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Gallium and Germanium Potential of Sydney Basin Coals, Nova Scotia

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. SUMMARY

1. Gallium (Ga) and germanium (Ge) concentrations from 11 seams in the Sydney Basin were compiled from channel samples collected by the Atlantic Coal Institute (ACI) and core made available by the Nova Scotia Department of Mines and Energy (NSDME). Compiled information was then compared with previously existing geochemical data.

2. Ga is enriched in ash of coal samples from the top of the Hub, Phalen and Gardiner seams and at the bottom of the Harbour seam (Lingan site).

3. Ga is enriched in whole coal calculated values at the top of the Indian Cove and bottom of the Spencer and Gardiner seams. These sites also correspond to relatively higher ash contents.

4. Due to its positive correlation with ash, Ga appears to be contained in the mineral fraction of the coal. However, as Ga-Zn, Ga-S and Ga-Al plots showed no obvious trends, the correlation of Ga with specific mineral species (i.e. sphalerite, pyrite, clays) could not be determined.

5. Ge is enriched in ash of coal samples from the top of the Hub, Harbour (Novaco) and Gardiner seams, and at the bottom of the Lloyd Cove, Harbour (Lingan) Phalen and Emery (Rider) seams. The Point Aconi seam displays high Ge values throughout the seam section sampled. The latter, however, may be due to outcrop exposure to sea water.

6. Unlike Ga, Ge generally tends to exhibit enrichments in whole coal calculated values. This suggests a negative correlation with ash and supports an organic residence for germanium.

7. Lower Ga and Ge values in older seams (ie Mullins, Tracy and McAuley seams) may be related to the depositional environment or the absence of marine water infiltration after coalification.

8. Since neither Ga nor Ge were found to be enriched in pyrite concentrates (the dominant sulphide species present in the coals), it appears that these elements are not hosted by pyrite.

9. Preliminary geochemical analyses of coal and ash float-sink fractions tend to support an organic association for Ge. Further work, however, is necessary to corroborate these findings.

10. Elemental variations between the Lingan and Novaco sampling sites of the Harbour seam reveal that within seam enrichment trend are not always laterally consistent.

11. Neither manual (non-computerized) nor automated (computerized) scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDX) of a wide range of minerals failed to detect either Ga or Ge. This suggests that the nature of Ga and Ge elemental occurence in Sydney Basin coals is extremely disseminated, and below the detection limits of the energy dispersive X-ray system.

2. RECOMMENDATIONS

1. To further outline within seam lateral elemental variances, additional channel samples should be taken of those Sydney Basin coal seams that display Ga and/or Ge enrichment.

2. Additional float-sink analyses should be completed on those samples exhibiting Ge enrichment in order to confirm elemental affinities in the organic fraction of Sydney Basin coals.

3. Samples of ash residues that have been correlated to source coal seams should be collected from coal burning utilities. The latter would facilitate the monitoring of Ga and Ge concentrations contained in Sydney Basin coals over time.

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4. INTRODUCTION

During 1985-86, a comprehensive study of the chemical composition of coals and associated rocks of the Sydney Basin, Nova Scotia, was completed by the Atlantic Coal Institute (ACI) under contract with the Geological Survey of Canada (GSC)[contract #48SZ.23233-5-0855; Birk et al., 1986]. The combining of E. Zodrow's (University College of Cape Breton) existing geochemical coal data with analytical results obtained by the ACI resulted in the creation of a sizeable geochemical database for Sydney Basin coals. Within this database, certain samples exhibited enrichments in gallium (Ga) and germanium (Ge) in concentrations of potential economic interest. This prompted the GSC to contract to ACI a follow-up study that would identify the concentrations and mineralogical occurrences of Ga and Ge in Sydney Basin coals.

5. BACKGROUND

5.1. Gallium and Germanium Utilization

Ga and Ge utilization has become increasingly important in both the electronics and telecommunications industries. Ga, in the form of arsenide (GaAs) and phosphide (GaP), is primarily used in the manufacture of light emitting diodes and solid state lasers. Ga also has potential applications in the construction of solar cells and computer memories (Habashi, 1988).

Ge is utilized in the manufacture of transistors and rectifiers, fiber optics, infrared glasses, and semiconductors (Lang, 1969; Habashi, 1988). Japanese research has also ascertained that utilization of Ge in medicines enhances the body's cell functioning and capability to 'fix' greater quantities of oxygen. Preliminary tests indicate these medicines have potential application in the treatment of a variety of ailments, including cancer (Jamison, 1987).

The annual increase in demand for Ga and Ge by the rapidly growing electronics industry is expected to be five to ten percent from 1983 to 2000 (Wardell and Davidson, 1987). In order to satisfy expected demand, new sources of these relatively rare elements are widely being sought, including their abundances in coals.

5.2. Occurrence of Gallium and Germanium in Coals

Many authors have reported on the enrichment of both Ga and Ge along coal seam margins and within rider seams, and the suggestion has been made that elemental enrichment in these zones may be a function of ground-water sorption (Miller and Given (1978); Dalton and Pringle (1962); and, Breger (1958).

Goldschmidt (1954) noted that within most coals, Ga occurs primarily in aluminum-rich minerals, with lesser amounts occuring in sulphides. Aluminium- rich minerals were identified as the source of Ga in coals by Swaine (1975), while Miller and Given's (1978) work indicated that Ga replaced aluminium in the clay fraction. In his study of Illinois coals, Ribbe (1975) detected Ga in sphalerite. Bonnett and Czechowski's (1980) work suggests that Ga may also be organically bound to the coal matrix. Their geochemical study of British coals determined that Ga was the principle metal present in extracted metalloporphyrins.

Ge has long been thought to be concentrated in the organic fraction of coals. This conclusion was originally based on the inverse correlation between total ash and Ge content and the frequent enrichment of Ge in the vitrain component of coal (Bernstein, 1985). Analyses and washability studies by Gluskoter et al., (1977) have illustrated that of all the elements in coal, Ge had the highest organic affinity with very little Ge occurring in the mineral fraction. The determination by Manskaya et al., (1972) that lignites absorb and retain a considerable amount of Ge in an acid medium also supports the organic affinity of this element.

Hawley (1955) was one of the first to note the enrichment of Ge at seam margins of coals from the Sydney Basin in Nova Scotia. The ACI's 1985-86 study sampled many of the same seams studied by Hawley (1955), including the Lloyd Cove, Harbour, Backpit, Phalen, Emery, Gardiner, Mullins and Tracy seams.

6. <u>SAMPLE COLLECTION AND HANDLING</u>

6.1 Field Collection

The samples utilized for this study consisted primarily of those collected during the 1985-86 field season by the ACI for its initial geochemical study of Sydney Basin coals (Birk et al. 1986). These samples included outcrop, open pit, underground mine and NSDME core samples. Seams sampled at that time included the Lloyd Cove, Hub, Harbour, Indian Cove, Phalen, Emery, Spencer, Mullins, Tracy and McAuley. In order to minimize the effects of oxidation, the ACI archived collected samples in plastic bags under a nitrogen atmosphere.

For the purposes of this follow-up study, a channel sample from the Gardiner seam and a partial channel sample from the Point Aconi seam were sampled during the 1987-1988 field season by ACI personnel. An inventory of all samples collected by the ACI is shown in Table 1. Figure 1. illustrates the stratigraphic position of each seam sampled in the Sydney Coalfield, while Figure 2 shows their geographical locations. Stratigraphic columns of each channel sample collected along with megascopic descriptions are contained in Appendix I.

At strip mine and outcrop sites, a cement saw was used to make two parallel cuts, approximately 20 cm apart, down the thickness of the seam. Coal samples were extracted every 15 cm and clay partings and coal/clay transition zones were sampled separately. In underground mines, chisels were used to cut channels for sample extraction. Samples were also collected from the overclay and underclay at varying intervals depending on lithologic changes and accessibility. Archived core was sampled at the NSDME core laboratory in Stellarton, Nova Scotia. To sample previously crushed and pulverized archived core, splits were taken of the various intervals that comprised the coal seam, roof and floor.

6.2 Sample Preparation and Storage

Archived samples were retrieved from storage and prepared for analysis according to the flow chart presented in Figure 3. Samples collected from the Gardiner and Point Aconi seams were air dried and crushed to -1/2" using a Straub Model 4E grinding mill prior to being processed and prepared for analysis according to the procedures outlined in Figure 3.

All samples were pulverized to

TABLE 1. Sample inventory and stratigraphic position.

ORIGIN TYPE YEAR	N.S.D.M. core 1980-82		A.C.I. channel 1985-86		A.C.I. channel 1987-88	
SEAM	chan.	#	chan.	#	chan.	#
POINT ACONI					1	6
LLOYD COVE Upper (Bonar)			1	12		
Lower			1	17		
HUB (Stubbart)			1	16		
HARBOUR (Sydney Main)			2	33		
BOUTILIER						
BACKPIT (Indian Cove)	2	25				
PHALEN			1	14		
EMERY (Spencer)	2	23	2	30		
GARDINER					1	14
MULLINS	2	29				
TRACY	1	12				
MCAULEY			1	10		

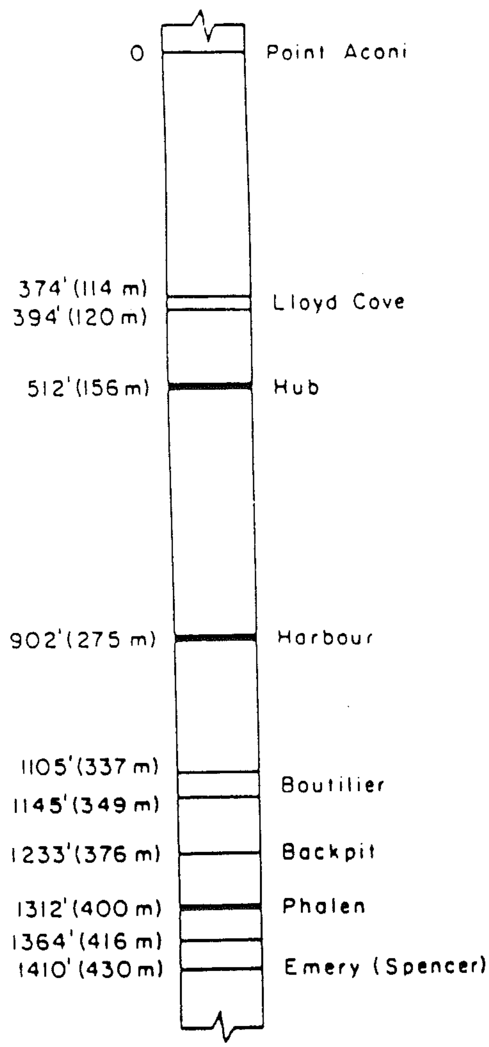


FIGURE 1   Idealized stratigraphic column of the Sydney coalfield showing major coal seams

Figure 2. Location Map - Sydney Coalfield (after Gillis, 1982)

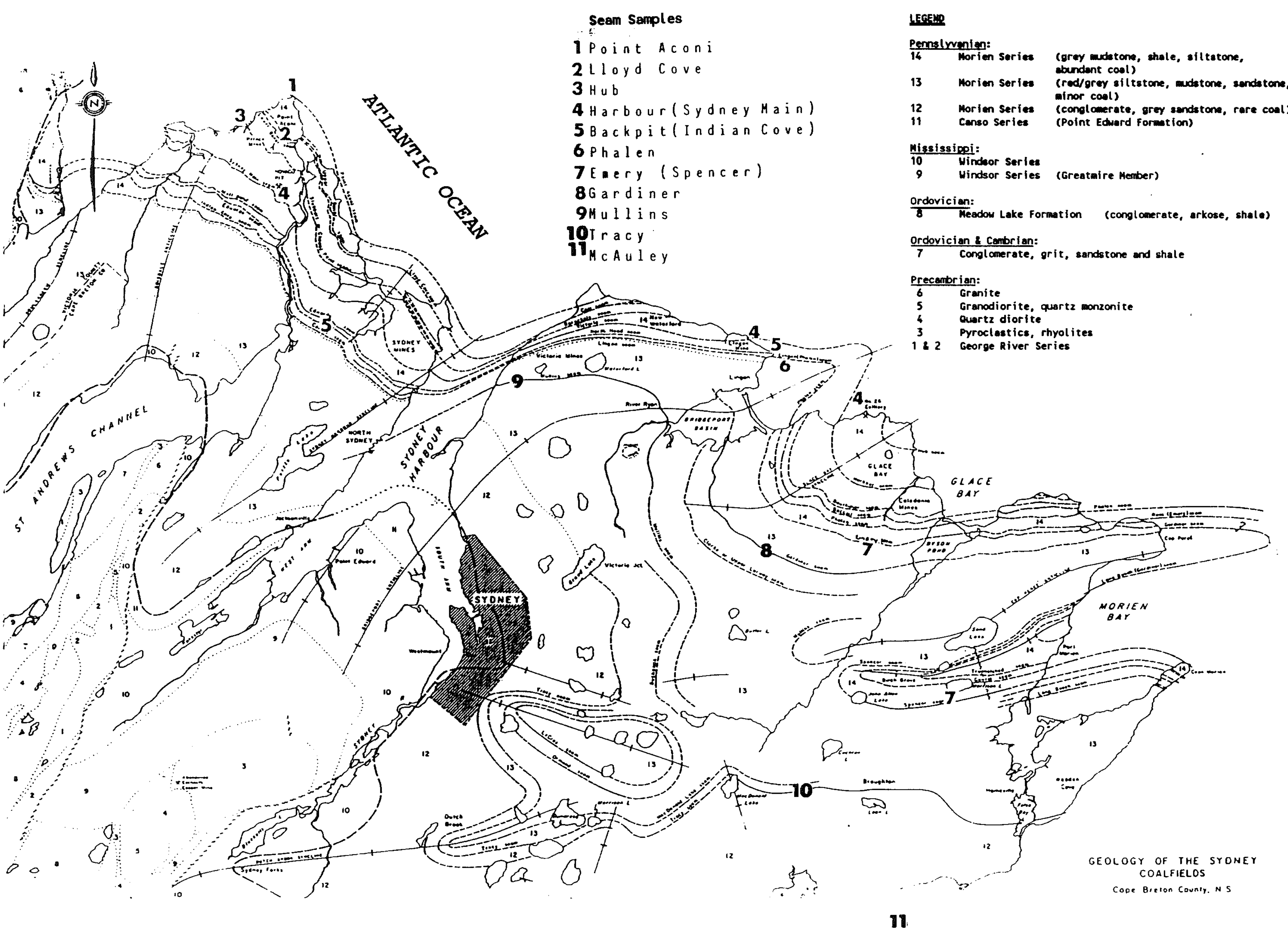
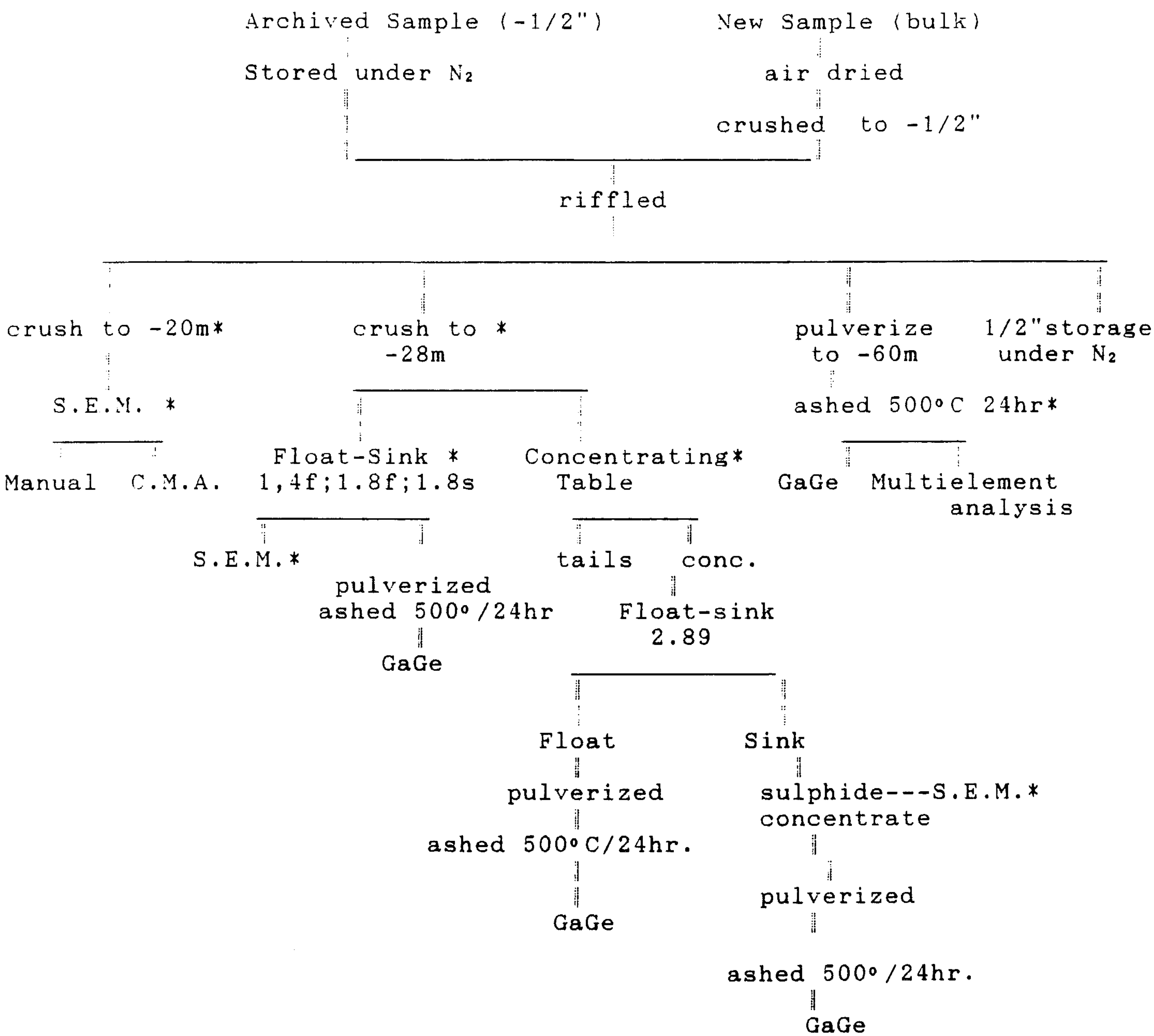


Figure 3. SAMPLE PREPARATION



* Selected Samples

-60 mesh using a Holmes Model 300 pulverizer, except small samples which were pulverized by hand. Hand crushing followed by sieving was also necessary for the -20 and -28 mesh fractions.

It was necessary to pulverize significantly larger quantities of low ash coal in order to obtain a sufficient quantity of ash for chemical analysis. The latter proved to be particularly problematic for NSDME archived cores. The limited size of certain samples ultimately resulted in the omission of some analyses.

7. <u>ANALYTICAL PROGRAM</u>

7.1. ASTM Ash Content

All samples were routinely analysed for total ash content. Ash analysis was carried out using a Fisher Model 490 Coal Analyser. Approximately 1 gram (± 0.1 mg) of -60 mesh coal was weighed into a fused quartz crucible. The crucible was placed in a cold muffle furnace and heated to 500°C at the rate of 10°C per minute. The sample was further heated to 750°C for four hours until a constant weight was reached. The samples were cooled to room temperature and reweighed. The percent ash was calculated from the difference in the weight of the coal, and the weight of the final ash product. Sample ash concentrations are presented in Table 5, Appendix II (A).

7.2. Total Sulphur

All samples were routinely analysed for total sulphur content. The total sulphur content of each sample was determined using a Leco Model 521 induction furnace sulphur determinator. In this process, a 0.1 gram sample of -60 mesh coal is burned in a combustion tube, and the SO_2 gas yielded in combustion is retained in a dilute HCl solution. The solution is titrated to endpoint using KIO_3 with a starch indicator. The sulphur content is then calculated using the following equation:

$$\% S = \frac{A}{B} * K$$

where:

A = mls iodate (KIO_3)
B = weight of coal in grams
K = determination factor (constant)

Total sulphur contents are presented in Table 5, Appendix II (A).

7.3. Gallium, Germanium and Multi-Element Analysis

Where volumes were sufficient, samples in close proximity to the roof and floor of each seam were ashed and analysed for Ga and Ge.

On the basis of the literature reporting an association in coals between Ga and the mineral fraction, previously collected ACI elemental data were scrutinized and those samples displaying elevated aluminum and/or zinc concentrations were re-analyzed for Ga [Goldschmidt (1954); Swaine (1975); Miller and Given (1978); Ribbe (1975) and Glick and Davis (1984)].

Selected samples were placed in a cold muffle furnace and heated to 500°C at a rate of 10°C per minute. The temperature remained at 500°C for 24 hours. The ashed samples were then bagged and sent to X-Ray Assay Laboratories Limited for Ga, Ge and S determinations using X-ray fluorescence (XRF). X-Ray Assay's analytical results are listed in Table 5, Appendix II (A). Table 10, Appendix II (A) contains results from the duplicate analysis of Ga and Ge in certain samples. Discrepencies in duplicate samples may be due to the inhomogeneous nature of the coal and/or the variability associated with taking sample splits and ashing them at different times. Selected ashed seam samples, which lacked data from the previous ACI study [Birk et al., (1986)], were also submitted to X-Ray Assay Laboratories for multi-elemenal analysis. These and previously completed analytical results are listed in Tables 1 to 4, Appendix II (A).

7.4. Sulphide Concentrates

Where sample volume permitted, sulphide concentrates were prepared from those samples that displaying enhanced total sulphur contents. Concentrates were prepared using a Model # 13 1.27 m long by 0.61 m wide Wilfley concentrating table. The longitudinal tilt of the table was set at 3^{o} with a 5^{o} cross tilt and a 20mm stroke length. The head motion of the Wilfley Table is described in Figure 4. Samples ranging in weight from 150 to 500 grams were placed in the feed box and washed over the table at a flow rate of 3 litres per minute. The idealized distribution of concentrating table product is shown in Figure 5. Although upgraded in pyrite/sulphide content, 'tabled' concentrates still contained a large portion of coaly matter.

In an attempt to upgrade the percentage of pyrite in concentrates, flotation tests were carried out on the initial 'tabled' material. Two types of flotation were used:

1. Concentration of pyrite by floating away the coal using Methyl-Isobutyl Carbinol (MIBC); and
2. Concentration of pyrite by flotation of sulphides using Sodium Ethyl Xanthate as a collector and aerofroth 65 as a frother.

Neither flotation technique significantly increased the yield of pyrite in the concentrates.

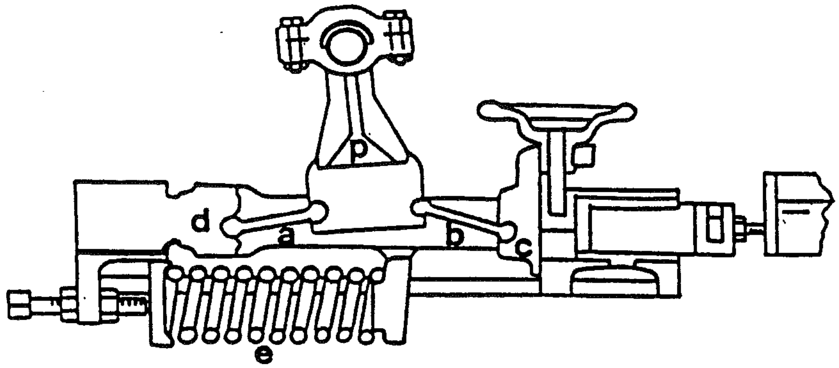
A second attempt to upgrade the 'tabled' concentrates utilized a separatory funnel filled with bromoform (specific gravity (S.G.) = 2.89). This density separation technique consisted of the placing of individual 'tabled' concentrates in the bromoform filled funnel; contents were then shaken and allowed to settle for approximately one minute. The sink (S.G. > 2.89) was separated from the float (S.G. < 2.89) and both fractions were dried and weighed. This technique resulted in a more sulphide-rich sink fraction. However, a considerable amount of coaly matter still remained in the sink fraction due to the intimate nature of the sulphides with the organic matter. Recoveries of pyrite concentrates and their corresponding Ga and Ge contents are presented in Table 7 and 8, Appendix II (A), respectively.

7.5. Float-Sink Analysis

Although the contract did not stipulate float-sink analysis, as the project progressed, it was considered useful to separate the coal into 1.40 and 1.80 specific gravity (S.G.) fractions.

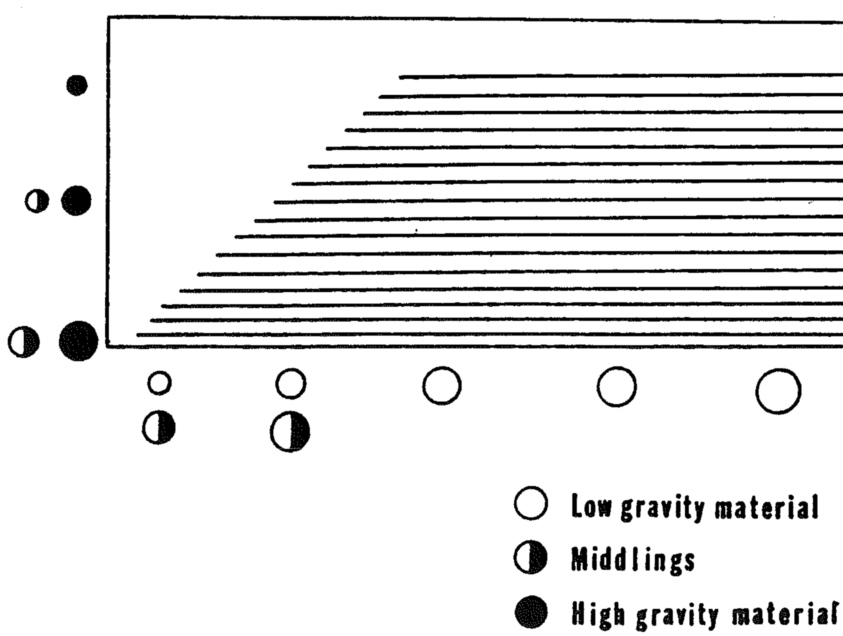
Approximately 500 grams of the bottom sample from the Novaco/Harbour seam [Sample (01-Q), 1.37 to 1.47 m] was crushed to -28 mesh and subsequently split into three samples each consisting of approximately 150 grams. Such a large volume of sample was deemed necessary to provide enough coal in each gravity fraction for analyses of Ga and Ge.

FIGURE 4. - Head Motion of Wilfley Table (B.A. Wills, 1981)



The head motion of a standard Wilfley concentrating table consists of two toggles driven by a pitman (p). The back toggle (b) is seated against a fixed mounting (c), while the front toggle (a) bears on yoke (d) connected to the table deck. The system is held together by a spring (e) and driven by the eccentric and pitman. At the beginning of the forward stroke, the toggles are flattened out, and the spring is compressed. As the pitman rises, the toggles steepen out, and are at their most acute angle at the top of the stroke where the table reaches maximum speed. As the pitman descends, the toggle angle flattens out and the direction of the table is abruptly reversed.

Fig. 5 Distribution of Table Products



Each 150 gram split was placed in a separatory funnel with the 1.80 S.G. Certigrav fluid and mixed thoroughly. The sample was allowed to settle for one-half hour and the 1.80 sink fraction was drained and dried. The 1.80 float fraction was then strained, dried and placed into a separatory funnel containing 1.40 S.G. Certigrav fluid and the process was repeated. The latter two-stage procedure resulted in a 1.40 float sample, a 1.80 sink sample and a 1.40 sink and/or 1.80 float sample. Subsequent Ga, Ge, and S analyses completed on the float-sink fractions are presented in Table 9, Appendix II (A).

7.6. Mineralogy: Scanning Electron Microscopy

7.6.1 Introduction

A JEOL T-300 digital beam controlled scanning electron microscope (S.E.M.) equipped with a Tracor Northern Model TN-5500 microanalyser, secondary electron image detector, backscatter electron detector and X-ray detectors was utilized for both manual (non-computerized/automated) S.E.M. - E.D.X. surveys and automated (computerized) Coal Mineral Analyses (C.M.A.).

S.E.M. analyses commenced only after the completion of X-ray fluoresence analysis. In an effort to maximize the likelihood of locating the residence sites of Ga and/or Ge in coals, manual S.E.M. - E.D.X. analyses were conducted only on those samples displaying relatively high Ga and Ge concentrations. Meanwhile, the automated C.M.A. program was completed on samples from each seam in order to document the mineralogy throughout the stratigraphic section.

7.6.2 Sample Preparation

Selected samples were split according to American Standard Testing Materials (ASTM) D2013 criteria and stage crushed to -20 mesh [ASTM, (1983)]. Using a Metaserv moulding unit, representative -20 mesh samples were mounted in 25 mm acrylic leucite pellets. The resultant pellets underwent three grinding stages using 240, 400, and 600 grit adhesive backed silicon carbide grinding papers attached to Metaserv grinding laps. This was followed by two polishing stages, first with polishing cloth and 0.3 μm alumina powder suspended in distilled water followed by double layered silk and 0.05μm alumina powder suspended in distilled water. This procedure resulted in a fine polished surface suitable for S.E.M. examination.

Pellet mounted samples were coated with an atomic layer of carbon using a fiber filament Polaron S.E.M. coating system. This was done to prevent beam charging.

A sulphide concentrate from the upper sample of the Prince/Hub seam [Sample (08-A), 0.00 to 0.15 m) was examined as a grainmount by dispersing the concentrate on a carbon planchet, using conductive carbon paint. This mount was also carbon coated using the Polaron S.E.M. coating system.

