t (revised); and 1993, 9000 t (estimated). [3] Data are for fiscal years beginning April 1 of that stated. [4] Formerly part of Czechoslovakia. [5] Dissolved December 31, 1992. All production in Czechoslovakia from 1989-92 came from what is now the Czech Republic. [6] Indian marketable production is 10-20% of mine production. [7] Turkish marketable production averages approximately 5% of run-of-mine production. Almost all is for domestic consumption. [8] Dissolved in December 1991.

GRAPHITE

By Rustu S. Kalyoncu

Domestic survey data and tables were prepared by Joseph Krisanda, statistical assistant, and the world production tables was prepared by Glenn J. Wallace, international data coordinator.

Graphite, a soft crystalline form of carbon, is also known by the names of black lead, plumbago, and mineral carbon. The word "graphite" is derived from the Greek word "graphein," to write. Graphite is a soft mineral with a Mohs hardness of 1 to 2, and it exhibits perfect basal cleavage. Depending upon the purity, the specific gravity is 2.20 to 2.30. The theoretical density is 2.26 grams per cubic centimeter (g/cc). It is gray to black in color, opaque, and has a metallic luster. It is flexible but not elastic. It has high thermal and electrical conductivities, is highly refractory, and is chemically inert. Graphite is one of three forms of crystalline carbon; the other two are diamond and fullerenes. It occurs naturally in metamorphic rocks such as marble, schist, and gneiss. Various silicate minerals are generally associated with graphite in ore.

There are two general types of graphite, natural and synthetic. Graphitization of naturally occurring organic carbon may occur at temperatures as low as 300° C-500° C or as high as 800° C-1,200° C, such as when an igneous intrusion contacts a body of carbonaceous rock.

The three principal types of natural graphite—lump, crystalline flake, and amorphous—are distinguished by physical characteristics that are the result of major differences in geologic origin and occurrence. Lump graphite occurs in veins and is believed to be hydrothermal in origin. It is typically massive, ranging in particle size from extremely fine to coarse, platy intergrowths of fibrous or acicular crystalline aggregates with the long axis parallel to the enclosing wall rock (Kenan, 1984). Crystalline flake graphite consists of isolated, flat, plate-like particles with angular, rounded, or irregular edges. It is usually found in layers or pockets in metamorphic rocks. In some deposits, the flake graphite occurs as massive accumulations in veins, lenses, or pods. Amorphous graphite is formed by the thermal metamorphism of coal. The designation amorphous is a misnomer. Its relatively low degree of crystalline order and very fine particle size make it appear amorphous. It is usually of lower purity than the crystalline flake graphite and, therefore, commands a lower price than its more ordered counterpart.

Legislation and Government Programs

Total National Defense Stockpile graphite inventories, excluding nonstock grade, were 9,000 metric tons (t) with a value of about $1.75 million. Madagascar natural graphite inventories in the United States were 4,200 t with a value of $0.7 million; there were 4,830 t of Sri Lanka amorphous lump with a value of $1.07 million (table 2). No acquisition of graphite for the strategic and critical materials stockpile took place in 1999. Graphite no longer has a Government stockpile goal and all graphite in the Government stockpile has been authorized for sale.

Production

No graphite was mined in the United States in 1999. Owing to insufficient response by its producers, synthetic graphite data were not compiled from 1995 to 1998. With renewed cooperation of the major manufacturers, however, synthetic graphite production figures for 1999 were successfully gathered. The U.S. production of synthetic graphite reached 267,000 t with a value of $817 million (table 4).

Graphite is mined from open pit and underground mine operations. Open pit operations are more economical and, thus, are preferred where the overburden is thin enough. Most mines in Madagascar are of this type. In the Republic of Korea, Mexico, and Sri Lanka, where the deposits are deep, underground mining techniques are required.

Consumption

The use of graphite has changed dramatically. Graphite exhibits the properties of a metal and a nonmetal, which make it suitable for many industrial applications. The metallic properties include thermal and electrical conductivity. The nonmetallic properties include inertness, high thermal resistance, and lubricity. The combination of conductivity and high thermal stability allows graphite to be used in many applications. Lubricity and thermal conductivity make it an excellent material for high-temperature applications, because it results in a material that provides effective lubrication at a friction interface while furnishing a thermally conductive matrix to remove heat from the same interface. Lubricity and electrical conductivity allow its use as the primary material in the manufacture of brushes for electric motors. A graphite brush effectively transfers electric current to a rotating armature while the natural lubricity of the brush minimizes frictional wear. Today's high-technology products, such as friction materials and battery and fuel cells demand higher purity graphite.