7.6.3 Manual Analysis S.E.M.-E.D.X..

As noted above, samples were selected for manual analysis on the basis of their Ga and/or Ge content as determined by X-ray fluoresence analysis.

Instrument accelerating voltage was set to 20 KeV with a working distance of 20 mm. After initial image focusing and stigmatism corrections in the secondary electron image mode (S.E.I.), the backscatter electron detector was activated to establish maximum contrast between macerals and minerals. Photographs were taken with Polaroid PN55 film at 90 second exposures on a high resolution 2000 line CRT. Energy dispersive X-ray microanalysis was performed with a Si(Li) detector and a Tracor Northern Model TN-5500 microanalyzer. Spectra were generally collected for 50 seconds and plotted on line by dot matrix printer/plotter. This system is capable of detecting all elements from sodium (Na) [Z = 11] to uranium (U)[Z = 92] in the Periodic Table. Elements below Na are not detected because of the presence of a beryllium window protecting the Si(Li) detector. Therefore, the system can differentiate most minerals except for the following:

1. Isomers such as pyrite (FeS_2) and marcasite (FeS_2).
2. Minerals differing only in light elements (H, Li, Be, B, C, N, O and F)
3. Hydrated species ($CaSO_4$ versus $CaSO_4 \cdot 2H_2O$)

Mineral identifications were based on the major element spectral characteristics identified by Huggins et al., (1980). Some assumptions were made based on published petrographic studies, including: 1) kaolinite and illite are the major clays present, rather than their spectral isomers - halloysite and muscovite; 2) "pyrite" was preferred over "marcasite" unless morphological evidence existed (i.e. sectored or radial crystals); and 3) "siderite" was preferred over "magnetite" or "hematite" even though E.D.X. analysis could not differentiate oxides from carbonates [Sprunk and O'Donnell (1942)].

7.6.4 Automated Analysis: S.E.M. - E.D.X. - C.M.A.

The Coal Mineral Analysis (C.M.A.) software package was employed to automatically analyze the mineralogy of coal samples on a particle-by-particle basis. Though computer controlled S.E.M.-E.D.X. image analysis systems can analyse thousands of particles, salient information provided by mineral-maceral textures cannot be obtained.

Standard S.E.M. operating conditions for the C.M.A. analysis included an accelerating voltage of 20 KeV, a working distance of 20 mm, a 1.000 nA beam current, and utilization of the backscattered electron image mode (B.E.I.).

The C.M.A. package is designed to classify mineral grains in coal with respect to size and chemical composition. Chemical classification is based on the relative X-ray intensities of eleven different elements, including: Na, Mg, Al, Si, P, S, Cl, K, Ti, Fe and Ca. Table 2, lists the chemical classes used in the C.M.A. program. Results of the automated analysis on the twenty-five samples selected are presented in Appendix III (A).

8. <u>GALLIUM AND GERMANIUM ENRICHMENTS</u>

8.1. Seam Enrichments

Ga and Ge concentrations for both ash and coal are plotted for each seam in Appendix II (B) and Appendix II (C), respectively. Table 3 qualitatively summarizes the enrichment of both elements within and among seams in the Sydney Basin. Ga appears to be enriched in ash of coal samples from the top of the Hub, Phalen and Gardiner seams; and at the bottom of the Harbour seam at the Lingan sampling site. These

TABLE 2. C.M.A. Chemical Classes

Group	Class	Main Elements	Other Elements	Remarks
Quartz	quartz	Si	various	
Silicates	kaolinite	Al/Si	various	
	illite	Al/Si	K/Fe	
	montmoril	Al/Si	various	montmorillonite
	mixsil	Al/Si/Fe	various	mixed silicates
	chamosite	Al/Si/Fe	various	
	quarorg	Si	various	organics + quartz
Sulphur bearing	pyrite	S/Fe	various	
	jarosite	S/Fe	Si/Al/K	
	pyjar	S/Fe	various	pyrite-jarosite
	Fe-sul	S/Fe	various	
	quarpyr	Al/Si	Fe/S	fine pyrites in clay
	gypsum	Ca/S	various	
	mixsul	S	various	
	orgsul	S	various	organic sulphur S>70
Chlorine bearing	sylvite	K/Cl	various	
	halite	Na/Cl	various	
	unkchlor	Cl	various	unknown chloride
Calcium bearing	calcite	Ca	various	
	mixcarb	Ca	various	mixed carbonates
	dolomite	Mg/Ca	various	
	ankerite	Mg/Ca/Fe	various	
	apatite	Ca/P	various	
Others	siderite	Fe	various	
	rutile	Ti	various	
	non-int			highest peak not recognized by computer. EDX intensities incompatable with any of the above groups
	unknown			

enrichments are not apparent, however, when ashed values are recalculated to whole coal. Most recalculated whole coal Ga values are less than 5 ppm. Ga enrichments noted at the top of the Indian Cove (SM-17, SM-18), and the bottom of the Spencer (PM-45) and Gardiner seams correspond with elevated ash content. The positive correlation between Ga in coal and ash weight percent is confirmed in the binary plots presented in Appendix II (D). The increase in Ga concentration (in coal) with ash content suggests that Ga is contained in the mineral portion of the sample. However, as Ga-Zn, Ga-S and Ga-Al plots [Appendix II (D)] showed no obvious trends, the correlation of Ga with specific mineral species (i.e. sphalerite, pyrite, clay) could not be determined.

Table 3 indicates that Ge appears to be enriched in the coal ashes from the top of the Hub, Harbour (Novaco) and Gardiner seams; and at the bottom of the Lloyd Cove, Harbour (Lingan) Phalen and Emery (Rider) seams. The Point Aconi seam displays high values through the seam section. Unlike Ga, Ge exhibits similar enrichments when ash concentrations are recalculated to the whole coal basis. This suggests that Ge concentration has a negative correlation with the ash content of the sample. Binary plots of Ge in coal and Ge in ash versus ash weight percent reveal that the highest Ge values usually correspond with samples having the lowest ash content [Appendix II(D)]. These findings suggest that Ge is associated with the organic phase, and confirm observations previously noted in the literature [Standnichenko et al., (1953); Zubovic, (1966)].

A compilation of all 'meaningful' Ga and Ge coal data, including seam averages, for the Sydney Basin is presented in Table 6, Appendix II (A). Certain seam sections from the previous ACI database are not included in this listing because of the questionable nature of these data [refer to Birk et al., (1986)]. Table 4 summarizes average seam Ga and Ge concentrations as reported by Hawley (1955) and Zodrow (1986, 1987) and Birk et al., (1986). In general, average Ga values do not fluctuate greatly down the section, however Ge concentrations tend to be higher in the younger seams. This may be related to the depositional environment or marine water infiltration following coalification.

8.2. Pyrite Concentrates and Float-Sink Analysis

Prepared pyrite concentrates were analysed for Ga and Ge in order to determine if the sulphides were hosts for either element. Analytical results are presented in Table 8, Appendix II (A). The sink fraction concentrates exhibited little or no enrichment in either element, with most values being below the detection limits.

The 1.40 S.G. float fraction of sample [(01-Q) 1.37 to 1.47 m], of the Novaco/Harbour seam, exhibited a threefold enrichment in both Ga and Ge. Analytical results, however, decreased as the specific gravity of the sample's float-sink fraction increased [refer to Table 9, Appendix II (A)]. Sample enrichment in Ga disappears when concentrations are recalculated to a whole coal basis, and Ge enrichment becomes less pronounced. The latter is suggestive of Ge having an organic affinity. Further work, on a greater number of float-sink samples, is necessary to substantiate the observed enrichments.

TABLE 3 Gallium and germanium enrichments within and among seams in the Sydney Basin.

SEAM		GALLIUM in ash	GALLIUM in coal	GERMANIUM in ash	GERMANIUM in coal
Point Aconi		var-low	var-low	high	bot enr.
Lloyd Cove	Upper	var-mod	var-low	bot enr.	bot enr.
	Lower	var-low	var-low	bot enr.	bot enr.
Hub		top enr.	var-low	top enr.	top enr.
Harbour	Novaco	var-mod	var-low	top bot enr.	top bot enr.
	Lingan	bot enr.	low	bot enr.	var-low
Indian Cove	SM-17	var-low	top enr.	var-low	var-low
	SM-18	var-low	top enr.	var-low	var-mod
Phalen		top enr.	var-low	bot enr.	bot enr.
Emery	Main	var-mod	var-mod	low	low
	Rider	top enr.	var-low	bot enr.	bot enr.
Spencer	PM-45	var-mod	bot enr.	var-low	var-low
	PM-48	low	low	low	low
Gardiner		top enr.	bot enr.	top enr.	top enr.
Mullins	NW-13	low	low	low	low
	NW-16	low	low	low	low
Tracy		low	low	low	low
McAuley		low	low	low	low

TABLE 4 Comparison of gallium and germanium concentrations within the stratigraphic section of the Sydney Basin.

SEAM	Gallium (ppm)				Germanium (ppm)					
	Zodrow	n=	A.C.I.	n=	Zodrow	n=	A.C.I.	n=	Hawley	n=
Youngest ↑										
Point Aconi			21	4	177	7	188	4		
Lloyd Cove			23	17	120	6	91	17	9	12
Hub	86	15	37	9	54	14	72	9		
Harbour	21	21	33	15	93	35	76	14	50	26
Indian Cove/ Backpit	10	7	24	9	101	7	45	8	50	55
Phalen	15	13	38	7	18	13	44	7	15	37
Emery/Spencer			35	12			33	12	50	5
Gardiner			34	7			69	7	30	15
Mullins			16	10			15	6	20	14
Tracy			<14	1					9	12
Oldest										
McAuley			35	2			60	2		

8.3 Scanning Electron Microscopy

8.3.1 Manual Analysis S.E.M.-E.D.X.

In an initial attempt to locate and document the residence sites of Ga and/or Ge in seven Sydney Basin coal samples, manual energy dispersive X-ray spectra were collected from coal matrices. Though no organically bound Ge was detected, these spectra did indicate traces of sulphur (S), chlorine (Cl) and calcium (Ca). At the site where enrichment of these elements occurs, coal grains were found to exhibit distinct colour changes. In general, manual S.E.M. - E.D.X. analysis of Sydney Basin coals was not successful in detecting Ga or Ge from any of the minerals listed in Table 5.

The prepared pyrite concentrate from the Hub seam [sample (08-A) 0.00 to 0.15 m] was also subjected to manual S.E.M.-E.D.X. analysis. Though this sample contained several galena crystals as contaminants from the concentrating table, the analysis of indigenous galena and other "heavy" minerals (i.e. pyrite, arsenopyrite, cassiterite, fluorite (?) and sphalerite) failed to detect the presence of Ga.

The 1.40 (specific gravity) float fraction sample from the Harbour seam [Novaco sample (01-Q) 1.37 to 1.47 m] was also 'manually' examined in anticipation of detecting Ge in the organic matrix of a coal grain with woody structure (fusinite ?). S, Ca, Cl and bromine (Br) (Br being a contaminant from float-sink fluids) were detected, but traces of Ge were not observed. This suggests that if germanium is present in the coal matrix, it is finely disseminated and below detection limits of the E.D.X. system.

8.3.2 Automated Analysis S.E.M.-E.D.X.-C.M.A.

Semi-quantitative mineralogical data on twenty-five samples of Sydney Basin coals were obtained by, automated C.M.A. [Appendix III (A)]. The variable C.M.A. mineralogy encountered within the different seams are presented in Appendix III (B).

Mineral abundances appear to vary greatly both within and among seams studied in the Sydney coalfield. Of all the sulphur-bearing mineral classes analyzed (PYRITE, JAROSITE, PYJAR, Fe-SUL, QUARPYR, GYPSUM, MIXSIL, ORGSUL - refer to Table 2), PYRITE appears to be the dominant species. However, PYRITE's significantly higher contrast in the backscatter image mode, compared to that displayed by the other C.M.A. minerals, may explain this domination.

In order to determine if a relationship exists between Ga and C.M.A. mineralogy, binary plots were made of Ga verses sulphur-bearing mineral classes [Ga vs S-Bearing (C.M.A. wt. %)] and Ga versus clays [Ga vs clays (C.M.A. wt. %)][Appendix IV (B)]. The degree of scatter displayed by these plots indicates that there is no clear correlation of Ga with these C.M.A. minerals and substantially more data would be required to ascertain any meaningful relationships.

TABLE 5 Summary of minerals encountered in S.E.M. manual analysis.

	Point Aconi		Hub	Phalen	Emery	Gardiner	
MINERAL	33-02	33-03	08-A	07-A	05-D	32-01	32-02
Quartz	X	X	X	X	X	X	X
Kaolinite	X	X	X	X	X	X	X
Illite	X		X	X	X	X	X
Calcite			X	X			
Siderite				X		X	
Ilmenite						X	
Rutile	X		X		X	X	X
Pyrite	X	X	X	X	X	X	X
Arsenopyrite						X	X
Sphalerite	X			X	X		
Galena						X	
Barite						X	
Zircon	X				X	X	X
Monazite	X			X		X	
Crandalite			X	X			

9. REFERENCES

American Society for Testing and Materials [ASTM]
1983: Annual book of ASTM standards, section 5: Petroleum products, lubricants and fossil fuels, v. 05.05: Gaseous fuels, coal and coke; American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Bernstein, L.R.
1985: Germanium geochemistry and mineralogy; Geochimica et Cosmochimica Acta, v. 49, p. 2409-2422.

Birk, D, Pilgrim, J. and Zodrow, E.
1986: Trace element contents of coals and associated rocks of the Sydney Basin Nova Scotia; Geological Survey of Canada, Open File 2090, 52 p., 4 appendices.

Bonnett, R., and Czechowski, F.
1980: Gallium porphyrins in bituminous coal; Nature, v. 283, p. 465-467.

Breger I.A.
1958: Geochemistry of Coal; Economic Geology, v. 53, p. 823-841.

Dalton, I.M., and Pringle, W.J.S.
1962: The gallium content of some Midland coals; Fuel, v. 41, p. 41-48.

Habashi, F.
1988: A hundred years of the Bayer Process for alumina production; Canadian Mining and Metallurgical, Bulletin, v. 81, no. 909, p.70-76.

Hawley, J.E.
1955: Germanium content of some Nova Scotia coals; Economic Geology, v. 50, p. 517-532.

Huggins, F.E., Kosmack, D.A., Huffman, G.P., Lee, R.J.
1980: Coal mineralogies by SEM automatic image analysis; Scanning Electron Microscopy, v. 1, p. 532-540.

Gillis, K.S.
1982: Evaluation of the Spencer seam for near-surface coal; Nova Scotia Department of Mines and Energy, Open File Report 524, 24 p.

Glick, D.C. and Davis, A.
1984: Variability in the inorganic content of United States coals - a multivariate statistical study; United States Department of Energy DOE/PC/30013-F10 (DE84014544), contract AC 22-8-PC30013, 404 p.

Gluskoter, H.J., Ruch, R.R., Miller, W.G., Cahill, R.A., Dreher, G.B. and Kuhn, J.K.
1977: Trace elements in coal: occurrence and distribution; Illinois Geological Survey Circular no. 499, 154 p.

Goldschmidt, V.M.
1954: Gallium and Germanium; in Geochemistry, edited by A. Muir, Oxford University Press, London, 730p.

Jamison, S.
1987: Germanium; Weekly World News Report, December 22, 1987.

Lang, A.H.
1969: Prospecting in Canada; Geological Survey of Canada, Economic Geology Report 7, p. 219.

Manskaya, S.M., Kodina, L.A., Generalova, V.N. and Dravtsova, R.P.
1972: Interaction between germanium and lignin structures in the early stages of formation of coal; Geochemistry International, v. 9, p. 385-394.

Miller, R.N., and Giver, P.H.
1978: A geochemical study of the inorganic constituents in some low rank coals; Technical Report 1(FE-2494-TR-1) to the U.S. Department of Energy, 314 p.

Ribbe, P.H.
1975: Trace and minor element distributions in coal and coal minerals as determined by ion microprobe mass analysis; Geological Society of America, Abstracts with Program, v. 7, no. 7, p.1244.

Sprunk, G.C. and O'Donnell, H.J.
1942: Mineral Matter in Coal; United States Bureau of Mines Technical paper 648, 67p.

Standnichenko, T., Murata, K.J., Zubonic P. and Hufschmidt, E.L.
1953: Concentration of germanium in ash of American coals: A progress report; U.S. Geological Survey Circular 272, p 1-34.

Swaine, D.J.
1975: Trace Elements in Coals; in Recent Contributions to Geochemistry and Analytical Chemistry, edited by A.I. Tugarinov, John Wiley and Sons, New York, p. 539-550.

Wardell, M.P. and Davidson, C.F.
1987: Acid leaching extraction of Ga and Ge; Journal of Metals, June 1987, p. 39-41.

Wills, B.A.
1981: Mineral Processing Technology; 2nd Edition, Pergammon Press, Toronto, Ontario.

Zodrow, E.
1986: Coal-stratigraphy geochemistry: Trends in coal samples from Sydney Coalfield, Upper Carboniferous, Nova Scotia; Canadian Institute of Mining and Metallurgy, Bulletin, v. 79, no. 893, p. 83-85.

Zodrow, E.
1987: Geochemical trend in whole-seam coal channel samples from the Sydney Coalfield (Upper Carboniferous), Nova Scotia, Canada; Maritime Sediments and Atlantic Geology, v. 23, p. 141-150.

Zubovic, P.
1966: Physicochemical properties of certain minor elements as controlling factors in their distribution in coal; in Coal Science Advances in Chemistry, Ser. 55, edited by R.F. Gould, Washington, p. 221.

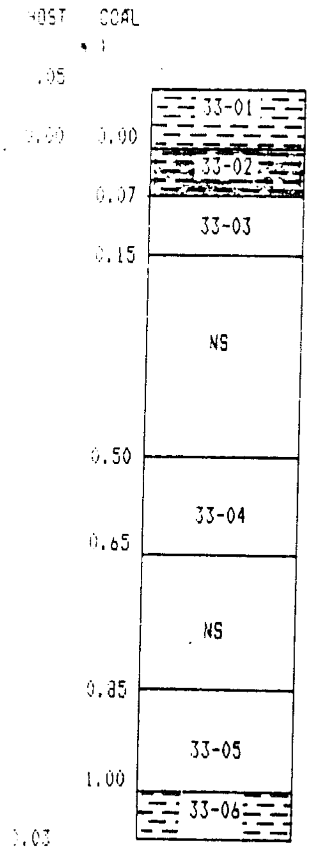
APPENDIX I

STRATIGRAPHIC COLUMNS (NOT DRAWN TO SCALE)

- Point Aconi Seam
- Lloyd Cove Upper Seam (Brogan)
- Lloyd Cove Lower Seam (Brogan)
- Hub Seam (Prince)
- Harbour Seam (Novaco)
- Harbour Seam (Lingan)
- Indian Cove (NSDME CORE SM-17)
- Indian Cove (NSDME CORE SM-18)
- Phalen Seam (Phalen Colliery)
- Emery Seam (Steele's Hill)
- Thin seam directly below Emery Seam (Rider/Steele's Hill)
- Spencer Seam (NSDME CORE PM-45)
- Spencer Seam (NSDME CORE PM-48)
- Gardiner Seam
- Mullins Seam (NSDME CORE NW-13)
- Mullins Seam (NSDME CORE NW-16)
- Tracy Seam (NSDME CORE PM-65)
- McAuley Seam (Near Round Island)

POINT ACONI SEAM

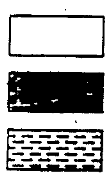
OUTCROP



Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
33-01	3.53	79.48			overclay; gy
33-02	4.08	34.57	7	<3	transition zone; coaly; oxidized
33-03	5.28	7.46	3	21	coal, signs of oxidation including sulphates
NS					
33-04	3.38	3.38	0.5	7	coal, bright to semibright banded
NS					
33-05	15.94	19.96	3	52	coaly; dull bands; visible pyrite
33-06	2.56	86.78			underclay; gy

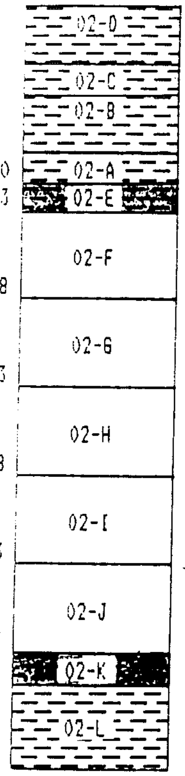
* recalculated from determination on ashed samples

LEGEND



- coal
- transitional zone
- mudstone; shale

BROGAN / LLOYD COVE UPPER SEAM OPEN PIT

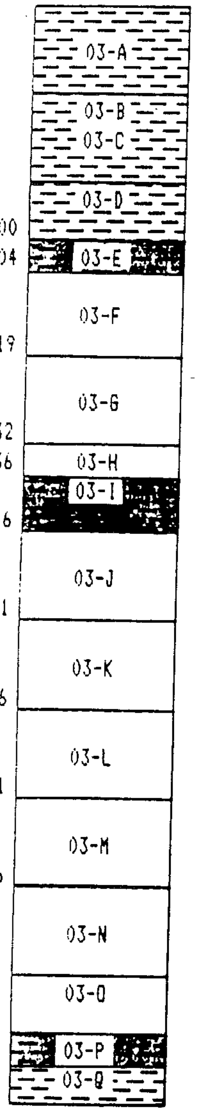


Sample	SUL (%)	ASH (%)	Ga ppm coal	Ge ppm coal	DESCRIPTION
02-D	----	92.41			overclay; gy; iron oxide stain; plant frags
02-C	----	92.04			overclay; gy; iron oxide stain; plant frags
02-B	----	91.01			overclay; gy-bk; carbonaceous
02-A	1.13	90.50		9	overclay; gy-bn; carbonaceous
02-E	4.20	29.99	5	<3	transition; bk; platy; some fusain; ab. pyrite
02-F	5.06	5.74	3	6	coal, bright; friable; ab. pyrite cleat fillings and lenses; some galena?
02-G	2.90	3.26	1	1	coal, bright; friable; some pyrite
02-H	2.86	3.43	1	1	coal, bright; friable; some pyrite
02-I	5.61	6.56	<1 2	1	coal, bright; friable
02-J	4.72	5.28	3	21	coal, bright; friable
02-K	10.08	15.50	3	29	transition; coaly
02-L	4.97	83.06			underclay; gy; cakey

LEGEND

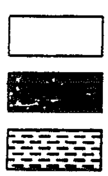
- coal
- transitional zone
- mudstone; shale

BROGAN /LLOYD COVE LOWER SEAM OPEN PIT



HOST	COAL	Sample	SUL (%)	ASH (%)	Ga ppm coal	Ge ppm coal	DESCRIPTION
0.40							
0.25		03-A	----	91.55			overclay; gy; plant frags
0.18		03-B	----	93.31			overclay; lt gy
0.09		03-C	----	93.04			overclay; lt gy
0.00	0.00	03-D	0.60	90.24			overclay; lt bn
	0.04	03-E	9.81	41.36	6	4	transition; bk; platy; ab. pyrite
	0.19	03-F	7.74	12.36	4	5	coal, bright; friable; ab. pyrite as cleat fillings and lenses
	0.32	03-G	11.90	17.38	2	3	coal, bright; friable; some fusain; ab. pyrite
	0.36	03-H	21.60	31.97			transition; coaly; ab. pyrite
	0.46	03-I	13.78	53.47	7	7	coal-clay mixture; coaly stringers; ab. pyrite; pyrite replacing fusa
	0.61	03-J	9.83	14.56	2	<1	coal, semibright; friable; some durain; ab. pyrite
	0.76	03-K	5.67	6.21			coal, bright; friable; some pyrite
	0.91	03-L	4.31	9.29	2	<1	coal, bright; friable; some pyrite
	1.06	03-M	4.88	4.78	1	3	coal, bright; friable; ab. pyrite
	1.21	03-N	5.98	6.66	1	7	coal, bright; friable; ab. pyrite
	1.28	03-O	4.40	6.54	1	24	coal, bright; friable some fusain; ab. pyrite
0.00	1.31	03-P	9.78	21.33	3	30	transition; coaly
0.05		03-Q	2.62	89.72		9	underclay; gy; muddy

LEGEND



- coal
- transitional zone
- mudstone; shale

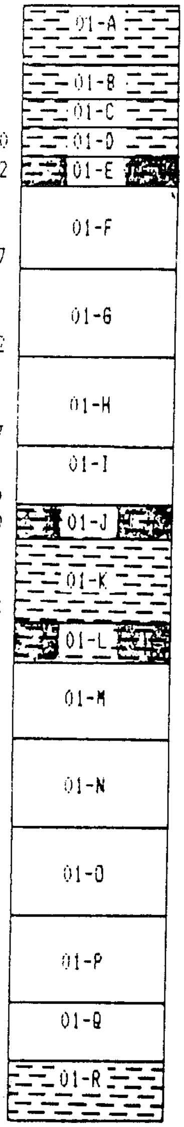
PRINCE / HUB UNDERGROUND

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga (ppm coal*)	Ge (ppm coal*)	DESCRIPTION
.20							
		08-P	0.20	90.04			overclay; dk gy; waxy; conchoidal fracture; fossils rare
[illegible]	0.00						
		08-A	3.26	7.28	6	31	coal, bright to semibright; ab. pyrite lenses, cleat fillings
	0.15						
		08-B	1.44	3.61	2	2	coal, bright; pyrite in cleats
	0.30						
		08-C	0.82	2.80			coal, bright; dull bone band in upper section; pyrite, calcite in cl
	0.45						
		08-D	1.92	11.02	5	<1	coal, bright; friable; pyrite and calcite in cleats
	0.60						
		08-E	5.05	18.40	5	<2	coal, bright; large pyrite lense; calcite and gypsum?
	0.75						
		08-F	1.07	2.61			coal, bright; pyrite in cleats
	0.90						
		08-G	1.03	2.06	1 1	0.5	coal, bright; pyrite lenses; cleat fillings; gypsum needles
	1.05						
		08-H	1.09	2.19			coal, bright; pyrite; calcite; gypsum?
	1.20						
		08-I	1.68	2.90	1	1	coal, bright; some fusain, ab. pyrite; some gypsum?
	1.35						
		08-J	3.31	3.80			coal, bright; pyrite, calcite, gypsum?
	1.50						
		08-K	7.36	11.69			coal, semibright; pyrite, gypsum?
	1.65						
		08-L	8.27	19.35	3	<2	coal, semibright; pyrite; gypsum?
	1.80						
		08-M	8.50	16.00	2	4	coal, semibright; pyrite; gypsum?
	1.95						
		08-N	9.28	21.04	7	17	coal, semibright; ab. pyrite;
0.00	2.15						
		08-O	0.39	94.43		<9	underclay; lt gy; ab. fossil frags
0.10							

LEGEND

- coal
- transitional zone
- mudstone; shale

NOVACO / HARBOUR SEAM OPEN PIT



HIST (m)	COAL (m)	SAMPLE	SUL (%)	ASH (%)	Ga (ppm)	Ge (ppm)	DESCRIPTION
0.25							
0.15		01-A	0.99	92.11			overclay; gy; rootlets,plant frags
0.10		01-B	1.00	92.08			overclay; gy; rootlets,plant frags
0.04		01-C	12.79	61.67			overclay; dk gy; carbonaceous; coaly stringers
0.00	0.00	01-D	3.71	84.74			overclay; gy; carbonaceous
	0.02	01-E	6.97	35.86	6	<4	transition; gy; silty; crenulated contact; siderite nodule
	0.17	01-F	8.01	11.90			coal; bright; mainly clarain; ab.well developed cleats rich in pyrite,pyrite lenses
	0.32	01-G		10.81	6	19	coal; bright; mainly clarain; pyritic cleat fillings,lenses
	0.47	01-H	8.04	13.89	3	22	coal;bright; mainly clarain; ab. pyrite
	0.56	01-I	4.99	8.33			coal; semibright; pyrite
	0.60	01-J	14.52	48.27	11	<5	transition; gy; carbonaceous; coaly stringers; pl;ab.pyrite
	0.73	01-K	1.68	82.93			clay parting; gy; carbonaceous
	0.77	01-L	5.06	15.10	4	2	transition;gy-bk; platy
	0.92	01-M		9.04			coal; ab.vitrain; some pyrite
	1.07	01-N	4.73	7.03	1	1	coal; bright; dull band,upper section
	1.22	01-O		6.63			coal; bright; pyrite lenses
	1.37	01-P		6.34	3	2	coal;semibright; clarian,vitrain,some fusain; pyrite lenses
0.[illegible]	1.47	01-Q		10.70	4 4	45 25	coal; semibright; ab. pyrite
6.10		01-R		90.00			underclay; gy; rootlets,plant frags

LEGEND

- coal
- transitional zone
- mudstone; shale

LINGAN / HARBOUR SEAM UNDERGROUND

HOST	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.2[illegible]							
		06-O	0.68	93.56		19	overclay; dk gy; coaly stringers; plant frags
0.00	0.00						
		06-A	3.40	9.68			coal, bright; calcite in cleats
	0.15						
		06-B	0.75	2.34	1	1	coal, bright; rel. clean
	0.30						
		06-C	0.71	3.36			coal, bright to semibright
	0.45						
		06-D	0.51	2.87	1	<1	coal, bright
	0.60						
		06-E	0.40	2.38			coal, bright to semibright
	0.75						
		06-F	0.46	1.03			coal, bright
	0.90						
		06-G	0.44	1.86			coal, bright to semibright; some fusain
	1.05						
		06-H	0.76	3.19	<1 1	1	coal, bright
	1.20						
		06-I	3.48	6.24	1	<1	coal, bright to semibright; some fusain; pyrite in cleats
	1.35						
		06-J	0.78	1.39	0.3	<1	coal, bright; ab. vitrain
	1.50						
		06-K	0.60	0.92			coal, bright; ab. vitrain; concoidal fracture
	1.65						
		06-L	3.31	7.44	1	<1	coal, bright; pyrite and calcite in cleats
	1.80						
		06-M	1.63	3.94	3	10	coal, bright; some calcite in cleats
0.00	2.00						
		06-N	1.36	89.83		9	underclay; lt gy; some plant frags
0.20							

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / INDIAN COVE CORE SM-17

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.30							
		10-A		82.75			overclay; gy
0.15							
		10-B		73.24		<7	overclay; gy
0.00	0.00						
		10-C		58.32	22	12	transition; carbonaceous
	0.12						
		10-D	9.96	51.85	10	<5	transition; carbonaceous
	0.30						
		10-E	6.32	13.73	2	4	coal
	0.60						
		10-F	5.96	10.87			coal
	0.90						
		10-G	6.72	13.29	6		coal
	1.15						
		10-H	3.50	60.48			coal
	1.28						
		10-I	4.30	9.17			coal
	1.48						
		10-J	7.28	13.98	2	15	coal
0.00	1.78						
		10-K		81.83		8	underclay; gy
0.15							
		10-L		86.66			underclay; gy
0.30							
		10-M		91.11			underclay; gy
0.45							

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / INDIAN COVE CORE SM-18

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm coal*	Ge ppm coal*	DESCRIPTION
0.23							
		11-A		73.24			overclay; gy
0.05							
0.00	0.00						
		11-B		75.97			overclay; gy
		11-C		40.32	12	20	transition; carbonaceous
	0.17						
		11-D	12.18	51.85	7	13	transition; carbonaceous
	0.47						
		11-E	7.76	15.01			coal
	0.70						
		11-F	3.96	10.54	3	2	coal
	0.88						
		11-G	3.86	71.86			clay parting
	1.18						
		11-H	3.40	12.30			coal
0.00	1.38						
		11-I	7.62	16.88	3	15	coal
0.08							
		11-J		82.24			underclay; gy
0.21							
0.26		11-K		90.62			underclay; gy
		11-L		58.33			underclay; gy; carbonaceous
0.41							

LEGEND

- coal
- transitional zone
- mudstone; shale

PHALEN COLLIERY / PHALEN SEAM — UNDERGROUND

HIST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm coal	Ge ppm coal	DESCRIPTION
0.20							
0.00	0.00	07-N	0.73	88.30			overclay; dk gy; coaly stringers near base; waxy; conchoidal fracture; fossils rare
	0.15	07-A	2.62	4.93	6		coal, bright; ab. pyrite cleat fillings
	0.30	07-B	2.41	5.03	1	1	coal, bright; ab. pyrite cleat fillings
	0.45	07-C	1.75	6.83	2	1	coal, bright; some pyrite visible
	0.60	07-D	1.43	7.68			coal, bright; pyrite lenses
	0.75	07-E	1.33	3.81			coal, bright; ab.vitrain; pyrite lenses
	0.90	07-F	1.25	4.75	1	<2	coal, bright; some fusain layers; calcite visible as cleat fillings
	1.05	07-G	1.88	3.70			coal, bright; ab. calcite in cleats
	1.20	07-H	4.53	6.41	1	<2	coal, bright; calcite in cleats
	1.35	07-I	1.83	3.67			coal, bright; some calcite
	1.50	07-J	2.12	3.86	1	<1	coal, bright; some calcite
	1.65	07-K	6.38	13.44			coal, semibright; bone band; some calcite
0.00	1.83	07-L	6.01	10.11	3	23	coal, bright; some calcite and pyrite
0.20		07-M	0.79	91.06		<9	underclay; lt gy; fossils rare

LEGEND

- coal
- transitional zone
- mudstone; shale

STEELE'S HILL / EMERY SEAM OUTCROP

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm coal*	Ge ppm coal*	DESCRIPTION
0.31–0.21		04-U	----	77.82			overclay; gy; iron oxide stain; ox; plant frags; thin carbonaceous beds
0.21–0.18		04-T		84.10			overclay; gy; iron oxide stain; ox; plant frags thin carbonaceous beds
0.18–0.10		04-S		26.76	9	5	coaly layer; iron oxide stain
0.10–0.00		04-R		84.25		8	overclay; gy; iron oxide stain; plant frags
	0.00–0.13	04-Q		20.63	12	8	coal,highly ox; bone band near bottom; upper 1 cm not inc. in sample
	0.13–0.33	04-P		4.87	2	1	coal, bright; friable; iron oxide stain
	0.33–0.48	04-O		3.54			coal, bright; friable; iron oxide stain
	0.48–0.63	04-N		13.59	4	2	coal, bone band in upper section; pyrite rich zone lower section; iron oxide staining
	0.63–0.78	04-M		6.86	2	<1	coal, bright; friable; thin clay stringer lower section
	0.78–0.93	04-L		6.36			coal, bright; friable
	0.93–1.08	04-K		9.56	4	<1	coal; large bone band upper section; iron oxide stain
	1.08–1.23	04-J		2.42	1	0.2	coal, bright; friable
	1.23–1.38	04-I		2.24			coal, bright to semibright; friable; upper 5 cm pyrite rich; iron oxide staining
	1.38–1.53	04-H		3.29			coal, bright to semibright; pyrite lenses; iron oxide stain
	1.53–1.68	04-G		7.86	2	1	coal, semibright; fractured
0.00–0.10		04-A		81.17		8	underclay; bk-gy; carbonaceous
0.10–0.20		04-B	----	99.08			underclay; gy; plant frags
0.20–0.29		04-C	----	93.45			underclay; gy; plant frags
0.29–0.39		04-D	----	92.44			underclay; gy; plant frags
0.39–0.43		04-E	----	14.69	8	6	coal; semibright
0.43–0.53		04-F	----	92.62			underclay; gy; plant frags

LEGEND

- coal
- transitional zone
- mudstone; shale

STEELE'S HILL / THIN SEAM DIRECTLY BELOW EMERY SEAM OUTCROP

HOST	COAL	SAMPLE	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.15							
		05-I		93.00			overclay; gy; plant frags
0.05							
0.00	0.00	05-H	3.87	60.78			transition; carbonaceous
		05-D	1.72	2.69	3	2	coal, bright; friable
	0.15						
		05-E	4.49	6.10	2	6	coal, bright; friable
	0.23						
	0.25	05-F	11.17	31.00	6	16	transition; coaly
0.00	0.30	05-G	7.63	11.79	3	21	coal, semibright; thin lenses of pyrite
		05-A	0.54	91.13			underclay; gy; plant frags
0.10							
0.15		05-B	----	91.97			underclay; gy; plant frags
0.20		05-C	----	93.55			underclay; gy; plant frags

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / SPENCER CORE FM-45

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.45							
		12-A		89.04			overclay; gy
0.30							
		12-B		93.20			overclay; gy
0.15							
		12-C		89.04			overclay; gy
0.00	0.00						
		12-D	2.32	7.74	3	9	coal
	0.30						
		12-E	3.94	6.69	1	2	coal
	0.60						
		12-F	1.30	2.78			coal
	0.90						
		12-G	1.91	5.71			coal
	1.20						
		12-H	5.87	30.58	12	15	transition
0.00	1.30						
		12-I		85.13			underclay; gy
0.15							
		12-J		90.96			underclay; gy
0.30							
		12-K		89.78			underclay; gy
0.45							
		12-L		88.74			underclay; gy
0.60							
		12-M		88.92			underclay; gy
0.75							

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / SPENCER CORE PM-48

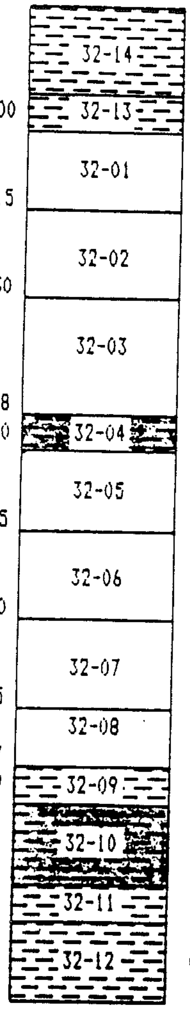
HOST (m)	COAL (m)	SAMPLE	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.45							
		13-A		94.18			overclay; gy
0.30							
		13-B		94.76			overclay; gy
0.15							
		13-C		91.75			overclay; gy
0.00	0.00						
		13-D	3.92	6.83	2	4	coal
	0.30						
		13-E	2.68	6.46	1	1	coal
	0.60						
		13-F	1.82	3.35			coal
	0.90						
		13-G	2.16	6.01			coal
0.00	1.06						
		13-H		85.40		<9	underclay; gy
0.15							
		13-I		88.44			underclay; gy
0.28							
		13-J		88.29			underclay; gy
0.43							

LEGEND

- coal
- transitional zone
- mudstone; shale

GARDINER SEAM

OPEN PIT



HOST	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
[illegible]							
0.04		32-14	0.11	93.43			overclay; siltstone; lt.gy; iron staining; hard.
0.00	0.00	32-13	1.05	85.42			overclay; dk.gy; carbonaceous; plant fragments + coaly material; some iron staining.
	0.15	32-01	0.97	5.03	3 3	22 20	banded coal; some clay(possibly epigenetic- deposited in cleats from runoff; iron staining; friable.
	0.30	32-02	1.32	5.08	2	1	banded coal; small clay stringer within sample; friable.
	0.48	32-03	2.29	8.76			coal mixed with clay; dirty; friable.
	0.50	32-04	1.39	33.17	10	5	clay band mixed with fusain; wet.
	0.65	32-05	2.92	20.97			coal; blocky; rather dull (high inert content);clay debris on cleat surfaces.
	0.80	32-06	3.42	7.49	1	<1	banded coal; clay on cleat surfaces.
	0.95	32-07	4.90	16.15	3	3	banded coal; clay on cleat surfaces; clay stringer 3cm from bottom of sample.
	1.07	32-08	6.96	19.34			coal; dirty; clay on cleat surfaces; clay stringer.
	1.09	32-09	4.53	61.22	22	<6	clay stringer; carbonaceous.
	1.23	32-10	5.40	38.08	13	<4	coal; platy; clay staining; dull(high in inerts).
0.05		32-11	0.49	84.46			transitional zone; carbonaceous.
0.20		32-12	0.26	90.48			underclay; lt.gy.;coaly zones; root fragments.

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / MULLINS SEAM CORE NW-13

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.45 – 0.30		14-A		95.34			overclay; gy
0.30 – 0.15		14-B		94.92			overclay; gy
0.15 –	– 0.00	14-C		94.21			overclay; gy
	0.00 – 0.20	14-D	9.00	18.81	3	<2	coal
	0.20 – 0.45	14-E	4.93	10.44	3		coal
	0.45 – 0.70	14-F	11.02	20.16	3	<2	coal
	0.70 – 0.95	14-G	5.74	8.91	2		coal
	0.95 – 1.20	14-H	5.18	6.76	1		coal
	1.20 – 1.45	14-I	3.83	5.76	1		coal
	1.45 – 1.75	14-J	6.43	8.49	1	3	coal
0.00 – 0.15	1.75 –	14-K		94.70			underclay; gy
0.15 – 0.30		14-L		95.38			underclay; gy

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / MULLINS SEAM CORE NW-16

HOST (m)	COAL (m)	SAMPLE	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.47							
		15-B		99.21			overclay; gy
0.32							
		15-C		93.83			overclay; gy
0.17							
		15-D		93.90			overclay; gy
0.00	0.00						
		15-E	11.76	23.59	3	<2	coal
	0.25						
		15-F	4.34	6.31			coal
	0.50						
		15-G	5.18	11.73			coal
	0.75						
		15-H	5.84	9.55	1	<1	coal
	1.00						
		15-I	5.38	7.56			coal
	1.25						
		15-J	3.48	4.54			coal
	1.50						
		15-K	3.64	7.31			coal
	1.75						
		15-L	9.87	18.38	2	4	coal
0.00	1.95						
		15-M		92.79			underclay; gy
0.15							
		15-N		92.85			underclay; gy
0.30							

LEGEND

- coal
- transitional zone
- mudstone; shale

N.S.D.M. / TRACY SEAM CORE PM-65

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm	Ge coal*	DESCRIPTION
0.43							
		16-A		94.36			overclay; gy
0.28							
		16-B		91.64			overclay; gy
0.13							
		16-C		80.82		<8	overclay; gy
0.00	0.00						
		16-D	8.28	10.92			coal
	0.25						
		16-E	6.58	7.61			coal
	0.45						
		16-F	4.30	6.46			coal
	0.81						
		16-G	4.70	11.69	<2		coal
	1.07						
		16-H	8.33	14.52			coal
0.00	1.25						
		16-I		91.22		<9	underclay; gy
0.14							
		16-J		34.96	11	6	transitional; carbonaceous
0.27							
		16-K		81.42			underclay; gy
0.42							
		16-L		81.54			underclay; gy
0.57							

LEGEND

- coal
- transitional zone
- mudstone; shale

NEAR ROUND ISLAND / MC AULEY SEAM OUTCROP

HOST (m)	COAL (m)	Sample	SUL (%)	ASH (%)	Ga ppm coal*	Se ppm coal*	DESCRIPTION
0.40							
0.30		09-A	----	93.68			overclay; gy; iron oxide stain
0.20		09-B	----	93.45			overclay; dk gy; platy; iron oxide stain
0.10		09-C	----	91.14			overclay; dk gy; iron oxide stain; plant frags
0.00	0.00	09-D	2.07	89.57		9	overclay; dk gy; carbonaceous
	0.10	09-E	7.42	13.22	3	8	coal; vertically cleated, filled with calcite
	0.25	09-F	5.74	9.47			coal; vertically cleated, filled with calcite
	0.33	09-G	7.78	11.70	6	7	coal; vertically cleated, filled with calcite
0.00	0.48	09-H		93.33			underclay; gy; plant frags
0.10		09-I	----	94.56			underclay; gy; iron stain
0.15		09-J	----	93.80			underclay; gy;

LEGEND

- coal
- transitional zone
- mudstone; shale

APPENDIX II (A)

ANALYTICAL DATA

TABLE 1 - Major element data of selected coal seams - Sydney Basin 1985-86, 1987-88* study ASH

SEAM	SITE	ACI ID	Si wt %	Al wt %	Ti wt %	Fe wt %	Mn wt %	Mg wt %	Ca wt %	Na wt %	K wt %	P wt %	S on ash	Ash wt %
POINT ACONI	POINT ACONI	33-02*	27.9	11.49	1.01	8.1	0.010	0.28	0.2	0.14	1.5	0.06	0.20	34.57
		33-03*	13.2	9.32	0.23	34.1	0.029	0.22	0.6	0.09	0.5	0.05	0.52	7.46
		33-04*	13.4	8.73	0.30	31.2	0.043	0.46	1.0	0.13	1.7	0.03	1.69	3.38
		33-05*	3.2	1.74	0.10	61.7	0.020	0.08	0.2	0.03	0.3	0.02	0.23	19.96
LLOYD CV.	Up. BROGAN	02-H	4.0	2.62	0.15	53.1	0.056	0.35	1.3	0.24	0.1	0.05	1.62	3.43
	Lr.	03-J	5.2	4.87	0.092	51.8	0.067	0.15	0.2	0.046	0.1	0.02	0.29	14.56
HUB	PRINCE	08-G	15.0	14.2	0.48	12.6	0.15	0.81	2.6	1.4	0.8	0.03	2.69	2.06
HARBOUR	NOVACO	01-H	6.8	7.82	0.04	47.0	0.075	0.07	0.6	0.11	0.1	0.25	0.93	13.89
		01-N	6.4	4.51	0.31	48.3	0.049	0.11	0.8	0.15	0.3	0.05	1.02	7.03
	LINGAN	06-H	14.0	11.5	0.51	19.8	0.0068	0.95	1.9	1.9	0.7	0.09	1.80	3.19
INDIAN CV.	SM-17	10-G	7.9	3.98	0.17	41.8	0.18	0.63	1.9	0.11	0.9	0.02	1.45	13.29
	SM-18	11-C *	21.9	10.85	0.44	15.2	0.025	0.35	1.4	0.16	2.1	0.14	2.4	40.32
		11-I *	5.1	2.69	0.14	40.3	0.217	0.31	8.9	0.18	0.4	0.02	7.34	16.88
PHALEN	PHALEN COL.	07-A	8.3	5.65	0.24	35.3	0.056	0.33	4.0	0.70	0.7	0.03	2.20	4.93
		07-C	16.0	10.0	0.56	16.6	0.048	0.41	3.9	0.56	1.3	0.02	3.06	6.83
		07-F	7.1	5.10	0.22	16.7	0.17	0.44	12	0.74	0.3	0.04	9.30	4.75
		07-H	4.9	2.83	0.13	48.1	0.045	0.24	3.0	0.44	0.2	0.02	2.17	6.41
		07-J	13.0	6.41	0.37	26.4	0.052	0.44	4.2	0.97	0.6	0.09	2.85	3.86
		07-L	5.8	3.50	0.19	40.7	0.069	0.25	4.0	0.37	0.5	0.61	2.87	10.11
EMERY	STEELE'S H.	04-K	25.0	14.7	0.93	3.45	0.0068	0.39	<0.4	0.12	0.2	0.08	0.4	9.56
SPENCER	PM-45	12-D *	15.7	11.06	0.37	24.8	0.116	0.75	1.7	0.11	1.5	0.03	1.55	7.74
		12-H *	20.4	13.61	0.47	15.5	0.007	0.58	0.3	0.15	2.6	0.03	0.04	30.58
	PM-48	13-E	15.0	11.0	0.39	24.7	0.056	0.61	0.9	0.17	1.7	0.02	1.1	6.46
GARDINER	NOVACO	32-01*	20.9	13.02	0.71	11.3	0.026	0.70	1.7	0.23	2.0	0.07	1.32	5.03
		32-06*	13.3	8.73	0.30	30.9	0.033	0.44	1.3	0.15	1.7	0.03	1.18	7.49
		32-10*	21.5	14.03	0.42	12.5	0.017	0.77	0.2	0.24	3.4	0.03	0.33	38.08
MULLINS	NW-13	14-D	10.0	6.93	0.22	37.5	0.028	0.29	0.3	0.13	1.9	0.02	0.86	18.81
		14-E	12.0	8.67	0.37	32.3	0.029	0.40	0.8	0.10	2.1	0.04	0.75	10.44
		14-F	7.9	5.44	0.21	44.7	0.016	0.25	0.3	0.066	0.9	0.02	0.54	20.16
		14-G	7.3	5.25	0.27	46.8	0.033	0.24	0.9	0.056	0.5	0.02	0.89	8.91
		14-H	15.0	3.19	0.14	54.4	0.046	0.06	1.2	0.066	0.3	0.02	1.34	6.76
		14-I	8.1	5.79	0.27	44.2	0.036	0.29	1.0	0.068	0.9	0.02	1.33	5.76
		14-J	6.1	3.89	0.20	50.1	0.031	0.09	0.9	0.063	0.5	0.02	1.02	8.49
	NW-16	15-E *	10.7	4.32	0.29	45.3	0.022	0.15	0.3	0.09	1.1	0.00	0.54	23.59
		15-H *	9.1	5.61	0.31	45.7	0.039	0.09	0.9	0.02	0.6	0.03	0.78	9.55
		15-L *	10.3	4.55	0.29	45.1	0.012	0.11	0.4	0.06	1.2	0.00	0.72	18.38
TRACY	PM-65	16-G	7.6	6.30	0.47	17.8	0.55	<0.06	14	0.071	0.7	0.30	5.97	11.69
MCAULEY	ROUND IS.	09-G	1.9	2.21	0.052	46.0	0.62	<0.06	5.4	0.046	0.1	0.02	4.71	11.70

TABLE 2 - Major oxide data of selected coal seams - Sydney Basin 1985-86, 1987-88* study ASH

SEAM	SITE	ACI ID	SiO2 wt %	Al2O3 wt %	TiO2 wt %	Fe2O3 wt %	MnO wt %	MgO wt %	CaO wt %	Na2O wt %	K2O wt %	P2O5 wt %	SO3 ash	TOTAL MAJORS
POINT ACONI	POINT ACONI	33-02*	59.6	21.7	1.68	11.6	0.01	0.46	0.28	0.19	1.78	0.14	0.50	97.95
		33-03*	28.3	17.6	0.39	48.8	0.04	0.36	0.85	0.12	0.56	0.11	1.30	98.43
		33-04*	28.6	16.5	0.50	44.6	0.06	0.77	1.43	0.18	2.03	0.08	4.22	98.96
		33-05*	6.75	3.29	0.16	88.2	0.03	0.13	0.24	0.04	0.31	0.05	0.58	99.77
LLOYD CV.	Up. BROGAN	02-H	8.56	4.95	0.25	75.93	0.07	0.58	1.82	0.32	0.12	0.11	4.04	96.76
	Lr.	03-J	11.12	9.20	0.15	74.07	0.09	0.25	0.28	0.06	0.12	0.05	0.72	96.12
HUB	PRINCE	08-G	32.08	26.82	0.80	18.02	0.19	1.34	3.64	1.89	0.96	0.07	6.72	92.54
HARBOUR	NOVACO	01-H	14.55	14.77	0.07	67.21	0.10	0.12	0.84	0.15	0.12	0.57	2.32	100.81
		01-N	13.69	8.52	0.52	69.07	0.06	0.18	1.12	0.20	0.36	0.11	2.55	96.38
	LINGAN	06-H	29.95	21.72	0.85	28.31	0.01	1.58	2.66	2.56	0.84	0.21	4.49	93.18
INDIAN CV.	SM-17	10-G	16.90	7.52	0.28	59.77	0.23	1.04	2.66	0.15	1.08	0.05	3.62	93.31
	SM-18	11-C *	46.9	20.5	0.73	21.8	0.03	0.58	1.94	0.21	2.57	0.31	5.99	101.56
		11-I *	10.9	5.09	0.24	57.7	0.28	0.51	12.5	0.24	0.43	0.05	18.32	106.26
PHALEN	PHALEN COL.	07-A	17.75	10.67	0.40	50.48	0.07	0.55	5.60	0.94	0.84	0.07	5.49	92.87
		07-C	34.22	18.89	0.93	23.74	0.06	0.68	5.46	0.75	1.57	0.05	7.64	93.99
		07-F	15.19	9.63	0.37	23.88	0.22	0.73	16.79	1.00	0.36	0.09	23.22	91.47
		07-H	10.48	5.35	0.22	68.78	0.06	0.40	4.20	0.59	0.24	0.05	5.42	95.78
		07-J	27.81	12.11	0.62	37.75	0.07	0.73	5.88	1.31	0.72	0.21	7.11	94.31
		07-L	12.41	6.61	0.32	58.20	0.09	0.41	5.60	0.50	0.60	1.40	7.16	93.30
EMERY	STEELE'S H.	04-K	53.47	27.77	1.55	4.93	0.01	0.65	<0.56	0.16	0.24	0.18	1.00	89.97
SPENCER	PM-45	12-D *	33.6	20.9	0.61	35.4	0.15	1.24	2.42	0.15	1.80	0.06	3.87	100.20
		12-H *	43.7	25.7	0.78	22.1	0.01	0.96	0.38	0.20	3.18	0.07	0.10	97.18
	PM-48	13-E	32.08	20.78	0.65	35.32	0.07	1.01	1.26	0.23	2.05	0.05	2.75	96.25
GARDINER	NOVACO	32-01*	44.7	24.6	1.19	16.2	0.03	1.16	2.41	0.31	2.35	0.16	3.30	96.41
		32-06*	28.5	16.5	0.50	44.2	0.04	0.73	1.77	0.20	2.05	0.08	2.95	97.52
		32-10*	46.0	26.5	0.70	17.9	0.02	1.27	0.32	0.33	4.13	0.07	0.82	98.07
MULLINS	NW-13	14-D	21.39	13.09	0.37	53.63	0.04	0.48	0.42	0.18	2.29	0.05	2.15	94.07
		14-E	25.67	16.38	0.62	46.19	0.04	0.66	1.12	0.13	2.53	0.09	1.87	95.30
		14-F	16.90	10.28	0.35	63.92	0.02	0.41	0.42	0.09	1.08	0.05	1.35	94.87
		14-G	15.61	9.92	0.45	66.92	0.04	0.40	1.26	0.08	0.60	0.05	2.22	97.55
		14-H	32.08	6.03	0.23	77.79	0.06	0.10	1.68	0.09	0.36	0.05	3.35	121.82
		14-I	17.33	10.94	0.45	63.21	0.05	0.48	1.40	0.09	1.08	0.05	3.32	98.39
		14-J	13.05	7.35	0.33	71.64	0.04	0.15	1.26	0.08	0.60	0.05	2.55	97.10
	NW-16	15-E *	22.9	8.16	0.49	64.8	0.03	0.25	0.42	0.12	1.34	0.01	1.35	99.87
		15-H *	19.5	10.6	0.52	65.4	0.05	0.15	1.27	0.03	0.69	0.06	1.95	100.22
		15-L *	22.1	8.59	0.49	64.5	0.02	0.19	0.58	0.08	1.44	0.01	1.80	99.79
TRACY	PM-65	16-G	16.26	11.90	0.78	25.45	0.71	0.00	19.59	0.10	0.84	0.69	14.90	91.22
MCAULEY	ROUND IS.	09-G	4.06	4.17	0.09	65.78	0.80	0.00	7.55	0.06	0.12	0.05	11.76	94.45

TABLE 3 Trace element data of selected coal seams - Sydney Basin 1985-86, 1987-88* study ASH

SEAM	SITE	ACI I.D.	Ag ppm	As ppm	Au ppb	B ppm	Ba ppm	Be ppm	Bi ppm	Br ppm	Cd ppm	Cl ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Ga ppm	Ge ppm	Hf ppm	Hg ppm	I ppm	In ppm	Ir ppm
POINT ACONI	POINT ACONI	33-02*	<0.5	120	5	70	604	12	1.4	0.5	1		7.1	150	6.4	62.0	19.8	<10	10.0	37		<0.5	<5
		33-03*	<0.5	420	4	150	315	35	0.4	1.1	16		32.0	53.0	1.6	130	37.1	280	2.0			<0.5	<5
		33-04*	<0.5	2700	<5	390	453	44	0.3	1.1	30		22.0	62.0	2.0	360	13.8	200	<0.2	70		<0.5	<5
		33-05*	<0.5	3000	<2	10	282	25	0.2	<0.5	5		31.0	58.0	1.0	320	13.3	260	<0.2			<0.5	<5
LLOYD CV.	Up.BROGAN	02-H	0.50	4900	7	330	330	38		3.3	<1.0	<50	50	49	1.1	290	23		1.2		<3.9		
	Lr.	03-J	<0.50	1200	3	80	240	20		0.8	<1	<40	78	74	0.7	52	17		0.9		<3.1		
HUB	PRINCE	08-G	<0.5	230	5	420	350	14		11	<1	<110	42	150	7.8	150	38		4.7		<8.4		
HARBOUR	NOVACO	01-H	<0.5	870	<3	110	370	27		2.6	6	<60	140	91	<0.5	100	25		0.2		<3.9		
		01-H	<0.5	700	1	170	250	19		2.4	<1	<50	26	70	1.4	260	16		3.2		<3.4		
	LINGAN	06-H	1.0	90	4	210	900	12		17	1	910	23	140	5.7	220	45		4.4		4.4		
INDIAN CV.	SM-17	10-G	<0.50	340	9	110	310	14		4.9	<1.0	<80	19	64	4.2	120	44		1.2		<6.3		
	SM-18	11-C *	<0.5	180		80	863	9	1.0		<0.2		10	100	11	61.0	30.6	50.0	2	8		<0.5	
		11-I *	<0.5	1300	<20	30	131	13	0.3		<0.2		35	34	3	210	16.8	90	<1	15		<0.5	
PHALEN	PHALEN COL.	07-A	<0.5	180	5	160	540	46		14	<1	110	27	110	2.3	99	130		2.2		5.0		
		07-C	<0.50	62	7	140	410	8		13	<1	230	15	100	9.7	90	34		4.6		<5.0		
		07-F	<0.50	37	<2	250	240	3		23	<1	230	18	52	1.3	92	12		1.7		<6.8		
		07-H	0.5	1900	1	100	310	7		7.0	<1	80	11	43	1.4	66	12		1.1		<2.9		
		07-J	<0.5	660	5	150	560	15		7.6	<1	100	16	86	4.1	150	25		3.1		<4.2		
		07-L	<0.5	2100	<4	70	370	22		8.1	<1	180	30	75	2.1	160	34		1.3		<3.4		
EMERY	STEELE'S H.	04-K	<0.50	35	4	100	540	5		3.9	<1	<50	19	150	22.7	87	37		7.8		4.4		
SPENCER	PM-45	12-D *	<0.5	1500		140		36	1.3		<0.2		90	96	13	120	40.4	120	3	17		<0.5	
		12-H *	<0.5	1100		80		14	0.7		<0.2		87	98	15	130	39.5	50	3	12		<0.5	
	PM-48	13-E	<0.5	500	2	170	570	15		6.3	1	<80	76	150	13.3	150	22		3.8		<5.2		
GARDINER	NOVACO	32-01*	<0.5	1000	6	100	540	95	0.7	12.0	<1		37.0	140	11.4	120	65.0	430	7.3			<1.0	<5
		32-06*	<0.5	1400	6	60	462	16	0.5	6.9	<1		81.0	100	7.6	180	18.4	<10	3.7			<0.5	<5
		32-10*	<0.5	610	9	60	628	11	0.6	2.0	<1		54.0	140	11.9	120	34.1	<10	5.5			<0.5	<5
MULLINS	NW-13	14-D	<0.5	920	2	50	400	11		3.4	<1	<40	86	86	8.2	180	17		2.3		2.6		
		14-E	<0.5	490	3	70	360	14		3.8	<1	<50	32	100	12.2	130	31		3.1		<3.7		
		14-F	<0.5	950	1	40	300	13		3.6	<1	<30	92	74	5.9	150	15		2.0		<2.9		
		14-G	<0.5	560	9	70	320	19		4.3	<1	<40	21	72	6.8	110	17		2.1		<3.4		
		14-H	<0.5	790	3	80	340	16		3.8	<1	<50	43	47	2.9	120	15		1.5		<3.7		
		14-I	*	460	12	90	420	12		5.9	<1	80	56	83	7.5	130	12		3.0		<4.4		
		14-J	<0.5	1100	<1	60	370	23		5.9	<1	<40	71	74	4.9	160	17		2.2		<3.1		
	NW-16	15-E *	<0.5	1900		<10	390	18	0.5		<0.2		142	48	7	280	11.9	<10	2	<0.5		<0.5	
		15-H *	<0.5	770	40	30		15	0.7		<0.2		34		6	180	12.2	<10	1	17		<0.5	
		15-L *	<0.5	1900		<10	376	22	0.7		<0.2		71	42	7	200	12.3	20	2	<0.5		<0.5	
TRACY	PM-65	16-G	<0.5	170	4	110	230	8		6.1	<1	<330	10	57	6.6	61	<14		3.0		<23		
MCAULEY	ROUND IS.	09-G	<0.50	1100	<3	100	170	3		6.3	<1	<340	46	33	0.9	150	49		0.3		<18		