U.S. consumption of natural graphite increased to 34,600 t, in 1999 from 27,400 t in 1998 (table 3). The crystalline grade increased by 19%, to 17,300 t, in 1999 from 14,500 t in 1998, whereas amorphous grade increased by an impressive 34%, to 17,300 t, in 1999 13,000 t in 1998. This translated into 20% increase in value in 1999 for natural graphite.

The four major industries— refractories, brake linings, lubricants, and foundries—for which natural graphite is used, continued to lead the way in graphite usage, accounting for one-half of the graphite consumed by U.S. industry in 1999 (table 3). The refractories industry was again the major consumer of crystalline flake graphite followed by the manufacture of brake linings and metal powders. Refractory applications of graphite included castable ramming, gunning mixtures, and carbon-bonded brick. Carbon-magnesite brick has applications in high-temperature corrosive environments such as steel furnaces, ladles, and iron blast furnaces. Carbon-alumina linings are principally used in continuous steel casting operations. Magnesite- and alumina-carbon brick require a particle size of 100 mesh and a purity of 95% to 99% graphite.

Crystalline flake graphite accounted for nearly 50% of graphite usage in the United States. It was mainly used in refractories, batteries, and other thermal and electrical conductivity applications. Amorphous graphite is mainly used as lubricant additives as pigment in paints, plastic refractories, and other applications where additions of graphite improve the process or the end product. Lump graphite finds appropriate uses in a number of areas depending on the purity and particle size.

Synthetic graphites remain the choice in North America, accounting for more than one-half of the market. The main market for high-purity synthetic graphites is iron and steel. This market consumes more than 50% of the synthetic graphite, as a carbon-raiser additive (table 4).

Other significant uses of all types of graphites are the manufacture of low-current, long-life batteries, steelmaking, solid carbon shapes, static and dynamic seals, valve and stem packing, catalyst supports, porosity enhancing inert fillers, manufacture of rubber, and powder metallurgy. The use of graphite in low-current batteries is gradually giving way to carbon black, which is more economical.

Prices

The range of graphite prices has remained steady and unchanged during 1999. Prices for crystalline flake graphite concentrates ranged from $480 to $550 per ton, and commanded higher prices than the amorphous, priced at $220 to $235 per ton. Carbon content, flake and crystal size, size distribution, and ash content affect the price of graphite. Customary negotiations between the buyer and the seller lead to wide short-term price fluctuations (table 5).

Foreign Trade

Total imports of natural graphite declined slightly in tonnage to 55,800 t in 1999 from 61,600 t in 1998, but the values remained essentially unchanged, $34.7 million in 1999 compared to $34.8 million in 1998 (table 7). Principal import sources of natural graphite, in order of tonnage, were China, Mexico, Canada, and Brazil which accounted for 80% of the dollar value of total imports. Mexico continued to be the major supplier of amorphous graphite; Sri Lanka provided the lump variety. A number of other producers supplied various types and grades of graphite to the United States, among the more notable being Germany, India, Japan, and Madagascar. In spite of showing a noticeable decrease in tonnage, total exports recorded an 8% increase in total revenue to $82,800 million in 1999, compared with $76,700 million in 1998 (table 6).

World Review

World production of graphite in 1999 was estimated to be 685,000 t, compared with 683,000 t in 1998. China maintained its position as the world's leading graphite producer, at 280,000 t, with India in second place with 145,000 t, followed by Brazil, Mexico, and Czech Republic. These five countries accounted for 80% of the world production (table 9).

For the past several years, Sri Lanka has accounted for nearly all the high-purity lump graphite produced. Sri Lankan deposits were estimated to average 95% graphite in situ.

The combination of a decrease in world demand in the early 1990's and competition from cheap Chinese material forced many non-Chinese producers to reduce production or even to leave the market altogether. China accounted for 40% of world production.