APPENDIX II (A)

TABLE 3 Contd Trace element data of selected coal seams - Sydney Basin 1985-86, 1987-88* study ASH

SEAM	SITE	ACI I.D.	Li ppm	Mo ppm	Nb ppm	Ni ppm	P ppm	Pb ppm	Rb ppm	Sb ppm	Sc ppm	Se ppm	Sn ppm	Sr ppm	Ta ppm	Tl ppm	Th ppm	U ppm	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
POINT ACONI	POINT	33-02*	170	15	42	40	611	190	83	5.1	27.5	<0.5	17	444	1.6	1.6	26.0	7.7	150	6	68	260	305
	ACONI	33-03*	130	24	27	100	480	280	<10	41.0	14.4	<0.5	56	141	<0.5	4.0	6.4	2.3	66	11	<10	3400	55
		33-04*	29	48	30	64	349	2200	<10	42.0	12.1	<0.5	94	351	<0.7	15.6	6.4	2.3	56	37	<10	7000	85
		33-05*	10	58	35	110	218	640	<10	58.0	11.3	<0.5	35	<10	<0.5	14.3	4.2	3.2	170	<1	<10	1500	<10
LLOYD CV.Up.	BROGAN	02-H		120	30	160	530	360	<10	63	6.01	2.7		150	0.5		4.0	1.84	42	88	10	310	<10
Lr.		03-J		75	50	170	160	500	<10	16	10.2	8.6		40	0.4		4.4	2.55	280	4	<10	170	<10
HUB	PRINCE	08-G		45	30	100	290	270	30	4.1	23.5	3.6		580	0.6		19	5.31	170	12	50	520	260
HARBOUR	NOVACO	01-H		29	50	90	2500	1200	<10	9.2	7.06	<0.5		1200	<0.3		2.2	0.98	100	9	10	2600	<10
		01-M		44	30	93	450	560	<10	8.7	12.2	<1.0		140	0.9		10	3.18	83	16	<10	220	90
	LINGAN	06-H		56	30	55	780	50	51	4.6	21.4	3.7		570	1.0		14	3.92	130	4	50	96	180
INDIAN CV.	SM-17	10-G		110	40	58	200	62	71	7.6	15.1	<0.7		150	0.2		7.0	3.41	120	<3	10	220	20
	SM-18	11-C *	68	60	12	33	1353	290	108	5.8	20	<0.5	10	833	2	4.8	14.8	3.3	200	4	21	66.0	140
		11-I *	24	131	4	110	230	230	26	18.0	22	<0.5	109	133	<1	11.8	3.8	2.9	52	3	35	200	18
PHALEN	PHALEN COL.	07-A		57	50	160	290	190	<10	25	59.5	2.2		480	0.7		8.6	4.65	140	16	100	320	40
		07-C		23	50	62	240	62	120	2.3	19.6	<0.5		590	1.2		14	3.77	130	4	40	120	180
		07-F		56	20	35	410	38	<10	1.1	7.53	4.8		1000	0.3		5.1	1.73	57	2	30	180	30
		07-H		120	30	30	160	88	<10	2.6	5.22	<0.7		280	<0.2		3.4	1.33	74	<2	<10	160	<10
		07-J		210	40	36	940	700	<10	3.0	12.2	<0.5		780	0.8		10	3.42	87	7	30	400	100
		07-L		180	30	70	6100	600	30	71	18.6	4.5		320	0.4		5.0	18.1	220	<3	10	240	40
EMERY	STEELE'S H.	04-K		37	40	48	780	100	190	4.1	31.9	<0.5		940	1.6		24	6.86	240	<1	60	110	330
SPENCER	PM-45	12-D *	48	127	13	170	262	90	128	34.0	51	<0.5	72		1	15.6	17.3	4.2	250	7	87	140	
		12-H *	100	82	18	200	306	160	184	20.0	59	<0.5	13		1	8.3	20.0	8.3	510	2	62	130	
	PM-48	13-E		57	30	260	240	130	90	10	22.1	<0.7		270	1.1		17	3.76	190	<6	20	330	170
GARDINER	NOVACO	32-01*	74	60	33	100	698	190	129	56.0	26.5	<0.5	48	985	<0.6	4.7	18.0	5.4	180	6	93	330	194
		32-06*	43	61	26	140	349	160	160	9.0	17.0	<0.5	74	349	<0.7	16.1	11.0	2.5	150	2	<10	160	102
		32-10*	88	12	19	180	306	180	223	34.0	30.4	<0.5	14	204	<0.7	4.1	18.0	5.3	210	<1	18	1100	126
MULLINS	NW-13	14-D		82	40	190	160	260	130	21	13.6	<0.7		130	0.4		8.7	3.35	170	<3	<10	100	80
		14-E		97	40	100	410	420	140	9.1	18.0	<0.5		330	0.7		11	4.19	140	5	10	150	120
		14-F		130	50	210	160	*	50	11	11.2	<1.0		110	0.5		8.0	2.42	140	<4	<10	82	70
		14-G		120	40	100	160	520	42	6.2	10.3	1.4		300	0.7		7.2	2.88	81	<3	<10	140	30
		14-H		130	20	140	160	680	<10	6.4	5.21	0.6		370	0.4		3.9	1.25	48	<4	<10	160	<10
		14-I		90	40	190	200	480	90	5.1	10.8	1.1		470	1.1		8.1	2.28	82	<5	<10	220	90
		14-J		120	40	160	160	6	<10	24	10.0	<1.0		300	0.5		6.1	2.36	140	7	<10	170	80
	NW-16	15-E *	48	62	5	360	40	560	60	58.0	30	<0.5	22	74	1	10.8	6.8	2.3	120	2	26	96.0	87
		15-H *	60	127	9	120		840	36	4.2	29	<0.5	51		<1	8.1	7.4	2.4	90	2	24	150	
		15-L *	20	66	5	360	20	840	48	98.0	263	<0.5	17	104	2	17.2	9.9	3.4	160	5	34	69.0	57
TRACY	PM-65	16-G		41	40	26	3000	6	70	2.6	10.5	3.0		360	0.7		8.4	2.16	69	<4	20	80	100
MCAULEY	ROUND IS.	09-G		100	50	52	240	460	<10	35	3.22	<0.5		210	0.3		1.4	0.99	30	19	30	120	<10

TABLE 4 - Rare earth element data of selected coal seams - Sydney Basin 1985-86, 1987-88* study ASH

SEAM	SITE	ACI I.D.	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm
POINT ACONI	POINT ACONI	33-02 *	87.9	169	16.8	76	14.5	2.60	10.0	---	8.1	1.67	4.7	0.7	7.76	1.21
		33-03 *	31.1	62	6.2	32	7.69	2.02	8.6	---	7.3	1.51	4.0	0.6	5.23	0.85
		33-04 *	17.9	33	1.9	21	3.60	1.05	2.9	---	2.2	0.54	1.2	0.2	2.29	0.40
		33-05 *	8.8	20	2.3	14	3.88	1.51	5.4	---	5.5	1.19	3.1	0.4	3.97	0.65
LLOYD CV.Up.	BROGAN	02-H	23.9	31.9		18.2	7.38	1.73	5.2	0.82	5.6				2.90	0.43
Lr.		03-J	11.8	28.8		15.2	5.07	1.43	5.5	1.02	7.1				3.01	0.43
HUB	PRINCE	08-G	97.5	172		76.8	16.0	3.41	19.2	1.90	14.1				6.08	0.93
HARBOUR	NOVACO	01-H	65.6	172		92.1	18.4	4.59	21.3	2.74	14.8				5.80	0.75
		01-N	60.7	125		63.1	13.9	3.10	15.6	1.86	10.3				4.14	0.61
	LINGAN	06-H	81.0	150		67.8	13.8	2.65	16.0	1.78	12.1				5.06	0.77
INDIAN CV.	SM-17	10-G	23.5	49.5		27.0	9.51	2.87	10.3	2.04	12.8				4.52	0.69
	SM-18	11-C *	67.9	125	14.4	54.2	8.1	1.93	6.3	0.6	4.4	0.81	1.9	0.2	2.2	0.27
		11-I *	13.5	25.4	3.6	15.8	4.0	1.30	5.6	0.8	4.9	1.16	2.7	0.2	2.1	0.47
PHALEN	PHALEN COL.	07-A	29.3	72.3		44.3	18.9	5.83	19.7	6.08	34.6				15.3	2.30
		07-C	56.9	104		45.3	11.6	2.34	11.9	1.51	9.0				3.87	0.66
		07-F	35.7	65.2		37.7	11.1	2.80	13.1	1.69	9.0				2.83	0.44
		07-H	17.9	31.7		14.0	4.45	1.23	5.5	0.55	3.6				1.42	0.26
		07-J	34.9	60.4		27.5	6.75	1.60	7.2	1.00	5.5				2.81	0.46
		07-L	28.4	68.3		40.2	15.6	4.47	18.5	2.80	14.8				5.28	0.93
EMERY	STEELE'S H.	04-K	95.0	173		69.3	14.2	2.50	16.7	1.93	11.0				5.73	0.93
SPENCER	PM-45	12-D *	56.4	121	15.2	67.8	14.9	4.04	17.2	2.3	13.0	2.60	6.2	0.7	5.2	0.95
		12-H *	57.4	108	14.1	59.0	11.7	2.90	11.1	1.8	11.6	2.48	6.1	0.7	5.6	1.00
	PM-48	13-E	57.6	109		52.9	11.3	2.52	12.0	1.56	9.6				4.75	0.73
GARDINER	NOVACO	32-01 *	91.1	151	18.1	77	14.6	3.22	15.9	---	12.9	2.72	7.0	1.0	6.81	0.99
		32-06 *	64.0	107	12.6	69	9.01	1.99	9.7	---	6.6	1.33	3.7	0.5	3.52	0.56
		32-10 *	79.6	130	14.2	53	10.3	1.88	6.4	---	5.6	1.22	3.2	0.5	4.53	0.82
MULLINS	NW-13	14-D	34.3	60.2		26.0	5.81	1.39	6.0	0.83	5.6				2.76	0.42
		14-E	59.5	109		56.9	11.3	2.48	13.2	1.47	9.0				3.96	0.60
		14-F	29.7	60.4		29.9	7.50	1.82	8.9	1.19	7.0				2.53	0.40
		14-G	53.3	96.8		46.3	10.0	2.21	11.2	1.24	7.1				2.63	0.43
		14-H	26.3	43.2		22.7	4.87	1.11	5.3	0.69	3.7				1.51	0.22
		14-I	39.4	63.8		30.7	6.59	1.56	7.7	0.99	5.5				2.50	0.39
		14-J	28.9	55.2		29.3	7.30	1.58	8.9	1.16	7.3				3.51	0.53
	NW-16	15-E *	22.1	43.2	5.1	19.9	4.4	1.19	4.9	0.7	5.1	0.96	2.3	0.2	2.0	0.33
		15-H *	29.4	54.8	7.2	31.6	6.4	1.58	5.5	0.7	4.6	0.94	2.0	0.1	1.7	0.44
		15-L *	25.0	52.5	6.7	30.3	6.2	1.68	6.4	0.7	5.8	1.17	2.8	0.3	2.6	0.36
TRACY	PM-65	16-G	37.8	67.3		29.0	6.11	1.35	8.0	0.81	5.6				2.28	0.37
MCAULEY	ROUND IS.	09-G	25.9	61.3		44.1	14.1	4.20	16.8	3.07	19.5				5.28	0.77

TABLE 5 - Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
POINT ACONI								
Outcrop	33- 01	Roof	3.53	79.48				
	33- 02	0.00 - 0.07m	4.08	34.57	19.8	<10	6.8	<3
	33- 03	0.07 - 0.15m	5.28	7.46	37.1	280	2.8	21
	33- 04	0.50 - 0.65m	3.38	3.38	13.8	200	0.5	7
	33- 05	0.85 - 1.00m	15.94	19.96	13.3	260	2.7	52
	33- 06	Underclay	2.56	86.78				
BROGAN/LLOYD COVE	02-D	0.19 - 0.27m	----	92.41				
Upper Seam	02-C	0.13 - 0.19m	----	92.04				
Open Pit Mine	02-B	0.05 - 0.13m	----	91.01				
	02-A	Roof; 0.05m	1.13	90.50		10		9
	02-E	0.00 - 0.03m	4.20	29.99	18	<10	5	<3
	02-F	0.03 - 0.18m	5.06	5.74	54	112	3	6
	02-G	0.18 - 0.33m	2.90	3.26	36	30	1	1
	02-H	0.33 - 0.48m	2.86	3.43	23	19	1	1
	02-I	0.48 - 0.63m	5.61	6.56	<10	10	<1	1
					23		2	
	02-J	0.63 - 0.77m	4.72	5.28	54	400	3	21
	02-K	0.77 - 0.82m	10.08	15.50	18	190	3	29
	02-L	Underclay; 0.13m	4.97	83.06				
BROGAN/LLOYD COVE	03-A	0.25 - 0.40m	----	91.55				
Lower Seam	03-B	0.18 - 0.25m	----	93.31				
Open Pit Mine	03-C	0.09 - 0.18m	----	93.04				
	03-D	Roof; 0.09m	0.60	90.24				
	03-E	0.00 - 0.04m	9.81	41.36	14	<10	6	<4
	03-F	0.04 - 0.19m	7.74	12.36	31	37	4	5
	03-G	0.19 - 0.32m	11.90	17.38	12	20	2	3
	03-H	0.32 - 0.36m	21.60	31.97				
	03-I	0.36 - 0.46m	13.78	53.47	13	13	7	7
	03-J	0.46 - 0.61m	9.83	14.56	17	<10	2	<1
	03-K	0.61 - 0.76m	5.67	6.21				
	03-L	0.76 - 0.91m	4.31	9.29	17	<10	2	<1
	03-M	0.91 - 1.06m	4.88	4.78	14	59	1	3
	03-N	1.06 - 1.21m	5.98	6.66	14	102	1	7
	03-O	1.21 - 1.28m	4.40	6.54	23	368	2	24
	03-P	1.28 - 1.31m	9.78	21.33	12	140	3	30
	03-Q	Underclay; 0.05m	2.62	89.72		10		9

TABLE 5 ContdGallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH (% as determined)	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
PRINCE/HUB Underground Mine	08-P	Roof; 0.20m	0.20	90.04		10		9
	08-A	0.00 - 0.15m	3.26	7.28	77	420	6	31
	08-B	0.15 - 0.30m	1.44	3.61	57	52	2	2
	08-C	0.30 - 0.45m	0.82	2.80				
	08-D	0.45 - 0.60m	1.92	11.02	47	<10	5	<1
	08-E	0.60 - 0.75m	5.05	18.40	26	<10	5	<2
	08-F	0.75 - 0.90m	1.07	2.61				
	08-G	0.90 - 1.05m	1.03	2.06	29	22	1	0.5
					38		1	
	08-H	1.05 - 1.20m	1.09	2.19				
	08-I	1.20 - 1.35m	1.68	2.90	30	19	1	1
	08-J	1.35 - 1.50m	3.31	3.80				
	08-K	1.50 - 1.65m	7.36	11.69				
	08-L	1.65 - 1.80m	8.27	19.35	16	<10	3	<2
	08-M	1.80 - 1.95m	8.50	16.00	13	23	2	4
	08-N	1.95 - 2.15m	9.28	21.04	32	80	7	17
	08-O	Underclay; 0.10m	0.39	94.43		<10		<9
NOVACO/HARBOUR Open Pit Mine	01-A	0.15 - 0.25m	0.99	92.11				
	01-B	0.10 - 0.15m	1.00	92.08				
	01-C	0.04 - 0.10m	12.79	61.67				
	01-D	Roof; 0.04m	3.71	84.74				
	01-E	0.00 - 0.02m	6.97	35.86	17	<10	6	<4
	01-F	0.02 - 0.17m	8.01	11.90				
	01-G	0.17 - 0.32m	6.62	10.81	54	180	6	19
	01-H	0.32 - 0.47m	8.04	13.89	25	160	3	22
	01-I	0.47 - 0.56m	4.99	8.33				
	01-J	0.56 - 0.60m	14.52	48.27	22	<10	11	<5
	01-K	0.60 - 0.73m	1.68	82.93				
	01-L	0.73 - 0.77m	5.06	15.10	28	12	4	2
	01-M	0.77 - 0.92m	6.14	9.04				
	01-N	0.92 - 1.07m	4.73	7.03	16	20	1	1
	01-O	1.07 - 1.22m	5.01	6.63				
	01-P	1.22 - 1.37m	4.24	6.34	46	30	3	2
	01-Q	1.37 - 1.47m	6.79	10.70	41	420	4	45
					35	234	4	25
	01-R	Underclay; 0.10m	1.03	90.00				

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
LINGAN/HARBOUR Underground Mine	06-O	Roof; 0.20m	0.68	93.56		20		19
	06-A	0.00 - 0.15m	3.40	9.68				
	06-B	0.15 - 0.30m	0.75	2.34	55	60	1	1
	06-C	0.30 - 0.45m	0.71	3.36				
	06-D	0.45 - 0.60m	0.51	2.87	29	<10	1	<1
	06-E	0.60 - 0.75m	0.40	2.38				
	06-F	0.75 - 0.90m	0.46	1.03				
	06-G	0.90 - 1.05m	0.44	1.86				
	06-H	1.05 - 1.20m	0.76	3.19	10	31	<1	1
					45		1	
	06-I	1.20 - 1.35m	3.48	6.24	16	<10	1	<1
	06-J	1.35 - 1.50m	0.78	1.39	23	<10	0	<1
	06-K	1.50 - 1.65m	0.60	0.92				
	06-L	1.65 - 1.80m	3.31	7.44	17	10	1	<1
	06-M	1.80 - 2.00m	1.63	3.94	79	260	3	10
	06-N	Underclay; 0.20m	1.36	89.83		10		9
INDIAN COVE N.S.D.M.E. Core SM-17	10-A	0.15 - 0.30m	----	82.75				
	10-B	Roof; 0.15m	----	73.24		<10		<7
	10-C	0.00 - 0.12m	----	58.32	38	20	22	12
	10-D	0.12 - 0.30m	9.96	51.85	20	<10	10	<5
	10-E	0.30 - 0.60m	6.32	13.73	12	30	2	4
	10-F	0.60 - 0.90m	5.96	10.87				
	10-G	0.90 - 1.15m	6.72	13.29	44		6	
	10-H	1.15 - 1.28m	3.50	60.48				
	10-I	1.28 - 1.48m	4.30	9.17				
	10-J	1.48 - 1.78m	7.28	13.98	14	110	2	15
	10-K	Underclay; 0.15m	----	81.83		10		8
	10-L	0.15 - 0.30m	----	86.66				
	10-M	0.30 - 0.45m	----	91.11				

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH (% as determined)	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
INDIAN COVE	11-A	0.05 - 0.23m	----	73.24				
N.S.D.M.E. Core	11-B	Roof; 0.05m	----	75.97				
SM-18								
	11-C	0.00 - 0.17m	----	40.32	30.6	50	12	20
	11-D	0.17 - 0.47m	12.18	51.85	13	26	7	13
	11-E	0.47 - 0.70m	7.76	15.01				
	11-F	0.70 - 0.88m	3.96	10.54	25	20	3	2
	11-G	0.88 - 1.18m	3.86	71.86				
	11-H	1.18 - 1.38m	3.40	12.30				
	11-I	1.38 - 1.46m	7.62	16.88	16.8	90	3	15
	11-J	Underclay; 0.12m	----	82.24				
	11-K	0.12 - 0.17m	----	90.62				
	11-L	0.17 - 0.32m	----	58.33				
PHALEN COL./PHALEN	07-N	Roof; 0.20m	0.73	88.30		<10		<9
Underground Mine								
	07-A	0.00 - 0.15m	2.62	4.93	130		6	
	07-B	0.15 - 0.30m	2.41	5.03	16	15	1	1
	07-C	0.30 - 0.45m	1.75	6.83	34	10	2	1
	07-D	0.45 - 0.60m	1.43	7.68				
	07-E	0.60 - 0.75m	1.33	3.81				
	07-F	0.75 - 0.90m	1.25	4.75	12	<10	1	<1
	07-G	0.90 - 1.05m	1.88	3.70				
	07-H	1.05 - 1.20m	4.53	6.41	12	<10	1	<1
	07-I	1.20 - 1.35m	1.83	3.67				
	07-J	1.35 - 1.50m	2.12	3.86	25	<10	1	<1
	07-K	1.50 - 1.65m	6.38	13.44		20		3
	07-L	1.65 - 1.83m	6.01	10.11	34	230	3	23
	07-M	Underclay; 0.20m	0.79	91.06		<10		<9

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH (% as determined)	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
STEELE'S HILL/ EMERY	04-U	0.21 - 0.31m	----	77.82				
	04-T	0.18 - 0.21m	1.74	84.10				
	04-S	0.10 - 0.18m	5.40	26.76	32	20	9	5
	04-R	Roof; 0.10m	0.72	84.25		10		8
	04-Q	0.00 - 0.13m	2.56	20.63	58	40	12	8
	04-P	0.13 - 0.33m	1.93	4.87	33	24	2	1
	04-O	0.33 - 0.48m	1.38	3.54				
	04-N	0.48 - 0.63m	2.24	13.59	27	12	4	2
	04-M	0.63 - 0.78m	1.70	6.86	36	<10	2	<1
	04-L	0.78 - 0.93m	1.96	6.36				
	04-K	0.93 - 1.08m	0.78	9.56	37	10	4	<1
	04-J	1.08 - 1.23m	1.06	2.42	60	10	1	0.2
	04-I	1.23 - 1.38m	1.38	2.24				
	04-H	1.38 - 1.53m	2.32	3.29				
	04-G	1.53 - 1.68m	4.63	7.86	28	10	2	1
	04-A	Underclay; 0.10m	3.04	81.17		10		8
	04-B	0.10 - 0.20m	----	99.08				
	04-C	0.20 - 0.29m	----	93.45				
	04-D	0.29 - 0.39m	----	92.44				
	04-E	0.39 - 0.43m	2.69	14.69	52	40	8	6
	04-F	0.43 - 0.53m	----	92.62				
LR. STEELE'S HILL/ EMERY	05-I	0.05 - 0.15m	----	93.00				
Outcrop - Rider Seam	05-H	Roof; 0.05m	3.87	60.78				
	05-D	0.00 - 0.15m	1.72	2.69	114	60	3	2
	05-E	0.15 - 0.23m	4.49	6.10	30	100	2	6
	05-F	0.23 - 0.25m	11.17	31.00	20	52	6	16
	05-G	0.25 - 0.30m	7.63	11.79	23	180	3	21
	05-A	Underclay; 0.10m	0.54	91.13				
	05-B	0.10 - 0.15m	----	91.97				
	05-C	0.15 - 0.20m	----	93.55				

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH (% as determined)	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
SPENCER N.S.D.M.E. Core PM-45	12-A	0.30 - 0.45m	----	89.04				
	12-B	0.15 - 0.30m	----	93.20				
	12-C	Roof; 0.15m	----	89.04				
	12-D	0.00 - 0.30m	2.32	7.74	40.4	120	3	9
	12-E	0.30 - 0.60m	3.94	6.69	12	35	1	2
	12-F	0.60 - 0.90m	1.30	2.78				
	12-G	0.90 - 1.20m	1.91	5.71				
	12-H	1.20 - 1.30m	5.87	30.58	39.2	50	12	15
	12-I	Underclay; 0.15m	----	85.13				
	12-J	0.15 - 0.30m	----	90.96				
	12-K	0.30 - 0.45m	----	89.78				
	12-L	0.45 - 0.60m	----	88.74				
	12-M	0.60 - 0.75m	----	88.92				
SPENCER N.S.D.M.E. Core PM-48	13-A	0.30 - 0.45m	----	94.18				
	13-B	0.15 - 0.30m	----	94.76				
	13-C	Roof; 0.15m	----	91.75		<10		<9
	13-D	0.00 - 0.30m	3.92	6.83	22	60	2	4
	13-E	0.30 - 0.60m	2.68	6.46	22	10	1	1
	13-F	0.60 - 0.90m	1.82	3.35				
	13-G	0.90 - 1.06m	2.16	6.01				
	13-H	Underclay; 0.15m	----	85.40		<10		<9
	13-I	0.15 - 0.28m	----	88.44				
	13-J	0.28 - 0.43m	----	88.29				

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH	Ga (ppm in ash)	Ge	Ga (ppm in coal)	Ge
GARDINER	32- 14	0.04 - 0.13m	0.11	93.43				
Coen Pit Mine	32- 13	Roof; 0.04m	1.05	85.42				
	32- 01	0.00 - 0.15m	0.97	5.03	65.0	430	3	22
					69	393	3	20
	32- 02	0.15 - 0.30m	1.32	5.08	37	10	2	1
	32- 03	0.30 - 0.48m	2.28	8.76				
	32- 04	0.48 - 0.50m	1.39	33.17	30	14	10	5
	32- 05	0.50 - 0.65m	2.92	20.97				
	32- 06	0.65 - 0.80m	3.42	7.49	18.4	<10	1	<1
	32- 07	0.80 - 0.95m	4.90	16.15	16	18	3	3
	32- 08	0.95 - 1.07m	6.96	19.34				
	32- 09	1.07 - 1.90m	4.53	61.22	36	<10	22	<6
	32- 10	1.09 - 1.23m	5.40	38.08	34.1	<10	13	<4
	32- 11	Underclay; 0.05m	0.49	84.46				
	32- 12	0.05 - 0.20m	0.26	90.48				
MULLINS	14-A	0.30 - 0.45m	----	95.34				
N.S.D.M.E. Core	14-B	0.15 - 0.30m	----	94.92				
NW-13	14-C	Roof; 0.15m	----	94.21		<10		<9
	14-D	0.00 - 0.20m	9.00	18.81	17	<10	3	<2
	14-E	0.20 - 0.45m	4.93	10.44	31		3	
	14-F	0.45 - 0.70m	11.02	20.16	15	<10	3	<2
	14-G	0.70 - 0.95m	5.74	8.91	17		2	
	14-H	0.95 - 1.20m	5.18	6.76	15		1	
	14-I	1.20 - 1.45m	3.83	5.76	12		1	
	14-J	1.45 - 1.75m	6.43	8.49	17	30	1	3
	14-K	Underclay; 0.15m	----	94.70				
	14-L	0.15 - 0.30m	----	95.38				
	14-M	0.30 - 0.45m	----	94.41				

TABLE 5 Contd Gallium, germanium, ash and sulphur data on coals from the Sydney Coalfield.

SITE/SEAM	ACI I.D.	THICKNESS	SULPHUR (% as determined)	ASH (% as determined)	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal)	Ge (ppm in coal)
MULLINS	15-B	0.32 - 0.47m	----	98.21				
N.S.D.M.E. Core	15-C	0.17 - 0.32m	----	93.83				
NW-16	15-D	Roof; 0.17m	----	93.90				
	15-E	0.00 - 0.25m	11.76	23.59	11.9	<10	3	<2
	15-F	0.25 - 0.50m	4.34	6.31				
	15-G	0.50 - 0.75m	5.18	11.73				
	15-H	0.75 - 1.00m	5.84	9.55	12.2	<10	1	<1
	15-I	1.00 - 1.25m	5.38	7.56				
	15-J	1.25 - 1.50m	3.48	4.54				
	15-K	1.50 - 1.75m	3.64	7.31				
	15-L	1.75 - 1.95m	9.87	18.38	12.3	20	2	4
	15-M	Underclay; 0.15m	----	92.79				
	15-N	0.15 - 0.30m	----	92.85				
	15-O	0.30 - 0.45m	----	94.54				
TRACY	16-A	0.28 - 0.43m	----	94.36				
N.S.D.M.E. Core	16-B	0.13 - 0.28m	----	91.64				
PM-65	16-C	Roof; 0.13m	----	80.82		<10		<8
	16-D	0.00 - 0.25m	8.28	10.92				
	16-E	0.25 - 0.45m	6.58	7.61				
	16-F	0.45 - 0.81m	4.30	6.46				
	16-G	0.81 - 1.07m	4.70	11.69	<14		<2	
	16-H	1.07 - 1.25m	8.33	14.52				
	16-I	Underclay; 0.14m	----	91.22		<10		<9
	16-J	0.14 - 0.27m	----	34.96	31	17	11	6
	16-K	0.27 - 0.42m	----	81.42				
	16-L	0.42 - 0.57m	----	81.54				
ROUND IS./MCAULEY	09-A	0.30 - 0.40m	----	93.68				
Outcrop	09-B	0.20 - 0.30m	----	93.45				
	09-C	0.10 - 0.20m	----	91.14				
	09-D	Roof; 0.10m	2.07	89.57		10		9
	09-E	0.00 - 0.10m	7.42	13.22	20	60	3	8
	09-F	0.10 - 0.25m	5.74	9.47				
	09-G	0.25 - 0.33m	7.78	11.70	49	60	6	7
	09-H	Underclay; 0.15m	0.22	93.33		10		9
	09-I	0.15 - 0.25m	----	94.56				
	09-J	0.25 - 0.40m	----	93.80				

TABLE 6 Gallium and germanium concentrations of coals from the Sydney Coalfield.

SEAM	E. Zodrow ppm ash Ga	E. Zodrow ppm ash Ge	A.C.I. ppm ash Ga	A.C.I. ppm ash Ge
POINT	Outcrop		Outcrop	
ACONI		360	19.8	<10
		140	37.1	280
		80		
		100	13.8	200
		260		
		260		
		40	13.3	260
SEAM AVERAGE		177	21.0	188
UPPER LLOYD COVE	Brogan		Open Pit	
		240	18	<10
		80	54	112
		60	36	30
		80	23	19
		60	16	10
		200		
			54	400
			18	190
SEAM AVERAGE		120	31	110
LOWER LLOYD COVE			Brogan Open Pit	
			14	<10
			31	37
			12	20
			13	13
			17	<10
			17	<10
			14	59
			14	102
			23	368
			12	140
SEAM AVERAGE			17	77

SEAM	E. Zodrow ppm ash Ga	Ge	Ga	Ge	Ga	Ge	A.C.I. ppm ash Ga	Ge	Ga	Ge
HUB	Prince						Prince			
	400	160					77	420		
	200						57	52		
	100	80								
	120						47	<10		
	40	80					26	<10		
	40	80								
	40	20					34	22		
	90	40								
	60	40					30	19		
	20	40								
	40	60								
	20	40					16	<10		
	40	40					13	23		
	40	20					32	80		
	40	20								
		40								
SEAM AVERAGE	86	54					37	72		
HARBOUR	Novaco		No. 26		Lingan		Novaco		Lingan	
	10	170		40	70	410	17	<10		
	10	80		60	70	490			55	60
	20	100		40	10	30	54	180		
				40	10	30	25	160	29	<10
	20	90		40	10	20				
	10	30		40	10	30	22	<10		
	10	280		40	10	20				
	70	830		20	10	30	28	12	28	31
				20	20	20			16	<10
				20	10	20	16	20	23	<10
				20	10	30				
				20	<10	20	46	30	17	<10
				20	10	20	38	327	79	260
				20	30	60				
SEAM AVERAGE	21	226		31	21	88	31	94	35	56

Note: "<" was dropped when calculating seam averages.

TABLE 5 (con't) Gallium and germanium concentrations of coals from the Sydney Coalfield

SEAM	E. Zodrow ppm ash Ga	E. Zodrow ppm ash Ge	A.C.I. ppm ash Ga	A.C.I. ppm ash Ge	A.C.I. ppm ash Ga	A.C.I. ppm ash Ge
INDIAN COVE	Outcrop		Core SM-17		Core SM-18	
	<10	30	38	20	30.6	50
	<10	20	20	<10	13	26
	10	20	12	30		
	10	20			25	20
	10	110	44			
	10	150				
	10	360			16.8	90
			14	110		
SEAM AVERAGE	10	101	26	43	21	47
PHALEN	No.26		Phalen Col.			
	30	30	130			
	10	20	16	15		
	20	10	34	10		
	10	20				
	20	<10				
	10	20	12	<10		
	20	20				
	20	20	12	<10		
	10	20				
	20	<10	25	<10		
	10	20		20		
	10	<10	34	230		
	10	20				
SEAM AVERAGE	15	18	38	44		
EMERY			Outcrop			
			58	40		
			33	24		
			27	12		
			36	<10		
			37	<10		
			60	10		
			28	10		
SEAM AVERAGE			40	17		
EMERY-RIDER			Outcrop			
			114	60		
			30	100		
			20	52		
			23	180		
SEAM AVERAGE			47	98		

SEAM	E. Zodrow ppm ash Ga	E. Zodrow ppm ash Ge	A.C.I. ppm ash Ga	A.C.I. ppm ash Ge	A.C.I. ppm ash Ga	A.C.I. ppm ash Ge
SPENCER			Core PM-45		Core PM-48	
			40.4	120	22	60
			12	35	22	10
			39.2	50		
SEAM AVERAGE			31	68	22	35
GARDINER			Open Pit			
			67	412		
			37	10		
			30	14		
			18.4	<10		
			16	18		
			36	<10		
			34.1	<10		
SEAM AVERAGE			34	69		
MULLINS			Core NW-13		Core NW-16	
			17	<10	11.9	<10
			31			
			15	<10		
			17		12.2	<10
			15			
			12			
			17	30		
					12.3	20
SEAM AVERAGE			18	17	12	13
TRACY			Core PM-65			
			<14			
SEAM AVERAGE						
MCAULEY			Outcrop			
			20	60		
			49	60		
SEAM AVERAGE			35	60		

Note: "<" was dropped when calculating seam averages.

TABLE 7 - PYRITE CONCENTRATION

SITE/SEAM	ACI I.D.	THICKNESS	CONCENTRATING TABLE STARTING WT.(g)	CONCENTRATING TABLE CONCENTRATE WEIGHT +	FLOAT-SINK ANALYSIS FLOAT WEIGHT %	FLOAT-SINK ANALYSIS SINK WEIGHT % ++
BROGAN/LLOYD COVE	02-F	0.03-0.18 m	*	7.1	73.80	26.20
Upper Seam	02-J	0.63-0.77 m	357.5	19.0	82.47	17.53
Open Pit Mine	02-K	0.77-0.82 m	150.6	23.8	76.09	23.91
BROGAN/LLOYD COVE	03-E	0.00-0.04 m	105.3	18.8	78.09	21.91
Lower Seam	03-H	0.32-0.36 m	314.5	56.8	68.50	31.50
Open Pit Mine	03-I	0.36-0.46 m	410.2	73.5	73.13	26.87
	03-N	1.06-1.21 m	311.4	14.9	85.44	14.56
	03-P	1.28-1.31 m	199.6	34.0	71.15	28.85
PRINCE/HUB	08-A	0.00-0.15 m	126.1	16.7	85.45	14.55
Underground Mine	08-E	0.60-0.75 m	246.8	13.9	69.64	30.36
NOVACO/HARBOUR	01-E	0.00-0.02 m	366.9	78.2	70.28	29.72
Open Pit Mine	01-H	0.32-0.47 m	300.2	66.2	59.59	40.41
	01-J	0.56-0.60 m	459.7	57.4	64.41	35.59
	01-P	1.22-1.37 m	300.9	19.3	61.09	38.91
	01-Q	1.37-1.47 m	*	29.0	20.07	79.93
LINGAN/HARBOUR	06-I	1.20-1.35 m	296.2	6.4	77.50	22.50
Underground Mine	06-M	1.80-2.00 m	332.2	3.8	87.37	12.63
PHALEN COL./PHALEN	07-L	1.65-1.83 m	143.9	13.7	87.74	12.26
Underground Mine						
Lr.EMERY/STEELE'S HILL	05-D	0.00-0.15 m	269.9	8.9	99.21	0.79
Outcrop-Rider Seam	05-G	0.25-0.30 m	266.5	48.3	34.41	65.59
GARDINER	232 01	0.00-0.15 m	324.6	13.1	94.73	5.27
Open Pit Mine	232 09	1.07-1.09 m	139.5	16.8	95.60	4.40
	232 10	1.09-1.23 m	239.3	23.0	96.04	3.96

* NOT AVALIABLE
+ FLOAT SINK STARTING WEIGHT
++ PYRITE CONCENTRATE % OF FLOAT-SINK SAMPLE

TABLE 8 Gallium and germanium in pyrite concentrates.

SITE/SEAM	ACI I.D.	THICKNESS	PYRITE CONCENTRATE FLOAT Ga (ppm)	FLOAT Ge (ppm)	SINK Ga (ppm)	SINK Ge (ppm)
Brogan/Lloyd Cove Lower Seam	03-H	0.32-0.36m	<10	16	<10	<10
Novaco/Harbour	01-E	0.00-0.02m	16	16	<10	17
	01-H	0.32-0.47m	17	115	<10	<10

TABLE 9 Float-Sink analysis of Novaco / Harbour Seam(1.37m-1.47m 260-01Q)

Relative Specific Gravity Fraction	Weight %	Ash wt%	Sulphur wt%	Ga (ppm in ash)	Ge (ppm in ash)	Ga (ppm in coal*)	Ge (ppm in coal*)
1.40 FLOAT	72.62	2.56	1.87	147	1020	4	26
1.80 FLOAT	13.69	13.54	5.08	25	128	3	17
1.80 SINK	13.69	54.30	32.30	<10	22	<5	12

* recalculated from concentrations in ash

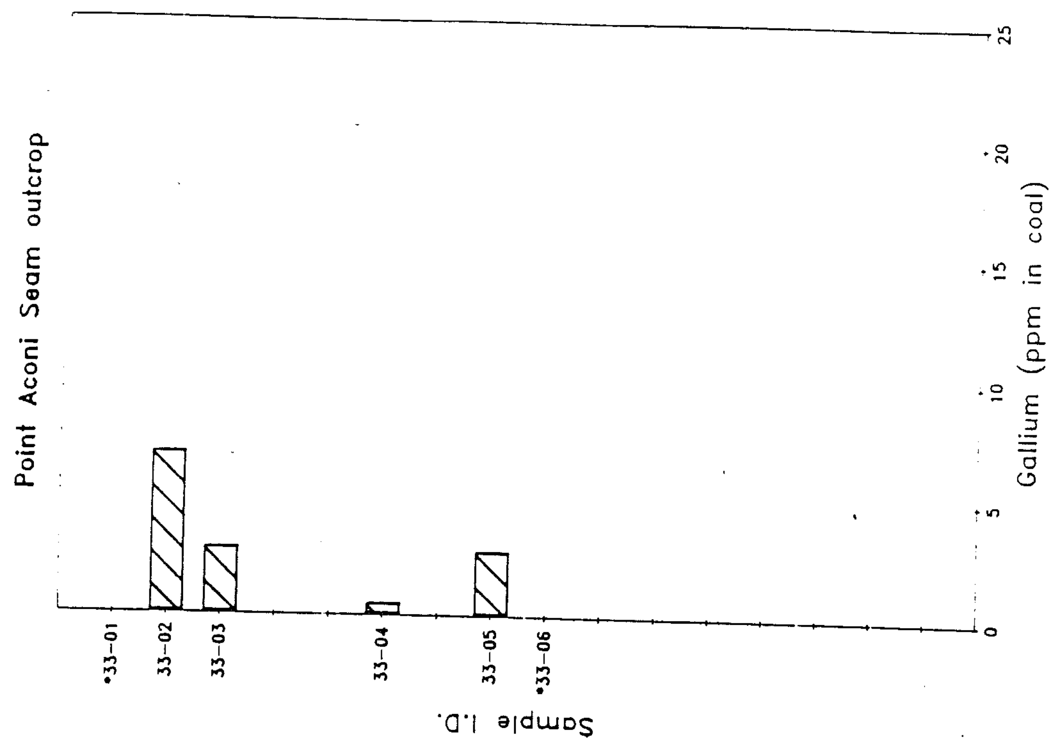
TABLE 10 Duplicate analysis of gallium and germanium

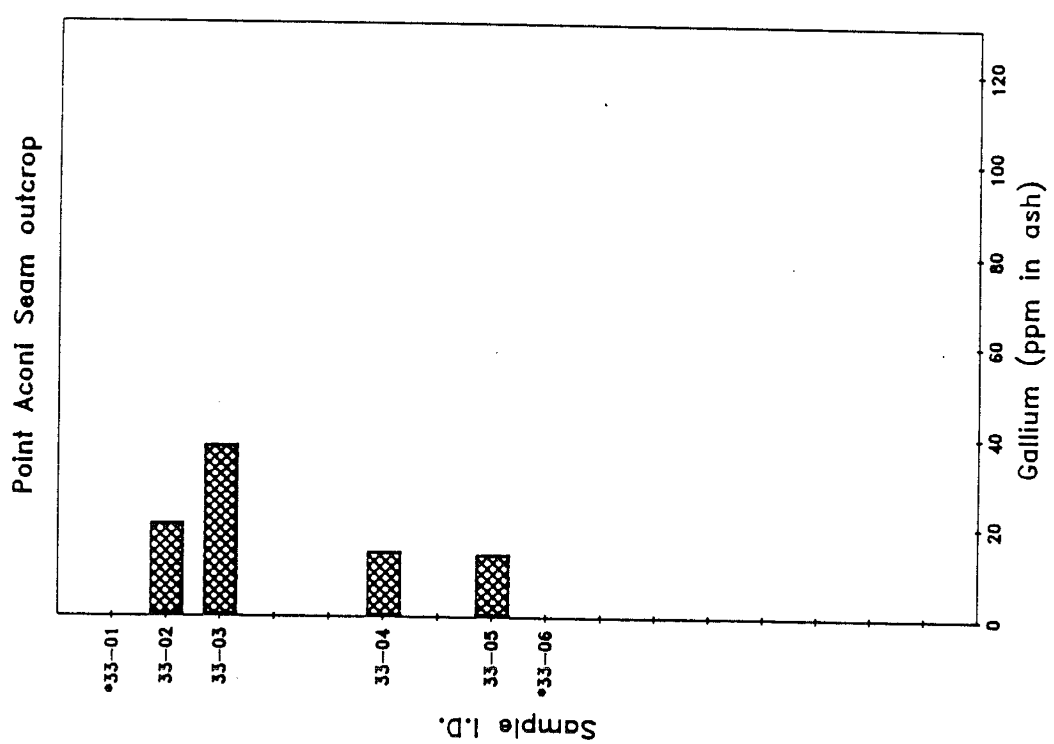
SEAM	DEPTH		Ga (ppm in ash)	Ge (ppm in ash)	Ga (duplicate)	Ge (duplicate)
Upper Lloyd Cove	02-I	0.48-0.63m	<10	10	23	
Hub	08-G	0.90-1.05m	29	22	38	
Harbour/Novaco	01-Q	1.37-1.47m	41	420	35	234
Harbour/Lingan	06-H	1.05-1.20m	<10	31	45	
Gardiner	32-01	0.00-0.15m	65	430	69	393

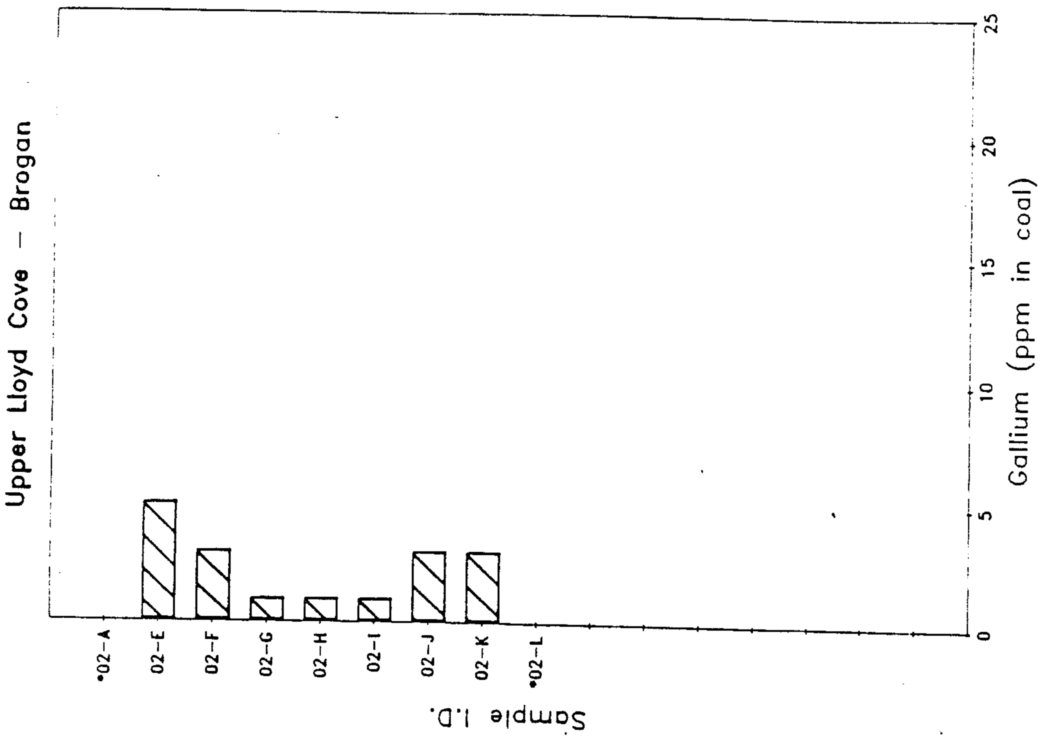
APPENDIX II (B)

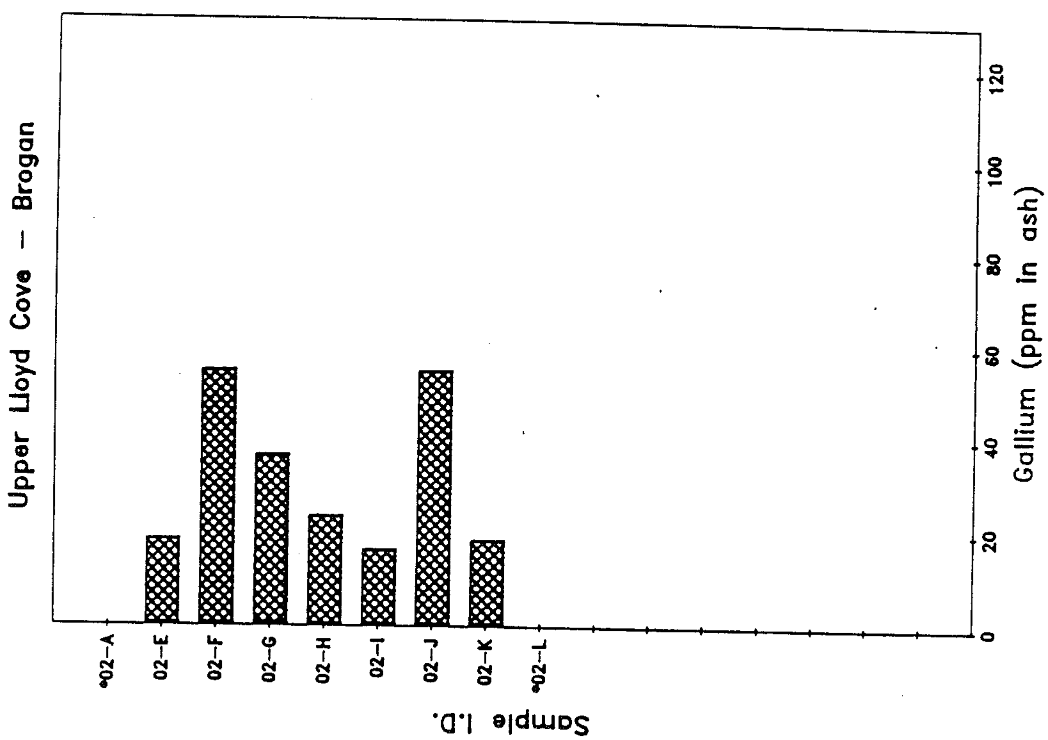
GALLIUM CONCENTRATIONS WITHIN SEAMS

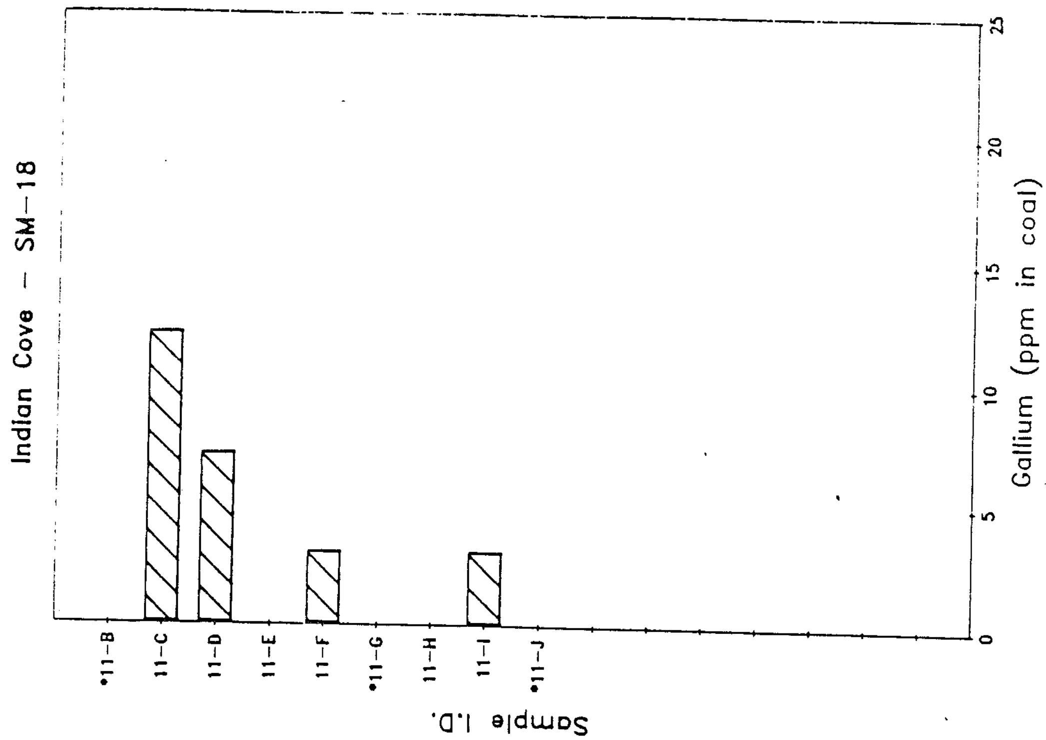
- Point Aconi Seam
- Lloyd Cove Upper Seam (Brogan)
- Lloyd Cove Lower Seam (Brogan
- Hub Seam (Prince)
- Harbour Seam (Novaco)
- Harbour Seam (Lingan)
- Indian Cove (NSDME CORE SM-17)
- Indian Cove (NSDME CORE SM-18)
- Phalen Seam (Phalen Colliery)
- Emery Seam (Steele's Hill)
- Thin seam directly below Emery Seam (Rider/Steele's Hill)
- Spencer Seam (NSDME CORE PM-45)
- Spencer Seam (NSDME CORE PM-48)
- Gardiner Seam
- Mullins Seam (NSDME CORE NW-13)
- Mullins Seam (NSDME CORE NW-16)
- Tracy Seam (NSDME CORE PM-65)
- McAuley Seam (Near Round Island)

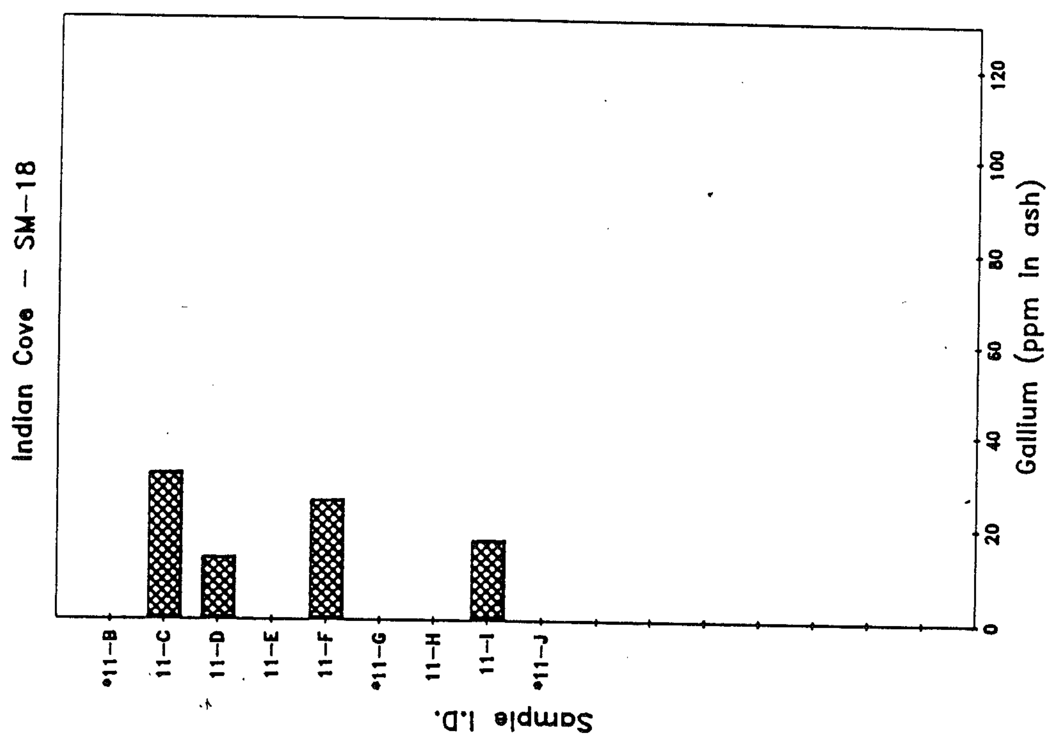

Point Aconi Seam outcrop
Gallium (ppm in coal)
0 5 10 15 20 25
Sample I.D.
•33-01
33-02
33-03
33-04
33-05
•33-06

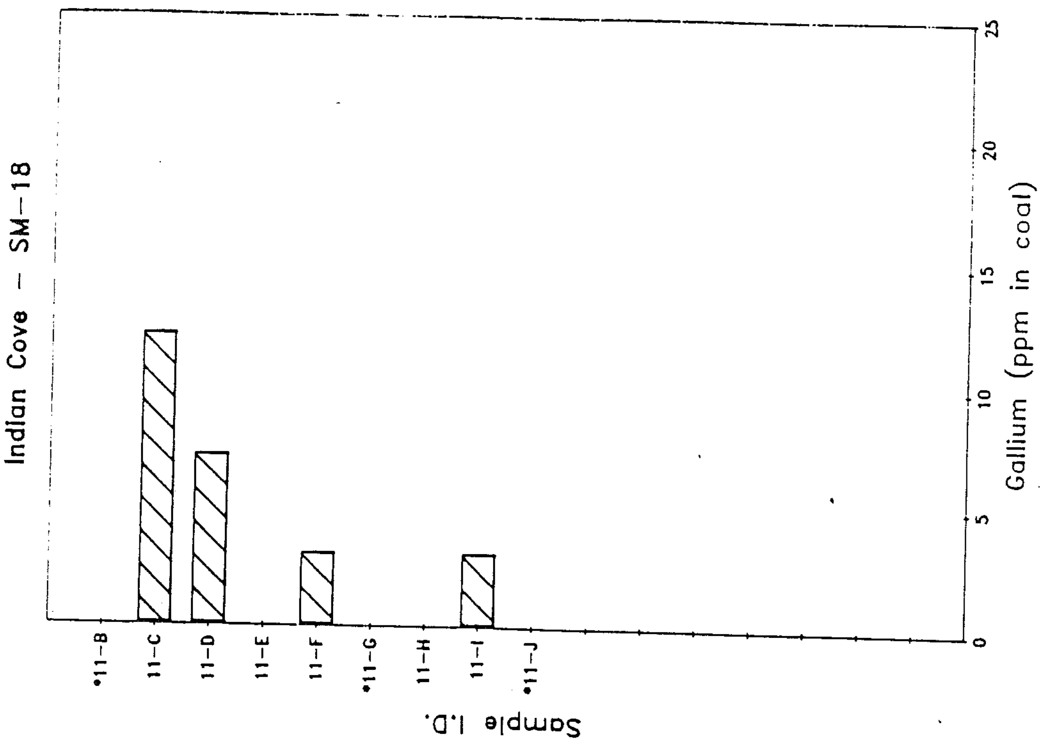

Point Aconi Seam outcrop
Gallium (ppm in ash)
0 20 40 60 80 100 120
Sample I.D.
•33-01
33-02
33-03
33-04
33-05
•33-06