Current Research and Technology

In recent years, new technology in processing and treatment has expanded the use of natural graphites in battery applications. Graphite for these applications has been purified to 99.9% carbon. Most new uses for graphite products are being developed through advances in graphite thermal technology. The ability to refine and modify graphite and carbon products will be the key to future growth in the graphite industry. Innovative refining techniques have enabled the use of improved graphite in friction materials, electronics, foil, and lubrication applications (Hand, 1997). Some of the new application areas include electrically conductive asphalt for heated runways at airports and roadway bridges.

With its low specific gravity, refractoriness, and corrosion resistance, graphite is critical for many industrial applications, such as dies for continuous casting, rocket nozzles, and heat exchangers for the chemical industry. However, relatively poor wear and oxidation resistance of graphite limit its use. A class of high-performance materials based on titanium carbide-coated graphite, makes the material suitable for some of the most demanding applications (Webb, 2000). Because titanium carbide is one of the hardest and most durable materials, the resulting components are extremely resistant to wear, corrosion, and elevated temperatures. These composites can be engineered to fit many industrial uses through control of the coating composition, thickness, microstructure, and surface finish. In metal melting applications, titanium carbide coatings have shown to improve the service life of the graphite components by as much as fivefold.

Enigmatic clusters of carbon atoms, called fullerenes, found as large carbon-cage molecules, have been puzzling scientists since 1985 when they were first discovered among the byproducts of laser-vaporized graphite (Pierson, 1993). Their hollow spherical structure, reminiscent of geodesic domes of architect Buckminster Fuller, earned them the names "buckyballs" and "fullerenes." Mistakenly called a "new form of carbon," fullerenes have been found to exist in interstellar dust as well as in geologic formations on earth. Fullerenes are fascinating because they exhibit unusual properties for carbon materials. For example, adding three alkali atoms per fullerene unit (C_{60}) results in a material that exhibits superconductivity at quite high temperatures (10° K.-40° K). These materials also exhibit lubricity superior to that of graphite. To date, no product based on fullerenes has been offered in the market. The full potential of fullerenes in practical applications remains to be explored.

Outlook

The main areas of natural graphite consumption in the near future will be in high-temperature applications for the iron and steel industry as the industry modernizes its production facilities. Brake linings and other friction materials will steadily consume more natural graphite as new automobile production continues to increase and more replacement parts are required for the growing number of existing vehicles. Flexible graphite product lines, such as grafoil (a thin graphite cloth) will probably be the fastest growing market but will consume small amounts of natural graphite compared with major end-use markets.

In the event of any price increases, China may increase its production to take advantage of potential high profits, leading to a sharp price decline in certain grades and possibly to a production stoppage in other countries. If, however, the Chinese iron and steel industry expands its consumption of natural graphite, then Chinese exports may eventually decline, encouraging new producers to enter the market (Roskill Information Services Ltd., 1998).

Industry trends that appear to be common to advances in graphite technology and markets include higher purity and consistency in specifications for some specialized and high-tech applications. Production of higher purity graphite, using thermal processing and acid leaching techniques, for such applications as advanced carbon-graphite composites, continues to be the trend.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT NATURAL GRAPHITE STATISTICS 1/

		1995	1996	1997	1998	1999
United States:						
Apparent consumption 2/	metric tons	23,500	27,400	18,400	33,600	26,400
Exports	do.	37,300	26,000	39,700	28,000	29,400
Value	thousands	$17,900	$14,600	$20,500	$14,100	$15,200
Imports for consumption	metric tons	60,700	53,400	58,100	61,600	55,800
Value	thousands	$30,100	$28,600	$32,400	$34,800	$34,700
World, production	metric tons	584,000	550,000 r/	678,000 r/	683,000 r/	685,000

r/ Revised.

1/ Data are rounded to no more than three significant digits.

2/ Domestic production plus imports minus exports.

TABLE 2
U.S. GOVERNMENT STOCKPILE GOALS AND YEAREND STOCKS OF NATURAL GRAPHITE IN 1999, BY TYPE 1/

(Metric tons)

Type	National stockpile inventory
Madagascar crystalline flake	4,200
Sri Lanka amorphous lump	4,830
Nonstockpile-grade, all types	49

1/ Graphite no longer has a goal.

Source: Defense National Stockpile Center, Inventory of Stockpile Materials as of December 31, 1999.