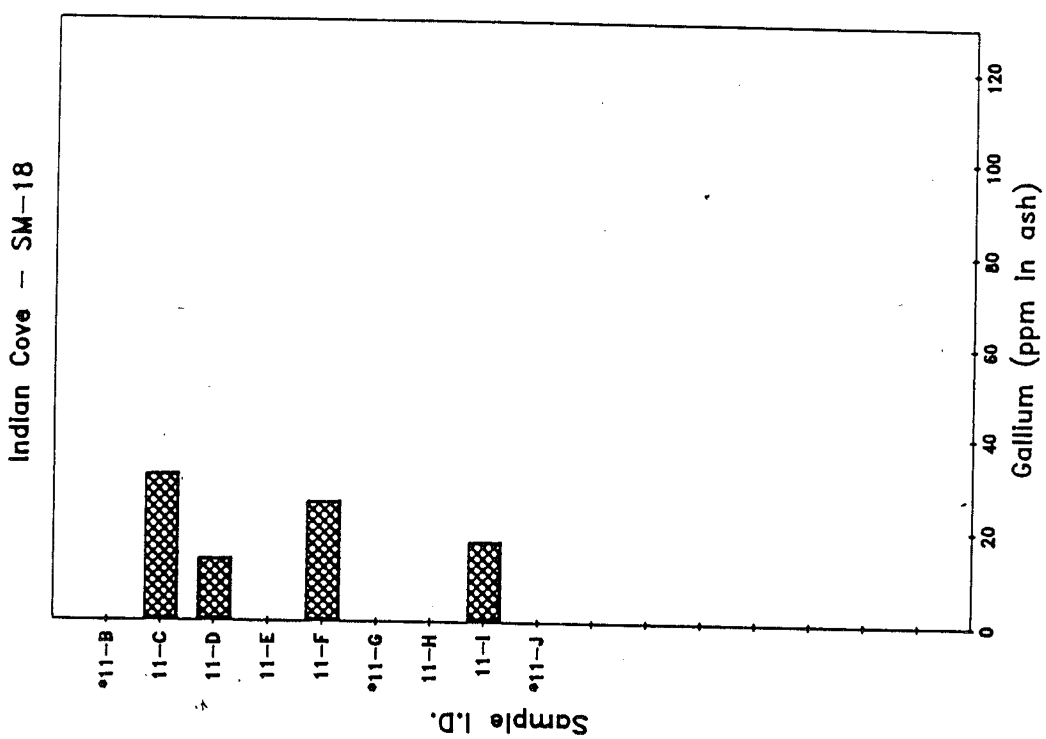

Upper Lloyd Cove — Brogan
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
•02-A
02-E
02-F
02-G
02-H
02-I
02-J
02-K
•02-L

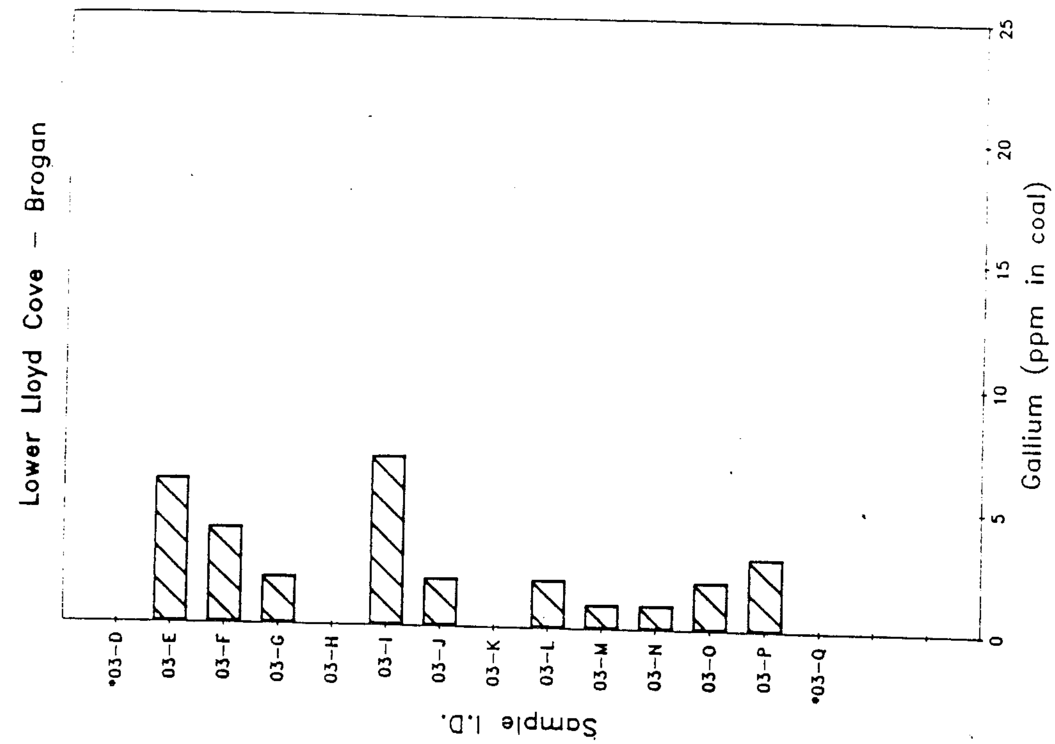

Upper Lloyd Cove — Brogan
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
•02-A
02-E
02-F
02-G
02-H
02-I
02-J
02-K
•02-L

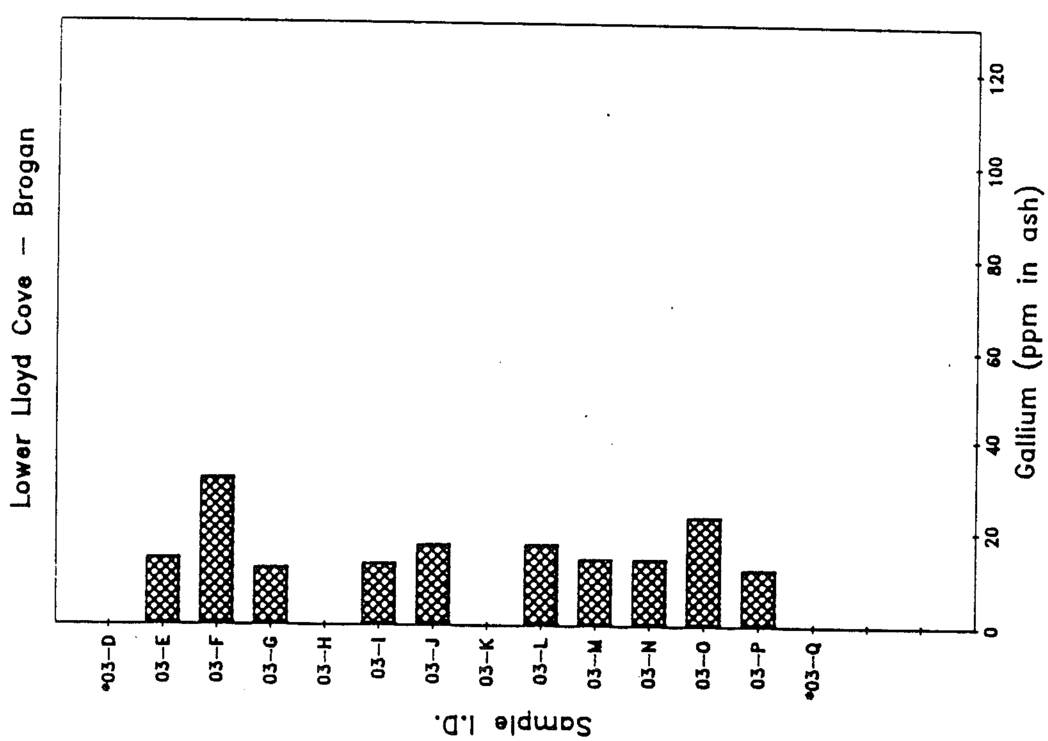

Indian Cove - SM-18
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*11-B
11-C
11-D
11-E
11-F
*11-G
11-H
11-I
*11-J

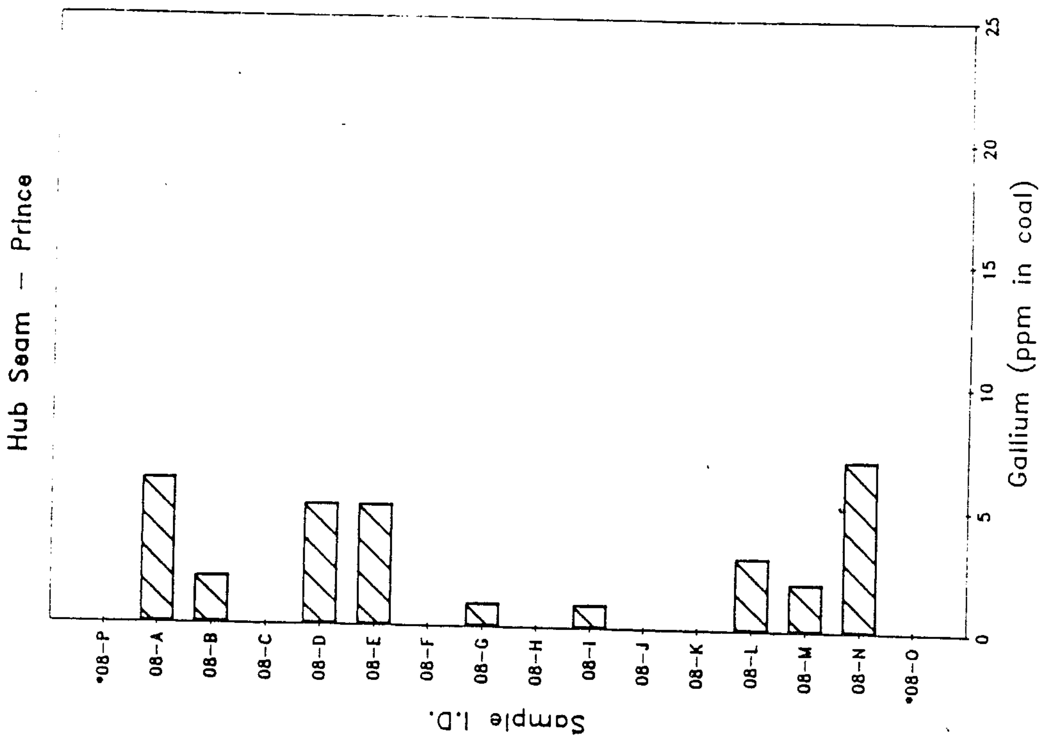

Indian Cove - SM-18
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*11-B
11-C
11-D
11-E
11-F
*11-G
11-H
11-I
*11-J

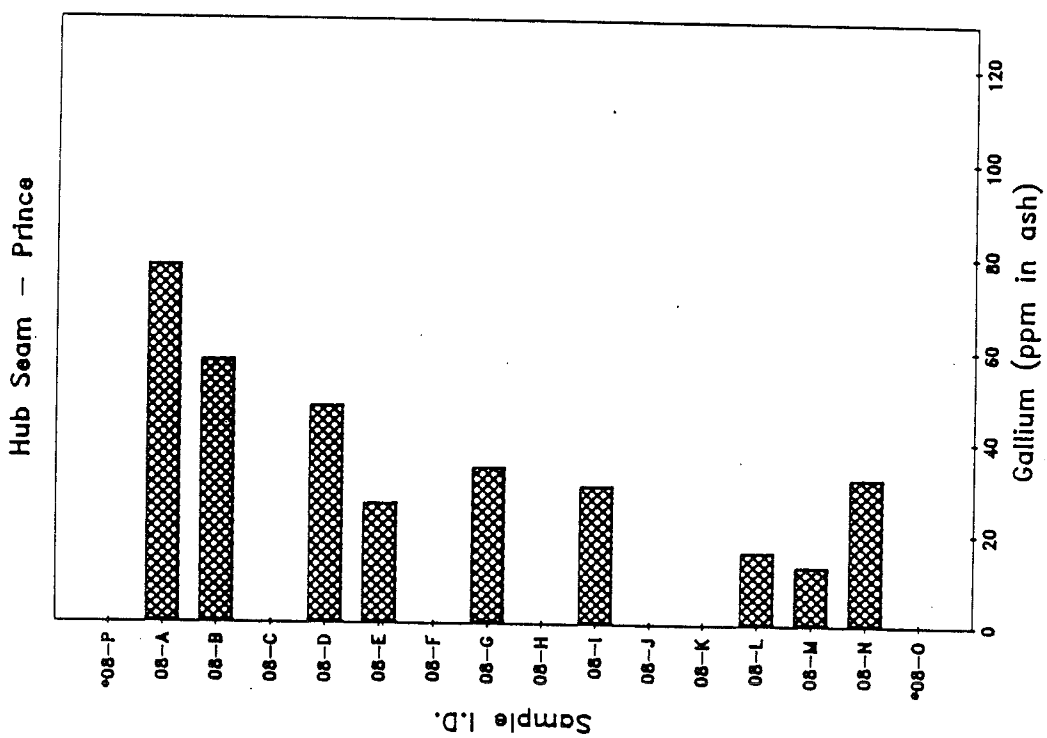

Indian Cove - SM-18
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*11-B
11-C
11-D
11-E
11-F
*11-G
11-H
11-I
*11-J

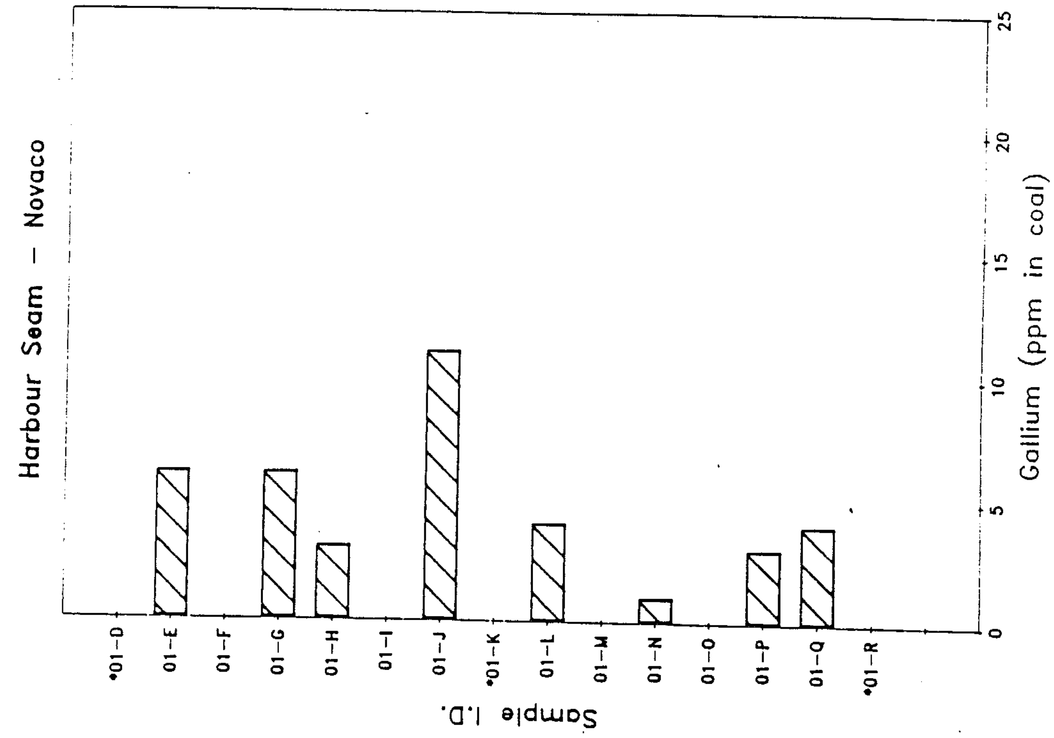

Indian Cove - SM-18
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*11-B
11-C
11-D
11-E
11-F
*11-G
11-H
11-I
*11-J

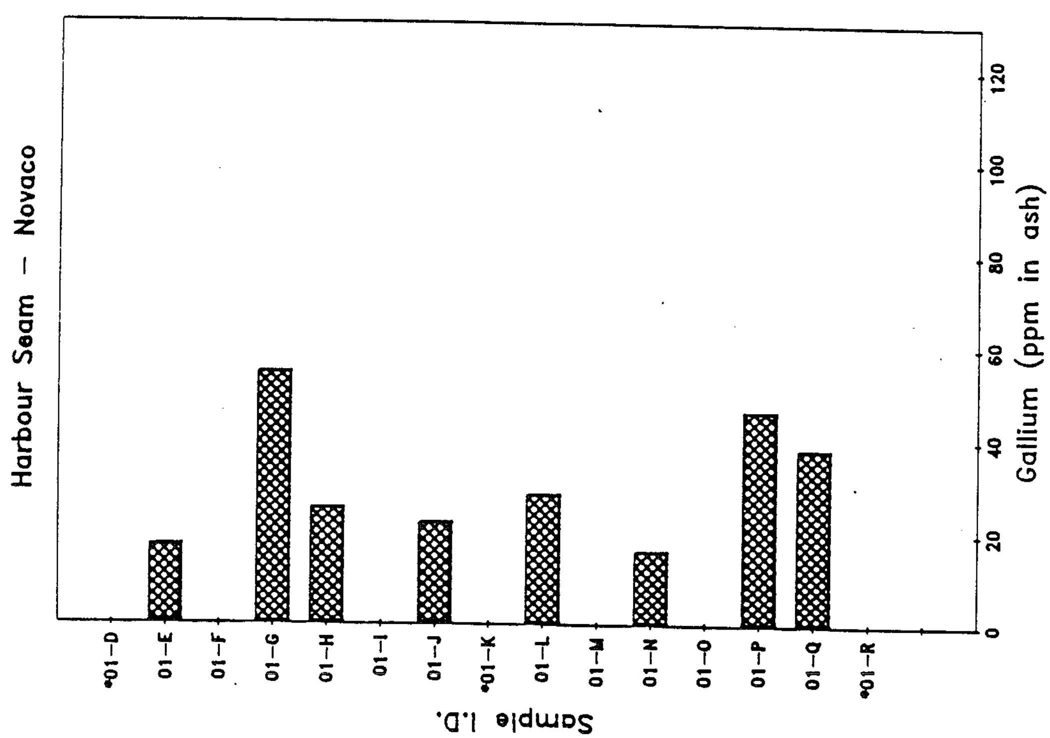

Lower Lloyd Cove — Brogan
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*03-D
03-E
03-F
03-G
03-H
03-I
03-J
03-K
03-L
03-M
03-N
03-O
03-P
*03-Q

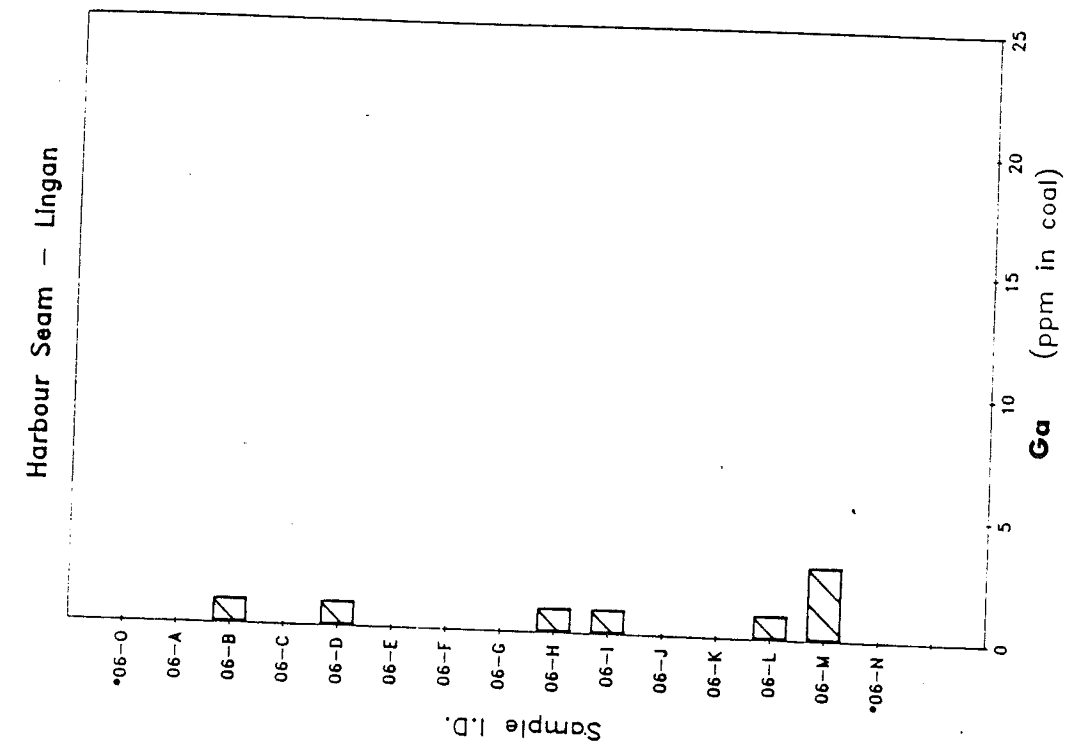

Lower Lloyd Cove — Brogan
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*03-D
03-E
03-F
03-G
03-H
03-I
03-J
03-K
03-L
03-M
03-N
03-O
03-P
*03-Q

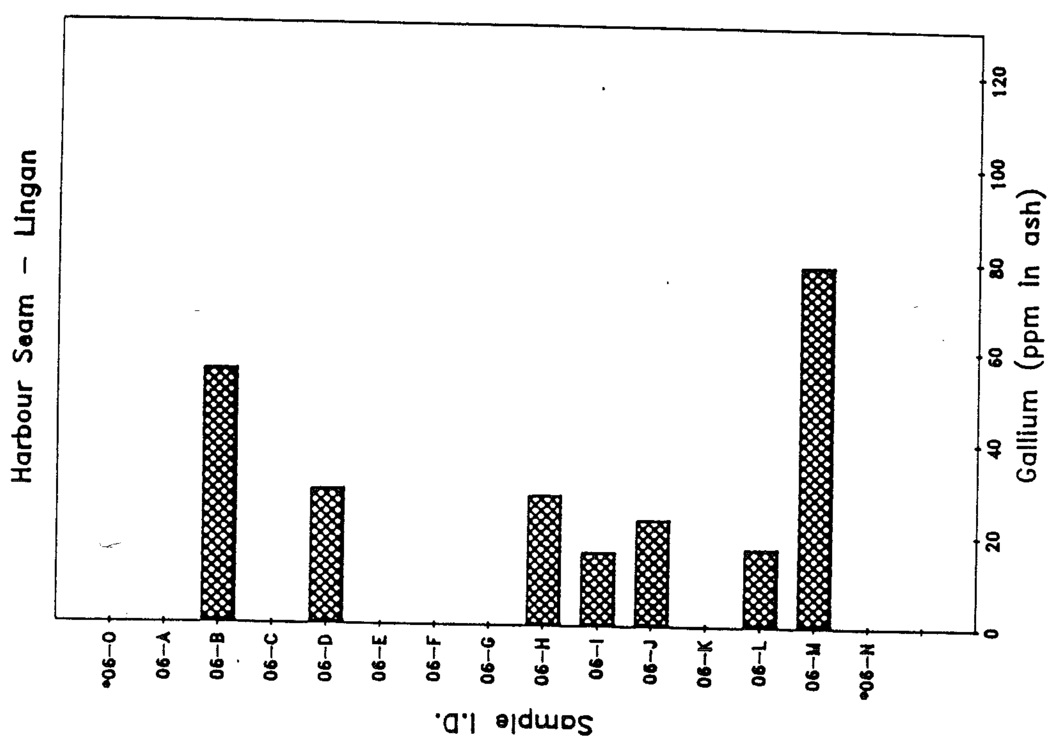

Hub Seam – Prince
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
•08-P
08-A
08-B
08-C
08-D
08-E
08-F
08-G
08-H
08-I
08-J
08-K
08-L
08-M
08-N
•08-O

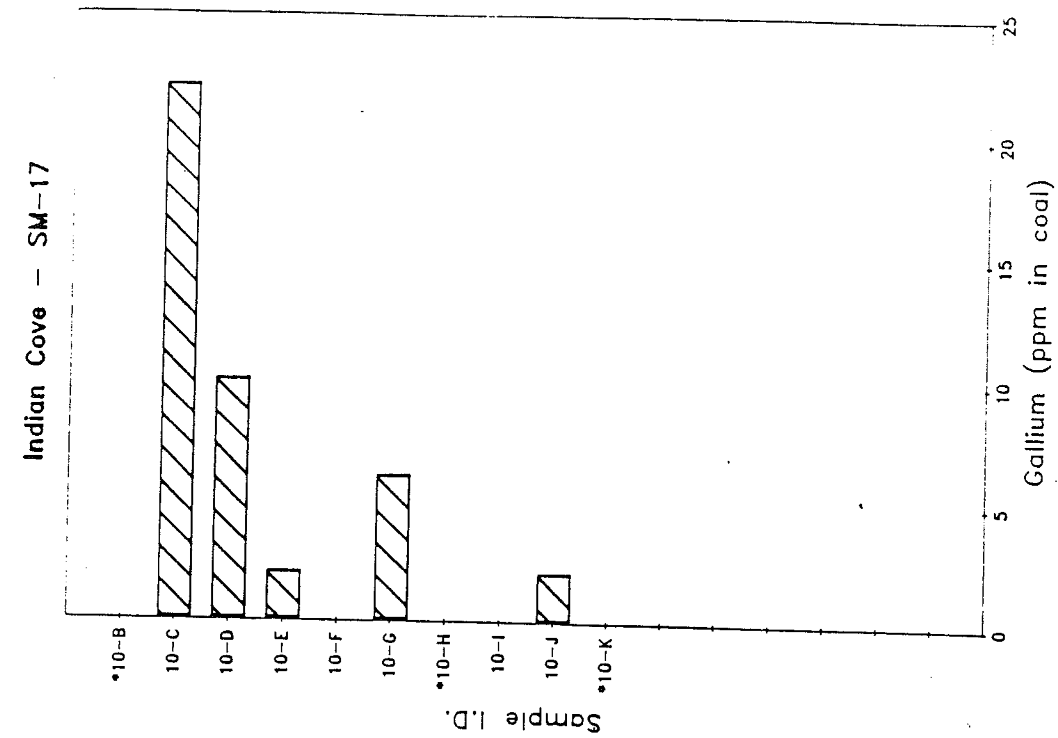

Hub Seam – Prince
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
•08-P
08-A
08-B
08-C
08-D
08-E
08-F
08-G
08-H
08-I
08-J
08-K
08-L
08-M
08-N
•08-O

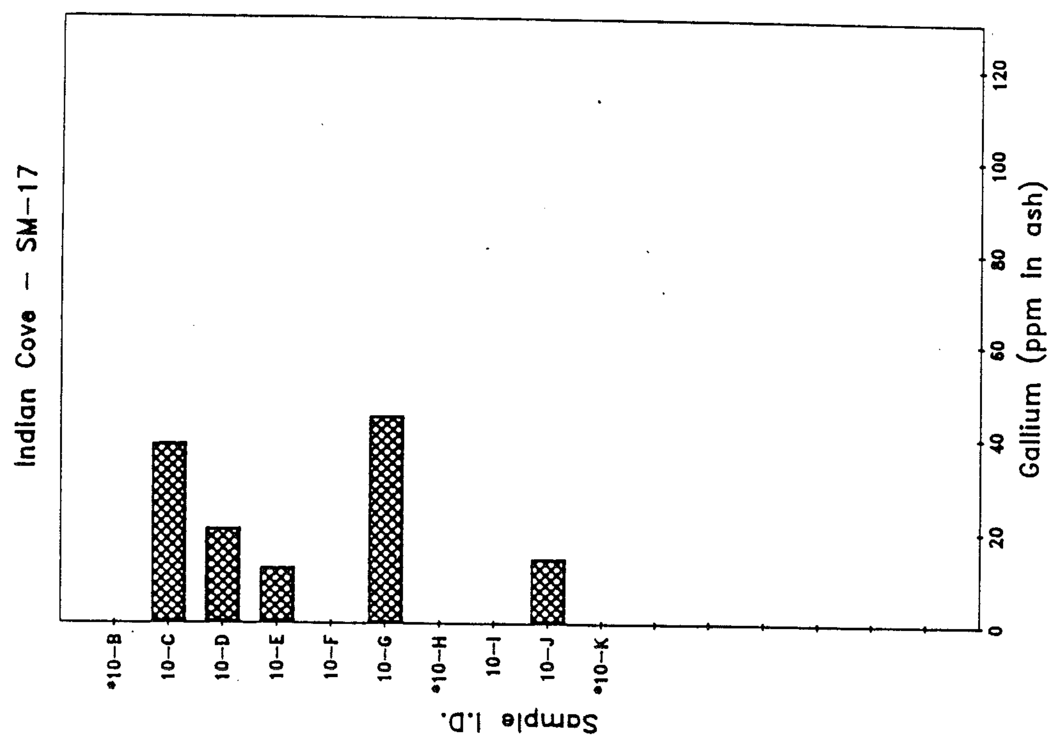

Harbour Seam - Novaco
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*01-D
01-E
01-F
01-G
01-H
01-I
01-J
*01-K
01-L
01-M
01-N
01-O
01-P
01-Q
*01-R

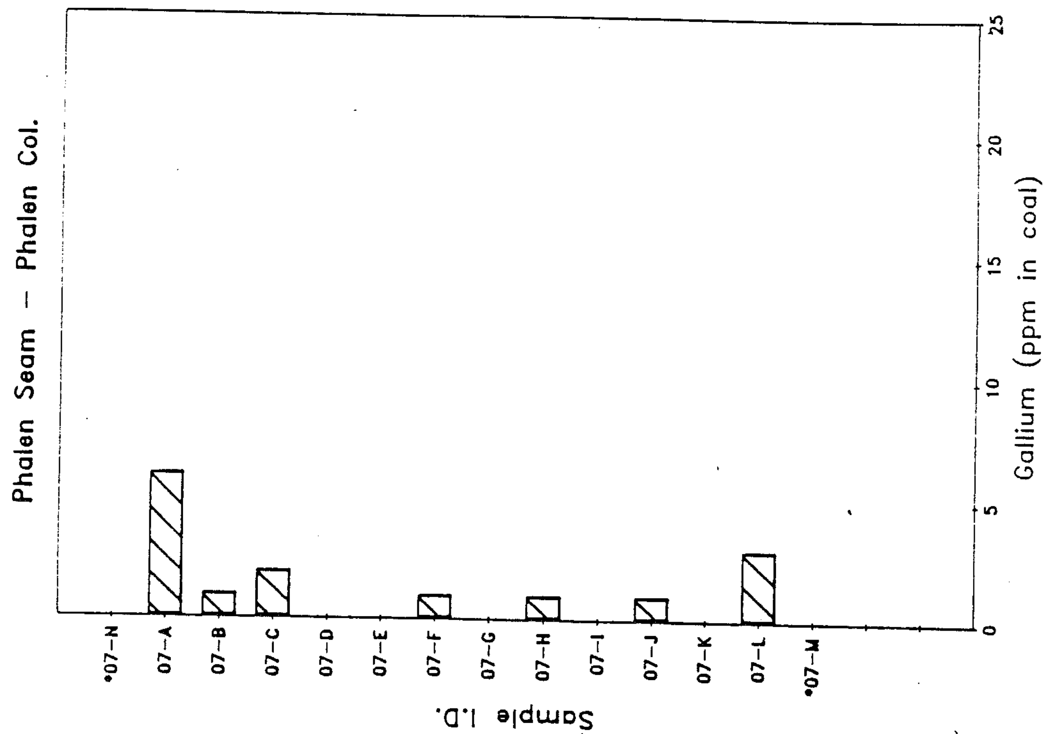

Harbour Seam - Novaco
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*01-D
01-E
01-F
01-G
01-H
01-I
01-J
*01-K
01-L
01-M
01-N
01-O
01-P
01-Q
*01-R

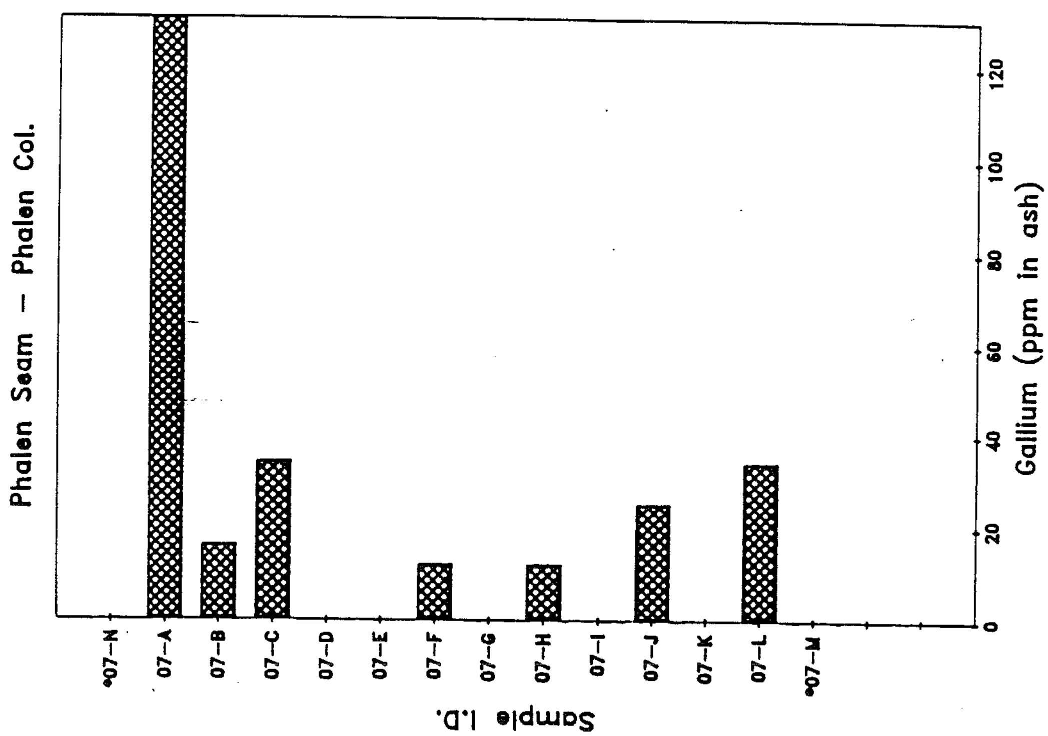

Harbour Seam – Lingan
Ga (ppm in coal)
0
5
10
15
20
25
Sample I.D.
90-O
90-A
90-B
90-C
90-D
90-E
90-F
90-G
90-H
90-I
90-J
90-K
90-L
90-M
90-N

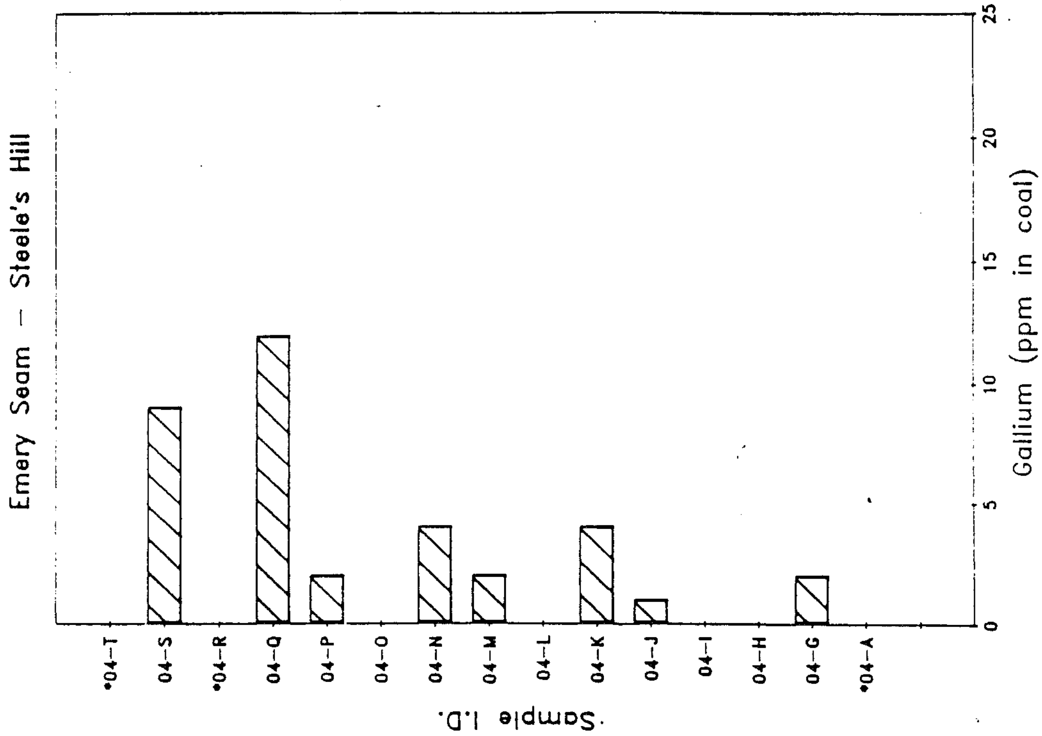

Harbour Seam – Lingan
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
90-O
90-A
90-B
90-C
90-D
90-E
90-F
90-G
90-H
90-I
90-J
90-K
90-L
90-M
90-N

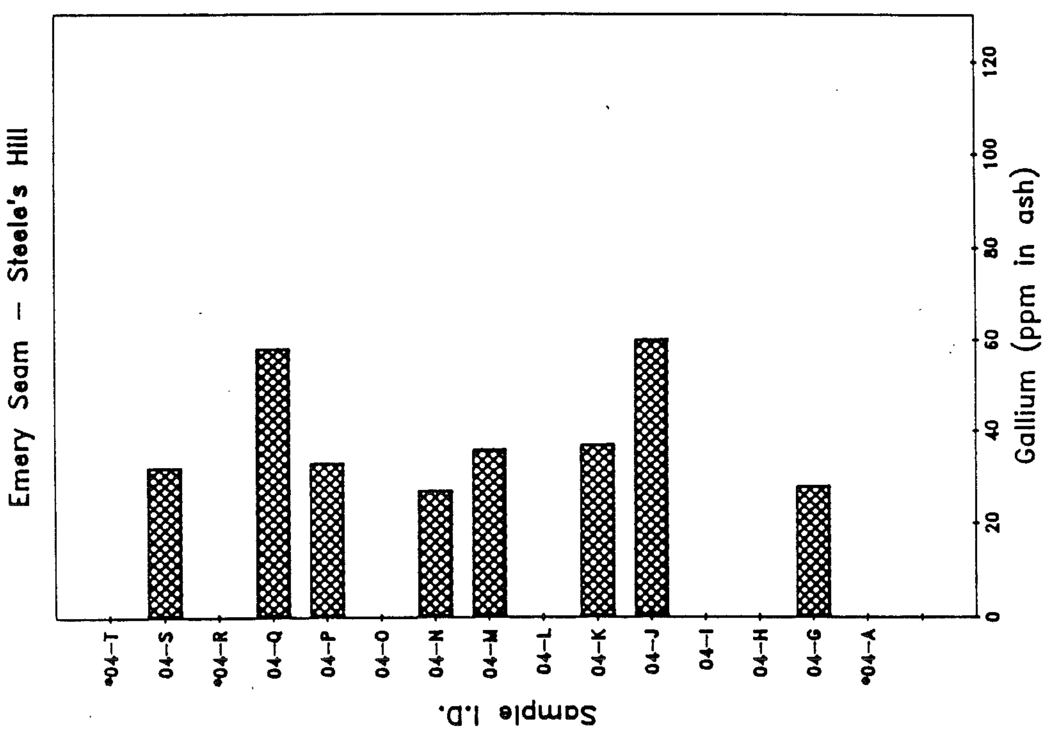

Indian Cove - SM-17
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*10-B
10-C
10-D
10-E
10-F
10-G
*10-H
10-I
10-J
*10-K

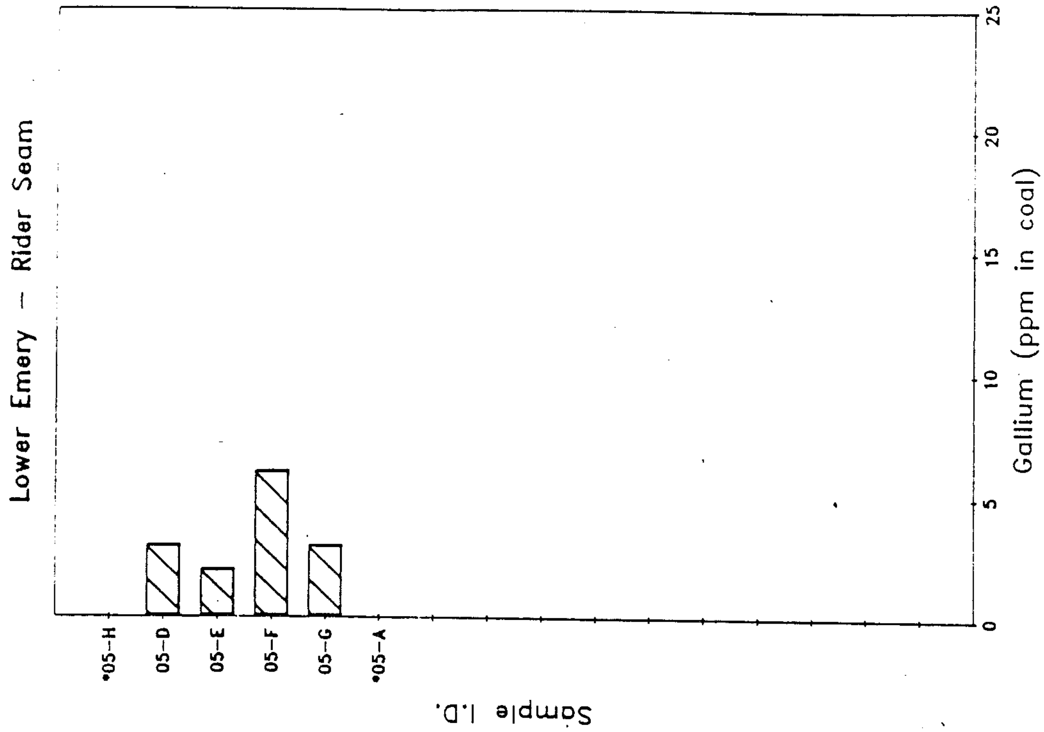

Indian Cove - SM-17
Gallium (ppm In ash)
0
20
40
60
80
100
120
Sample I.D.
*10-B
10-C
10-D
10-E
10-F
10-G
*10-H
10-I
10-J
*10-K

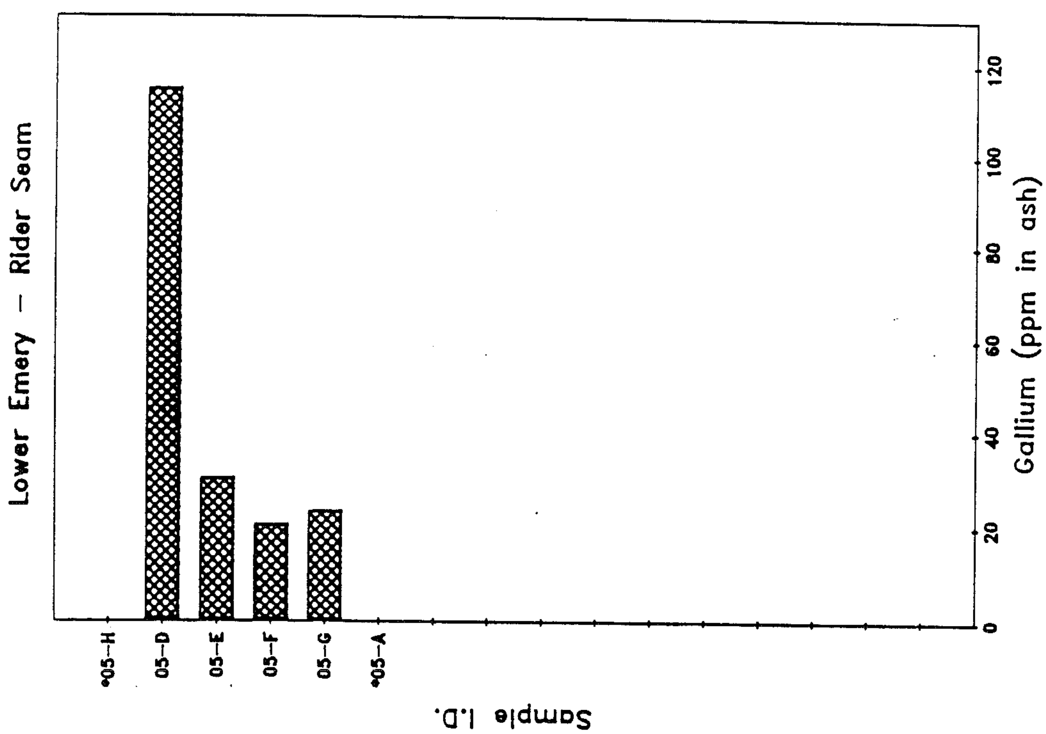

Phalen Seam – Phalen Col.
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*07–N
07–A
07–B
07–C
07–D
07–E
07–F
07–G
07–H
07–I
07–J
07–K
07–L
*07–M


Phalen Seam – Phalen Col.
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*07–N
07–A
07–B
07–C
07–D
07–E
07–F
07–G
07–H
07–I
07–J
07–K
07–L
*07–M

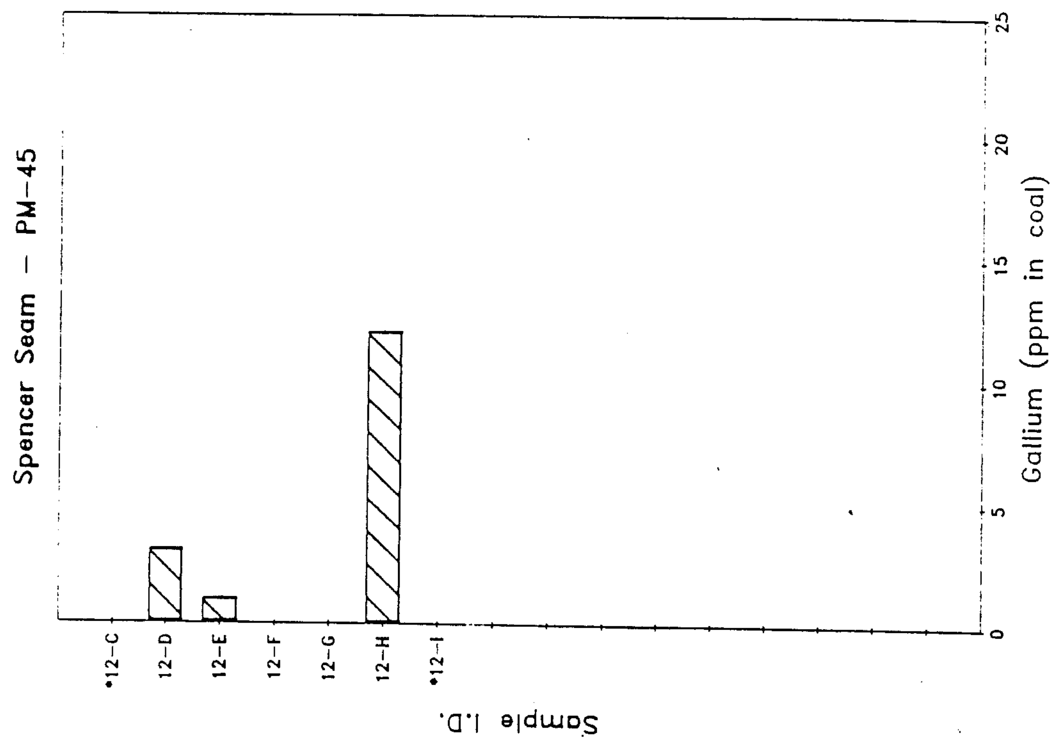

Emery Seam – Steele's Hill
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*04-T
04-S
*04-R
04-Q
04-P
04-O
04-N
04-M
04-L
04-K
04-J
04-I
04-H
04-G
*04-A

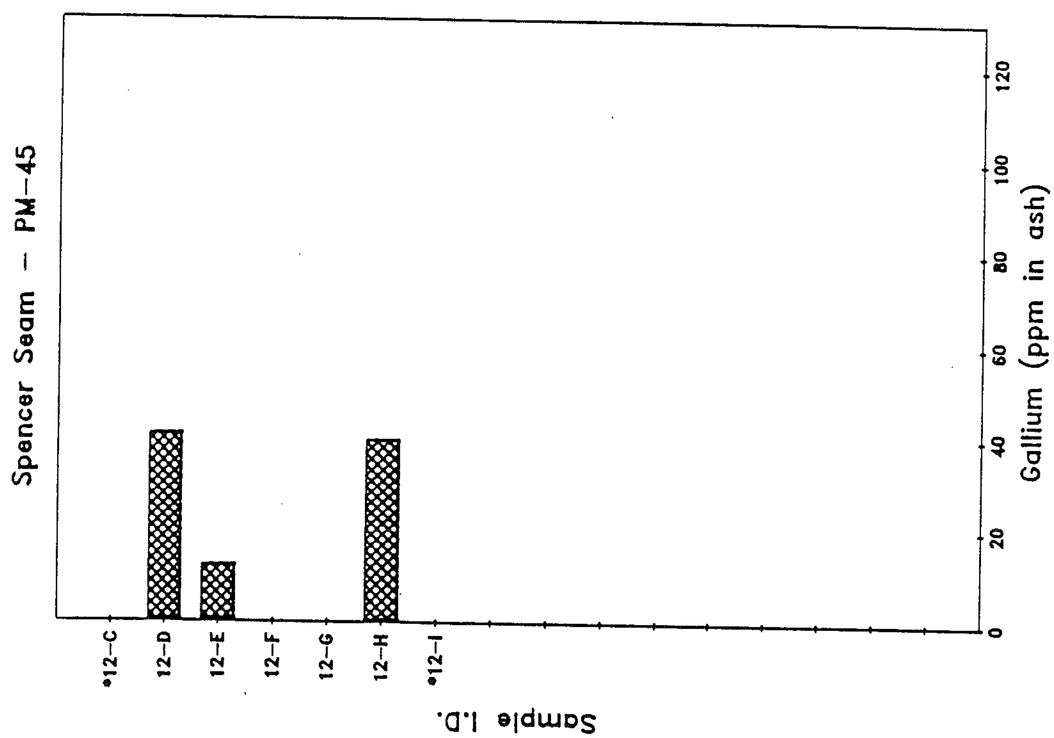

Emery Seam – Steele's Hill
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*04-T
04-S
*04-R
04-Q
04-P
04-O
04-N
04-M
04-L
04-K
04-J
04-I
04-H
04-G
*04-A


Lower Emery – Rider Seam
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
*05-H
05-D
05-E
05-F
05-G
*05-A

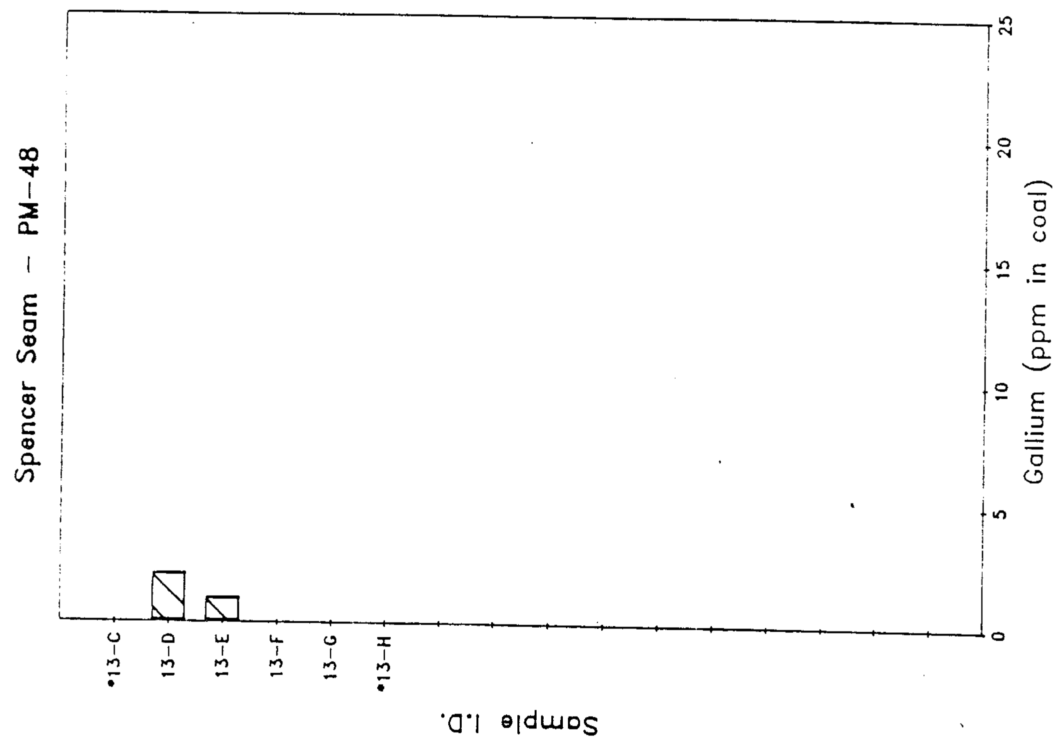

Lower Emery – Rider Seam
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
*05-H
05-D
05-E
05-F
05-G
*05-A

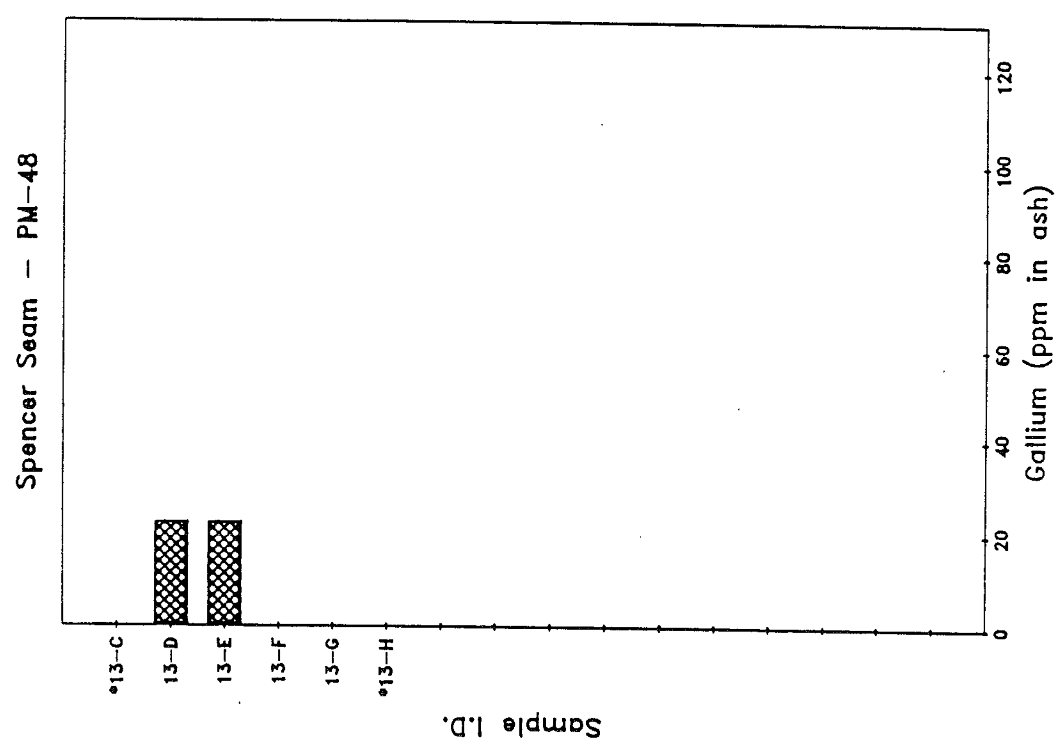
APPENDIX II (B)

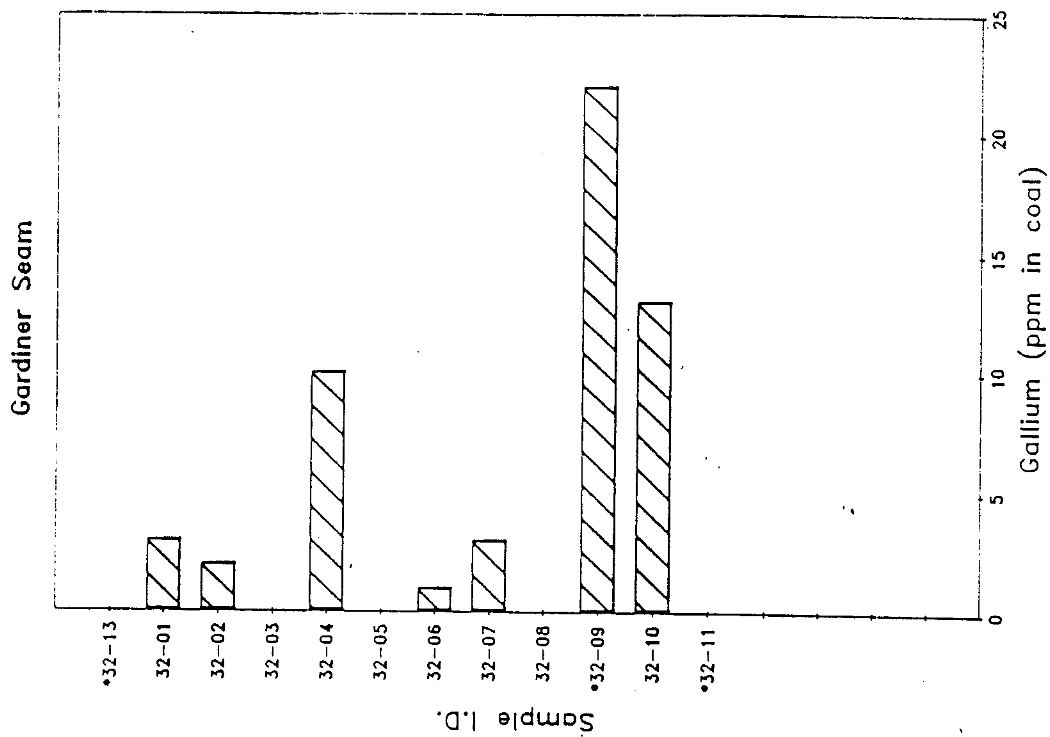


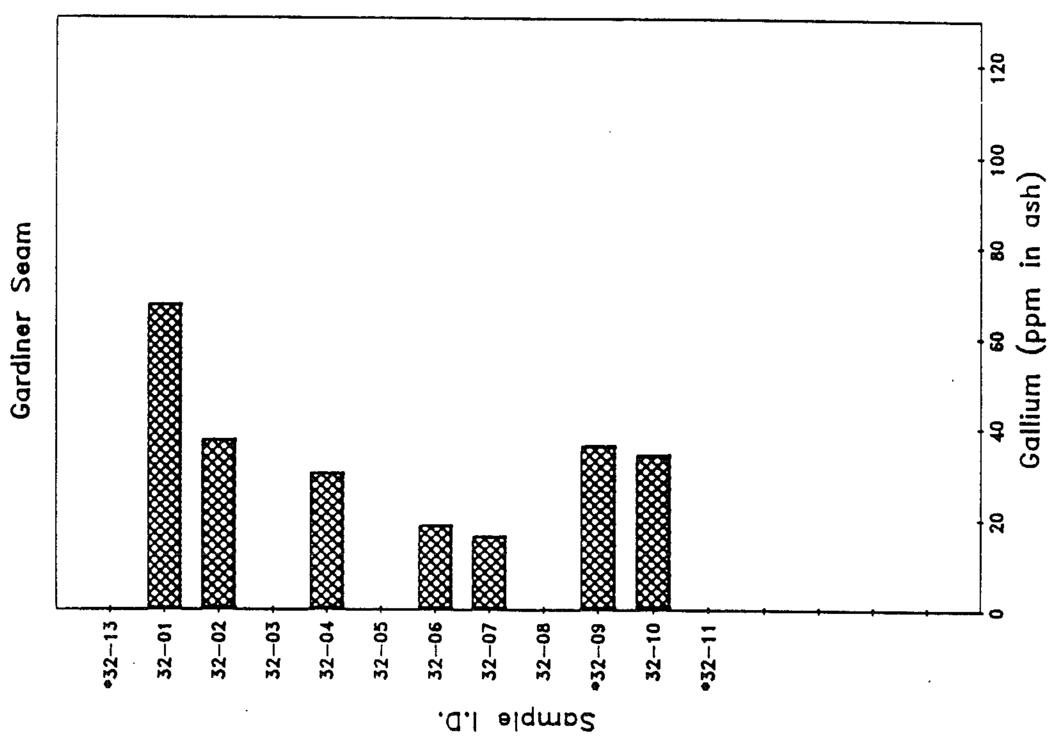


APPENDIX II (B)