TABLE 3
U.S. CONSUMPTION OF NATURAL GRAPHITE, BY END USE 1/

End use	Crystalline Quantity (metric tons)	Crystalline Value (thousands)	Amorphous 2/ Quantity (metric tons)	Amorphous 2/ Value (thousands)	Total Quantity (metric tons)	Total Value (thousands)
1998:						
Batteries	W	W	--	--	W	W
Brake linings	889 r/	$1,100 r/	3,090 r/	$2,870 r/	3,980 r/	$3,970 r/
Carbon products 3/	388	1,430 r/	W	225	W	1,650 r/
Crucibles, retorts, stoppers, sleeves, nozzles	993	845	W	W	W	W
Foundries 4/	W	310 r/	W	W	W	W
Lubricants 5/	339 r/	544 r/	1,260 r/	986 r/	1,600 r/	1,530 r/
Pencils	W	W	W	W	W	W
Powdered metals	445	1,020	26	55	471	1,080
Refractories	W	3,460	5,010 r/	3,390 r/	W	6,850 r/
Rubber	W	W	W	394	W	W
Steelmaking	W	W	W	W	W	W
Other 6/	W	W	798 r/	514 r/	W	W
Total	14,500 r/	16,600 r/	13,000 r/	9,180 r/	27,400 r/	25,800 r/
1999:						
Batteries	W	W	--	--	W	W
Brake linings	1,090	1,290	5,280	4,540	6,380	5,830
Carbon products 3/	425	1,310	318	268	743	1,570
Crucibles, retorts, stoppers, sleeves, nozzles	W	711	W	W	W	W
Foundries 4/	W	494	1,780	825	W	1,320
Lubricants 5/	328	580	1,180	905	1,510	1,490
Pencils	W	W	W	W	W	W
Powdered metals	432	995	27	57	459	1,050
Refractories	W	W	5,580	3,670	W	W
Rubber	W	844	W	367	W	1,210
Steelmaking	W	W	W	W	W	W
Other 6/	W	W	788	510	W	W
Total	17,300	18,800	17,300	12,300	34,600	31,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.
1/ Data are rounded to no more than three significant digits.
2/ Includes mixtures of natural and manufactured graphite.
3/ Includes bearings and carbon brushes.
4/ Includes foundries (other) and foundry facings.
5/ Includes ammunition and packings.
6/ Includes antiknock and other compounds, drilling mud, electrical/electronic devices, industrial diamonds, magnetic tape, mechanical products, paints and polishes, small packages, soldering/welding, and other end-use categories.

TABLE 4
U.S. PRODUCTION OF SYNTHETIC GRAPHITE IN 1999, BY END USE 1/

End use	Quantity (metric tons)	Value (thousands)
Anodes	W	W
Cloth and fibers (low modulus)	W	$80,500
Electric motor brushes and machined shapes	W	W
Electrodes	172,000	535,000
High-modulus fibers	2,450	54,400
Unmachined graphite shapes	5,520	43,900
Synthetic graphite powder and scrap 2/	W	W
Other	W	W
Total	267,000	817,000

W/ Withheld to avoid disclosing company proprietary data; included in "Total."
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes lubricants (alone/in greases), steelmaking carbon raisers, additives in metallurgy, and other powder data.

TABLE 5
REPRESENTATIVE YEAREND GRAPHITE PRICES 1/

(Per metric ton)

Type	1998	1999
Crystalline large flake, 94% carbon	$570-$750	$570-$750
Crystalline large flake, 90% carbon	480-550	480-550
Crystalline medium flake, 90% carbon	370-410	370-410
Crystalline small flake, 80% to 95% carbon	270-500	270-500
Amorphous powder, 80% to 85% carbon	220-235	220-235

1/ Prices are normally "cost, insurance, and freight" (c.i.f.) main European port.

Source: Industrial Minerals, no. 375, December 1998, p. 78; no. 387, December 1999, p. 70.

TABLE 6
U.S. EXPORTS OF NATURAL AND ARTIFICIAL GRAPHITE, BY COUNTRY 1/ 2/

	Natural 3/		Artificial 4/		Total	
Country	Quantity (metric tons)	Value 5/ (thousands)	Quantity (metric tons)	Value 5/ (thousands)	Quantity (metric tons)	Value 5/ (thousands)
1998:						
Canada	5,320	$3,330	9,410	$15,900	14,700	$19,200
France	10	49	8,820	5,040	8,830	5,080
Japan	450	562	19,200	9,540	19,600	10,100
Korea, Republic of	417	192	10,200	4,990	10,600	5,180
Mexico	14,400	5,320	4,550	2,740	19,000	8,060
Netherlands	257	131	8,670	3,600	8,930	3,730
Taiwan	1,280	697	1,370	2,120	2,650	2,810
Other	5,810	3,780	19,700	18,800	25,500	22,600
Total	28,000 r/	14,100	81,900	62,700	110,000	76,700 r/
1999:						
Canada	5,410	3,570	8,290	12,800	13,700	16,300
France	4	16	3,740	5,590	3,750	5,600
Japan	328	240	15,600	8,190	16,000	8,430
Korea, Republic of	238	202	8,470	4,870	8,710	5,080
Mexico	8,090	3,130	3,220	2,310	11,300	5,440
Netherlands	2,270	889	10,400	4,070	12,700	4,960
Taiwan	674	414	1,080	1,390	1,760	1,800
Other	12,400	6,760	21,600	28,400	34,000	35,100
Total	29,400	15,200	72,500	67,600	102,000	82,800

r/ Revised.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Numerous countries for which data were reported have been combined within the "Other" category under the "Country" list.
3/ Amorphous, crystalline flake, lump and chip, and natural, not elsewhere classified. The applicable Harmonized Tariff Schedule (HTS) nomenclature title and code (s) are: "Natural graphite in powder or in flakes"/"Other;" HTS numbers 2504.10/90.0000.
4/ Includes data from the applicable "Harmonized Tariff Schedule" (HTS) nomenclatures: "Artificial graphite" and "Colloidal or semicolloidal graphite;" their respective HTS code numbers are 3801.10/20.0000.
5/ Values are free alongside ship (f.a.s.).

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF NATURAL GRAPHITE, BY COUNTRY 1/ 2/

Country or territory	Crystalline flake and flake dust: Quantity (metric tons)	Crystalline flake and flake dust: Value 3/ (thousands)	Lump and chippy dust: Quantity (metric tons)	Lump and chippy dust: Value 3/ (thousands)	Other natural crude; high-purity; expandable: Quantity (metric tons)	Other natural crude; high-purity; expandable: Value 3/ (thousands)	Amorphous: Quantity (metric tons)	Amorphous: Value 3/ (thousands)	Total: Quantity (metric tons)	Total: Value 3/ (thousands)
1998:										
Brazil	--	--	--	--	3,450	$6,110	--	--	3,450	$6,110
Canada	13,400	$7,870	--	--	19	15	--	--	13,400	7,880
China	7,410	1,470	--	--	10,200	6,870	2,500	735	20,200	9,080
Germany	--	--	--	--	149	850	--	--	149	850
India	123	156	--	--	13	58	--	--	136	214
Japan	--	--	--	--	924	1,750	--	--	924	1,750
Madagascar	4,310	2,390	--	--	--	--	--	--	4,310	2,390
Mexico	--	--	--	--	--	--	15,400	2,560	15,400	2,560
Mozambique	1,900	1,620	--	--	--	--	--	--	1,900	1,620
Sri Lanka	--	--	838	1,000	--	--	--	--	838	1,000
Zimbabwe	440	200	--	--	--	--	--	--	440	200
Other 4/	384	721	--	--	49	320	84	138	517	1,180
Total	28,000	14,400	838	1,000	14,900	16,000	17,900	3,430	61,600	34,800
1999:										
Brazil	38	46	--	--	4,710	9,440	--	--	4,750	9,490
Canada	12,600	7,510	--	--	1	26	--	--	12,600	7,540
China	8,180	3,360	--	--	9,720	5,180	741	170	18,600	8,710
Germany	--	--	--	--	182	519	--	--	182	519
India	24	25	--	--	--	--	--	--	24	25
Japan	21	12	--	--	384	2,120	491	28	896	2,160
Madagascar	2,570	1,370	--	--	--	--	--	--	2,570	1,370
Mexico	--	--	--	--	570	264	12,500	1,820	13,100	2,080
Mozambique	1,190	1,050	--	--	--	--	--	--	1,190	1,050
Sri Lanka	--	--	418	530	--	--	--	--	418	530
Zimbabwe	200	81	--	--	--	--	--	--	200	81
Other 4/	815	552	--	--	207	581	216	53	1,240	1,190
Total	25,600	14,000	418	530	15,800	18,100	14,000	2,070	55,800	34,700

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ The information framework from which data for this material were derived originated from Harmonized Tariff Schedule (HTS) base data.

3/ Customs values.

4/ Includes Australia (1998), Austria (1998), Belgium (1998), Dominican Republic (1999), France, Greece (1998), Hong Kong , Italy, the Netherlands, Poland (1998), South Africa (1999), Sweden, Switzerland (1998), Ukraine, and the United Kingdom.

Source: Bureau of the Census, adjusted by the U.S. Geological Survey.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION
OF GRAPHITE ELECTRODES, BY COUNTRY 1/ 2/

Country	Quantity (metric tons)	Value 3/ (thousands)
1998:		
Brazil	6,930	$17,700
Canada	11,300	32,700
China	2,690	5,120
Germany	4,590	14,600
India	5,510	11,700
Italy	8,420	17,100
Japan	9,170	31,700
Mexico	12,600	21,300
Other 4/	1,760 r/	3,240 r/
Total	63,000	155,000
1999:		
Brazil	4,890	11,700
Canada	9,010	22,300
China	1,980	3,490
Germany	3,360	9,450
India	3,480	7,130
Italy	6,700	13,500
Japan	8,730	25,900
Mexico	17,500	28,300
Russia	3,630	4,930
Switzerland	1,680	3,860
Other 4/	1,910	4,490
Total	62,800	135,000

r/ Revised.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ The applicable Harmonized Tariff Schedule (HTS) code and nomenclature title are (HTS 8545.11.0000); "Electric Furnace Electrodes."

3/ Customs values.

4/ Includes data for countries reflecting less than 1,000 metric tons for yearly imports.

Source: Bureau of the Census.

TABLE 9

GRAPHITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1995	1996	1997	1998	1999 e/
Austria e/	12,019 3/	12,000	12,000	12,000	12,000
Brazil (marketable) 4/	28,028	31,254 r/	40,587 r/	61,369 r/	61,400
China e/	204,000	185,000	310,000 r/	270,000 r/	280,000
Czech Republic e/	27,000	30,000	25,000	28,000 r/	30,000
Germany (marketable)	5,214	2,603	1,030 r/	1,000 r/ e/	1,000
India (run-of-mine) 5/	129,368	115,233	102,143 r/	143,333 r/	145,000
Korea, North e/	40,000	40,000	40,000	35,000	25,000
Korea, Republic of	1,938	1,113	83 r/	62 r/	60
Madagascar 6/	16,119	12,134	13,975 r/	13,000 e/	12,000
Mexico:					
Amorphous	32,938	38,967	46,707	42,893 r/	43,000
Crystalline flake	1,450	1,445	1,275	568 r/	1,000
Mozambique	3,019	3,283	5,125	5,889 r/	4,500
Norway e/	2,588 3/	2,500	2,600	2,500	2,500
Romania	2,179	2,931	2,563 r/	2,600 r/ e/	2,600
Russia e/	8,000	6,000	6,000	6,000	6,000
Sri Lanka	8,000	5,618	5,127	5,000 e/	5,000
Tanzania	359	6,776	11,000 e/	-- e/ 7/	--
Turkey (run-of-mine) e/ 8/	20,000	20,000	15,000	15,000	15,000
Ukraine e/	30,000	25,000	25,000	25,000	25,000
Uzbekistan e/	60	60	60	60	60
Zimbabwe	11,381	7,691	12,779	13,806 r/	13,800
Total	584,000	550,000 r/	678,000 r/	683,000 r/	685,000

e/ Estimated. r/ Revised. -- Zero.

1/ World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Table includes data available through May 12, 2000.

3/ Reported figure.

4/ Does not include the following quantities sold directly without beneficiation, in metric tons: 1995--3,368; 1996--4,134; 1997--9,397 (revised); 1998--10,747 (revised); and 1999--10,700 (estimated).

5/ Indian marketable production is 10% to 20% of run-of-mine production.

6/ Exports. Source: United Nations, Department of International Economic and Social Affairs, Statistical Office.

7/ Graphtan Limited Mine closed. Only remaining stocks shipped in January-February 1998.

8/ Turkish marketable production averages approximately 5% of run-of-mine production. Almost all is for domestic consumption.