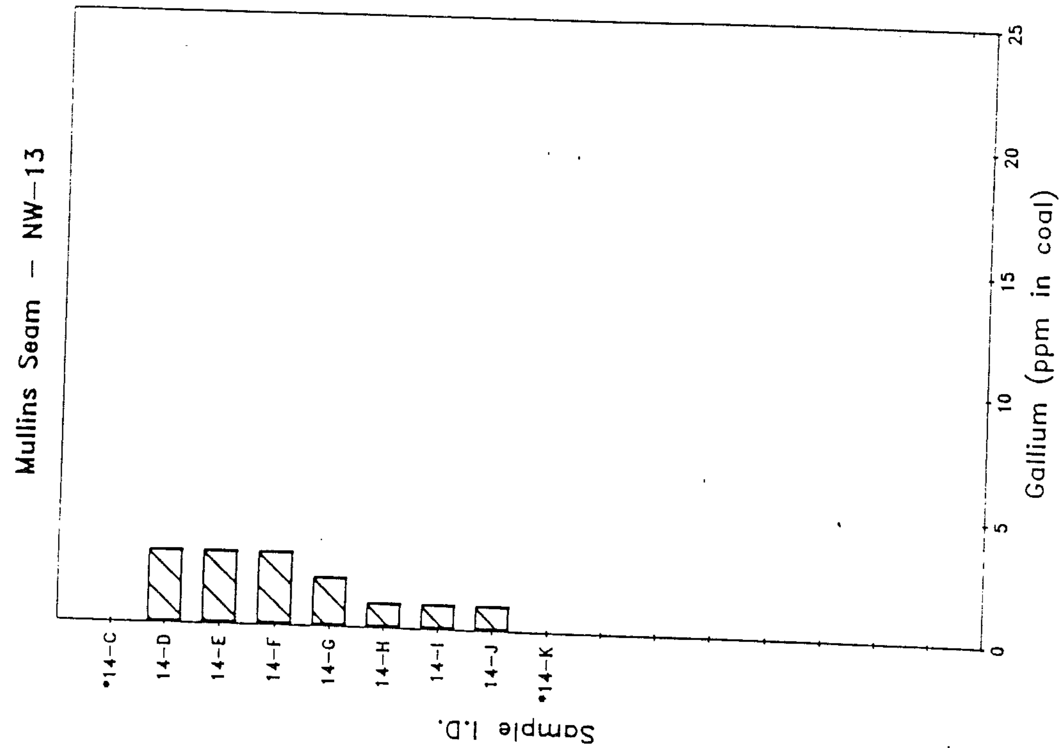


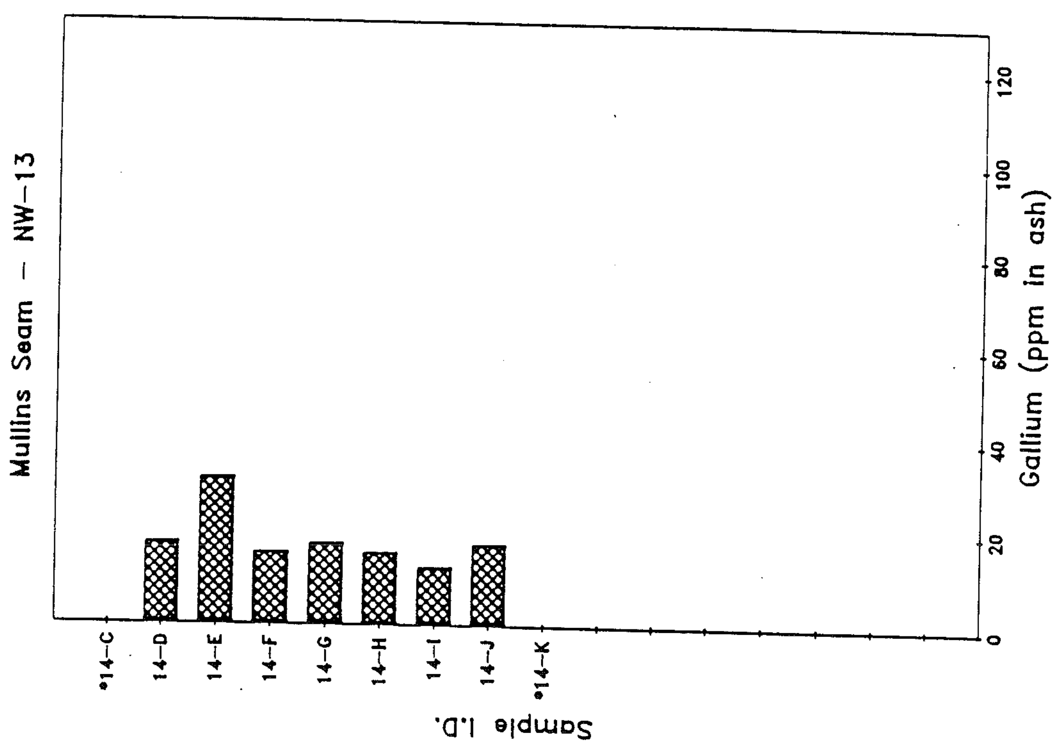


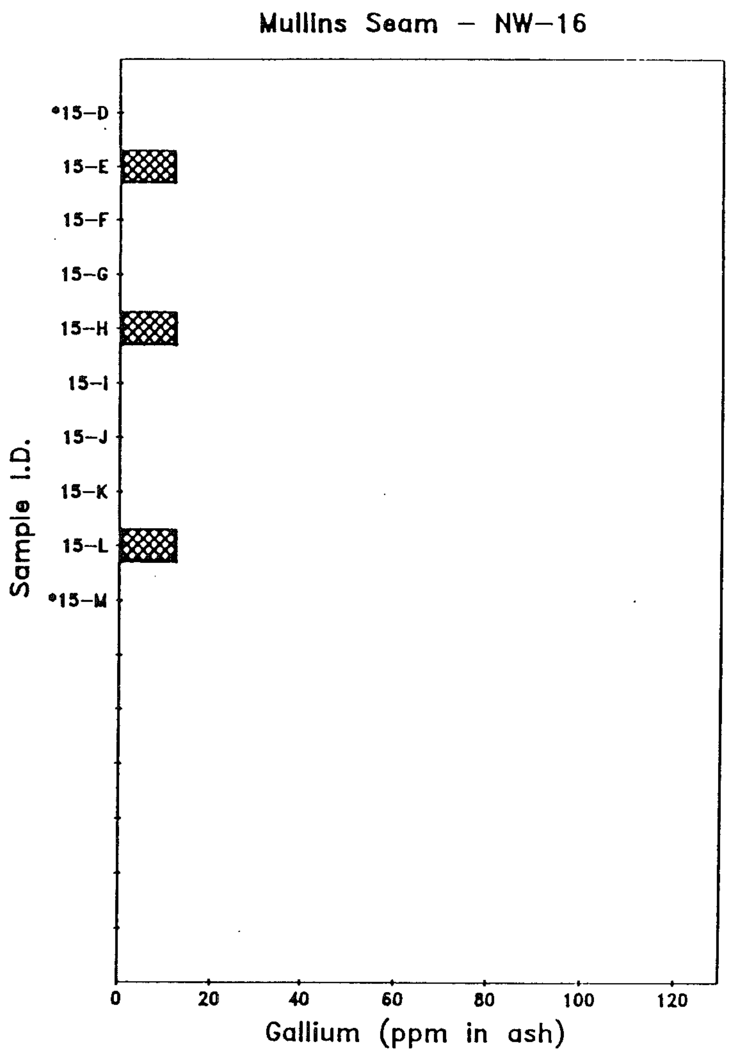

Gardiner Seam
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
•32-13
32-01
32-02
32-03
32-04
32-05
32-06
32-07
32-08
•32-09
32-10
•32-11

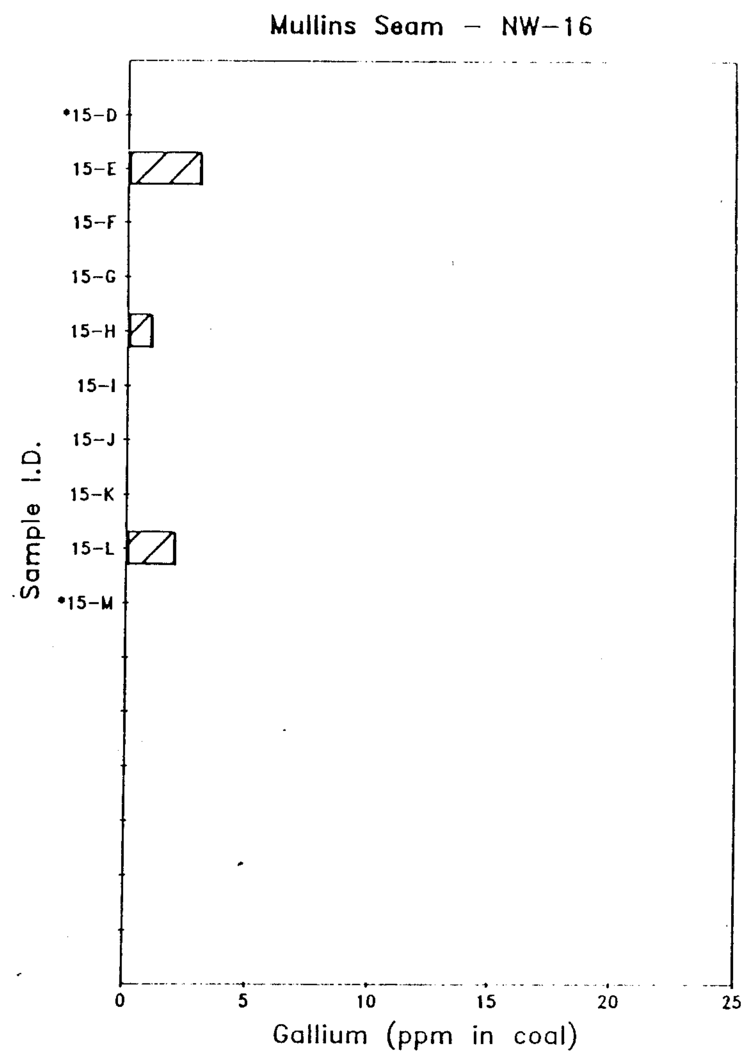

Gardiner Seam
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
•32-13
32-01
32-02
32-03
32-04
32-05
32-06
32-07
32-08
•32-09
32-10
•32-11

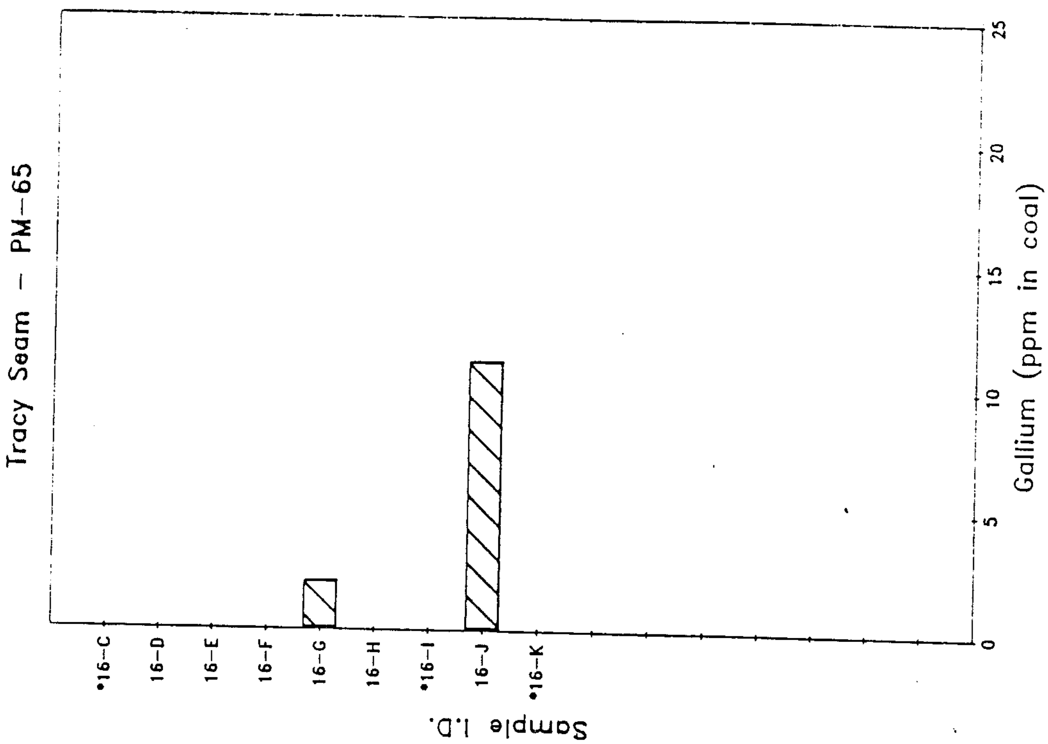
APPENDIX II (B)

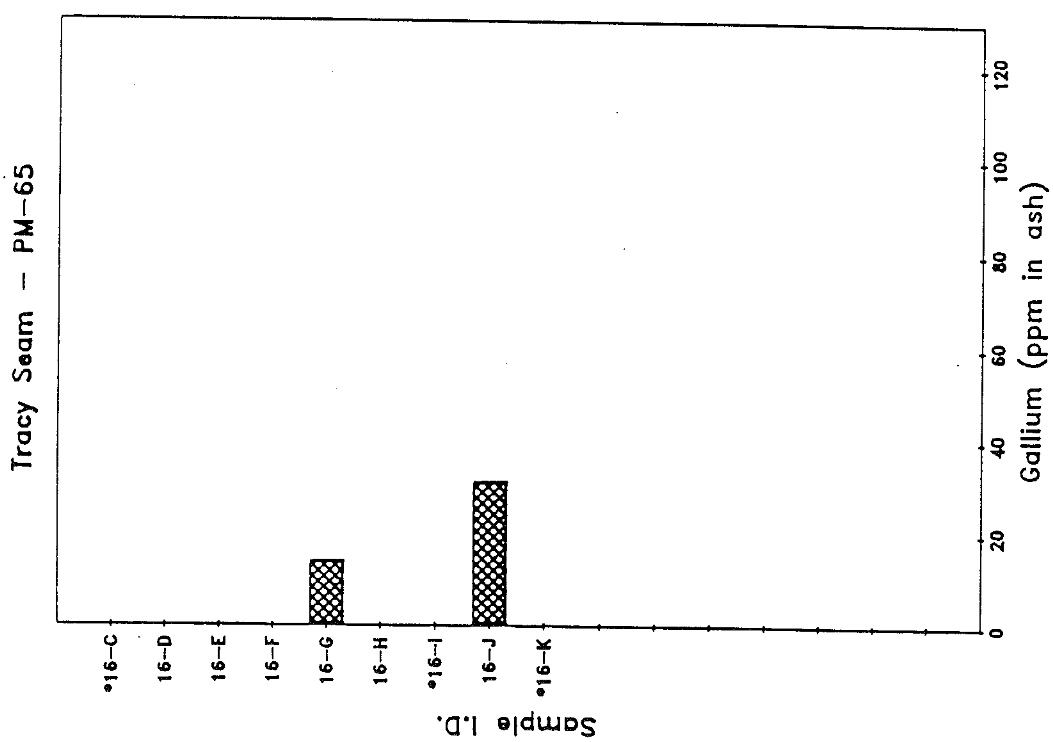


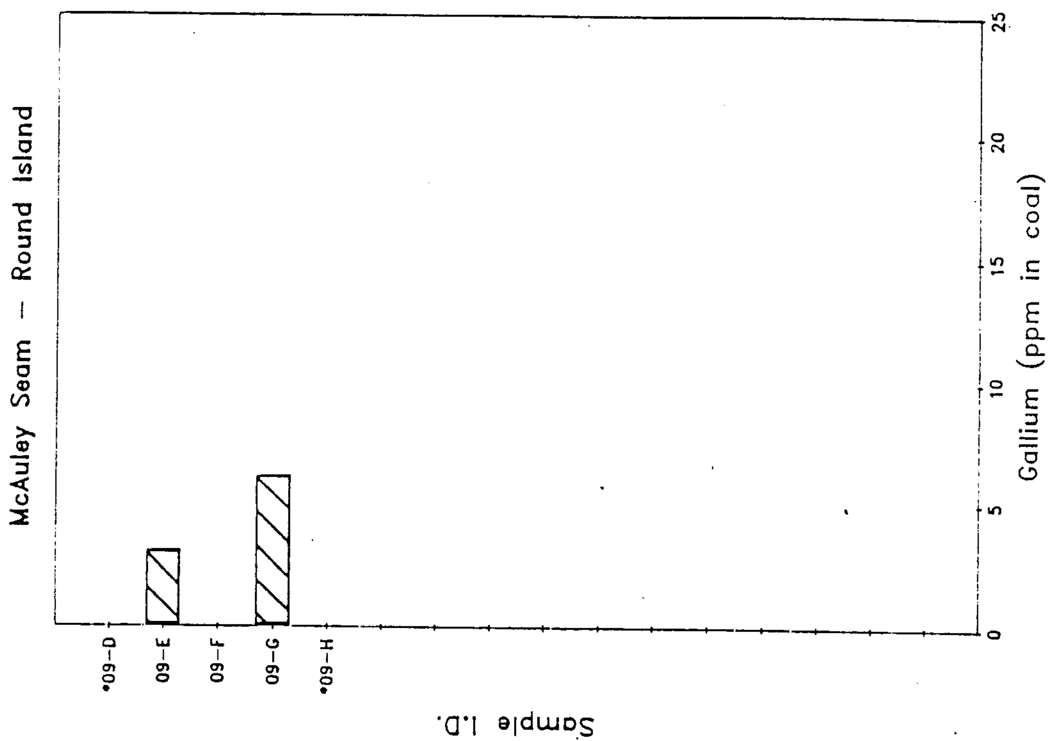


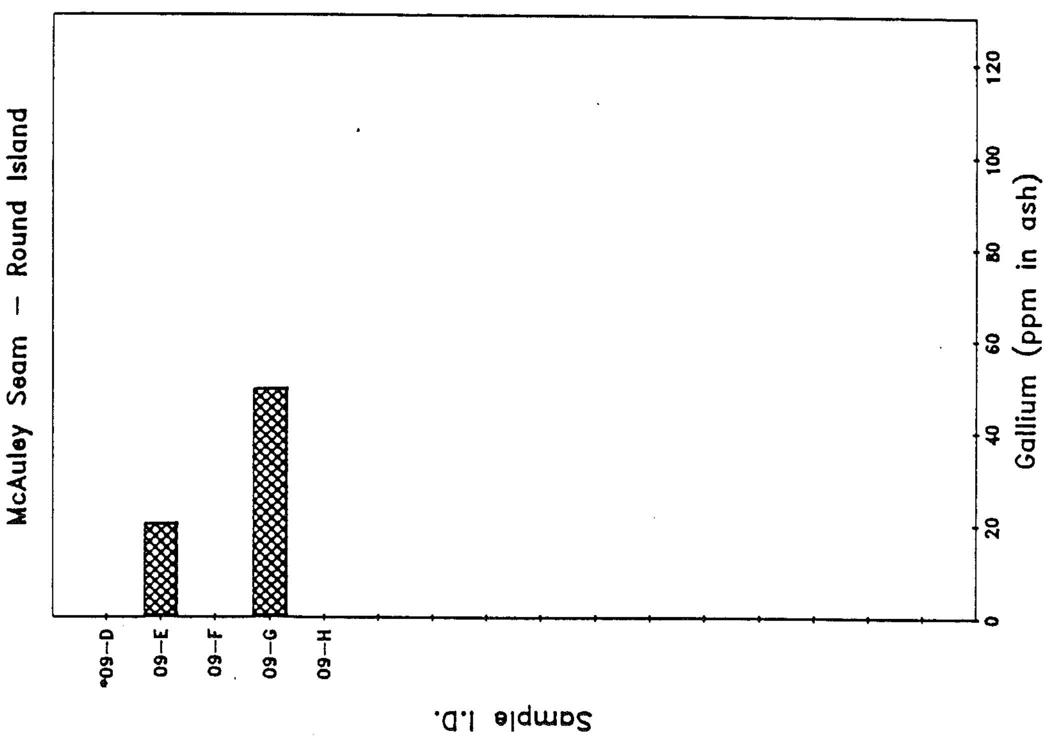

Mullins Seam – NW-16
•15-D
15-E
15-F
15-G
15-H
15-I
15-J
15-K
15-L
•15-M
Sample I.D.
0
20
40
60
80
100
120
Gallium (ppm in ash)


Mullins Seam – NW-16
•15-D
15-E
15-F
15-G
15-H
15-I
15-J
15-K
15-L
•15-M
Sample I.D.
0
5
10
15
20
25
Gallium (ppm in coal)


Tracy Seam - PM-65
Gallium (ppm in coal)
0
5
10
15
20
25
Sample I.D.
•16-C
16-D
16-E
16-F
16-G
16-H
•16-I
16-J
•16-K


Tracy Seam - PM-65
Gallium (ppm in ash)
0
20
40
60
80
100
120
Sample I.D.
•16-C
16-D
16-E
16-F
16-G
16-H
•16-I
16-J
•16-K

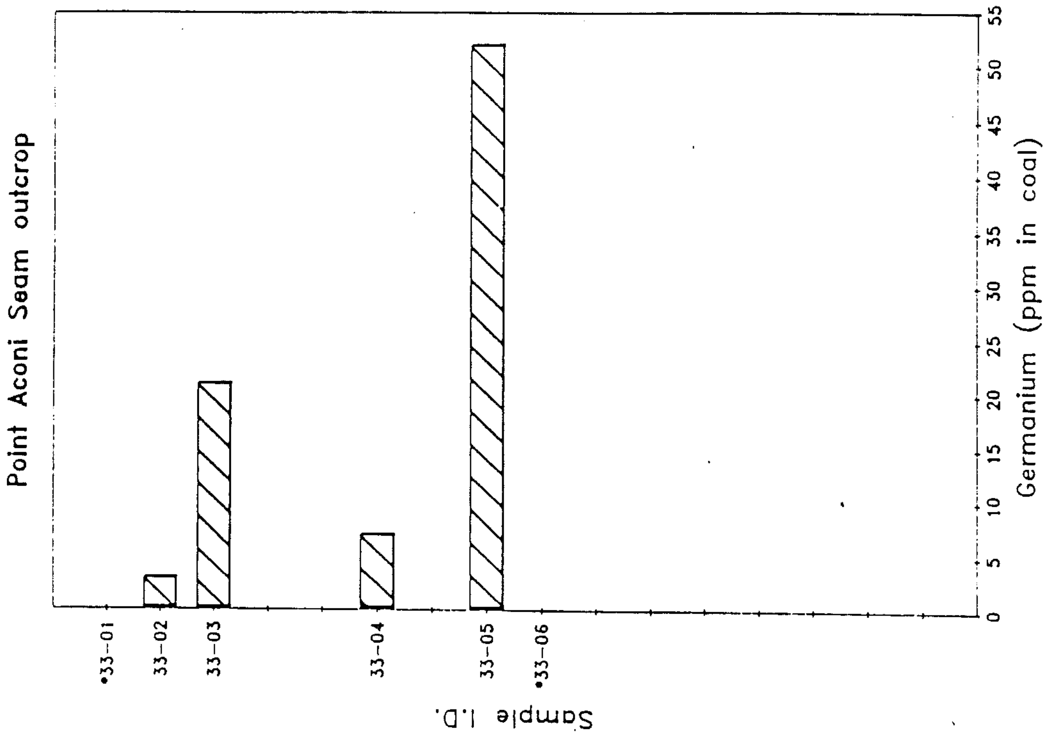

McAuley Seam — Round Island
Gallium (ppm in coal)
0
5
10
15
20
25
•09-D
09-E
09-F
09-G
•09-H
Sample I.D.

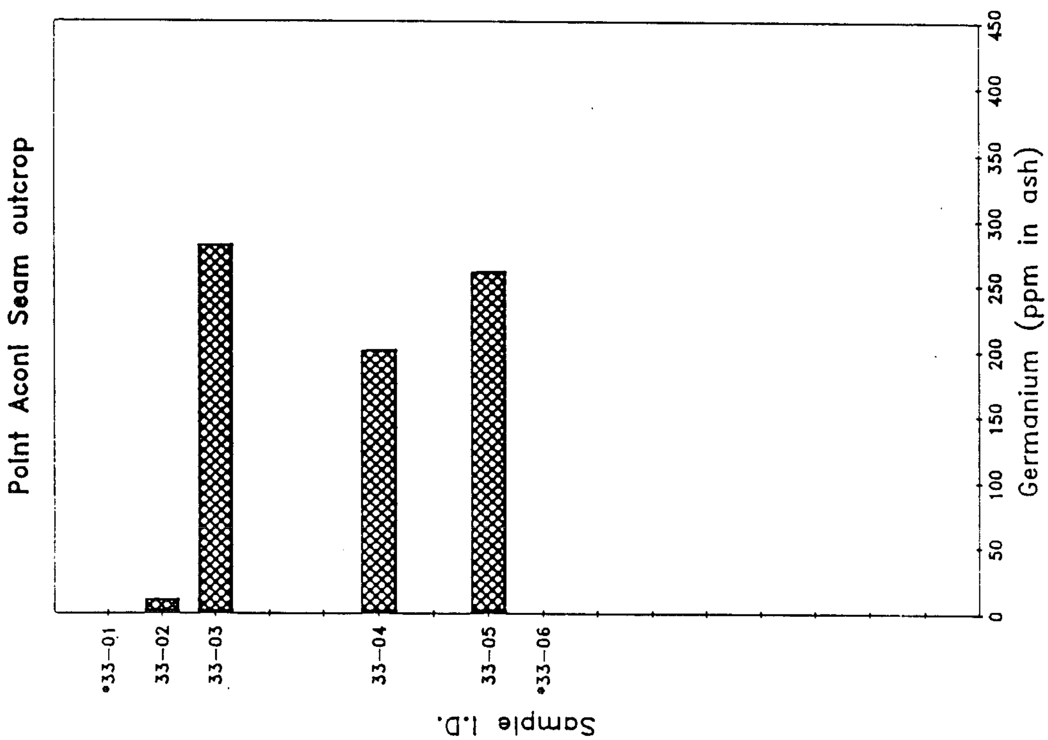

McAuley Seam — Round Island
Gallium (ppm in ash)
0
20
40
60
80
100
120
•09-D
09-E
09-F
09-G
09-H
Sample I.D.

APPENDIX II (C)

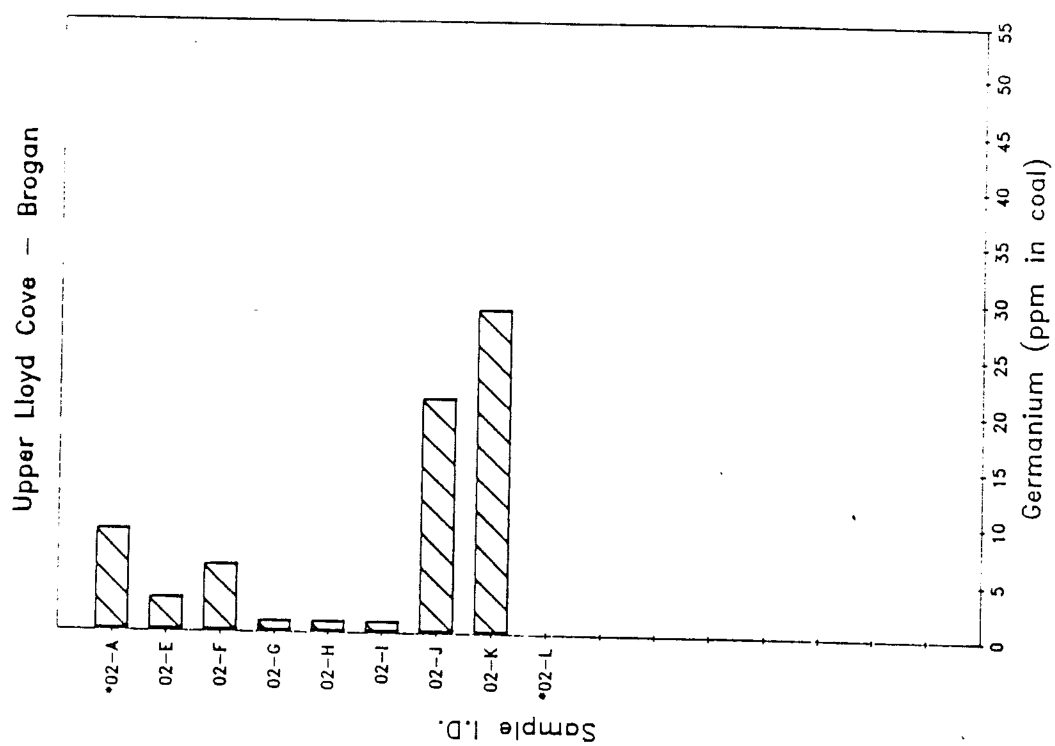
GERMANIUM CONCENTRATIONS WITHIN SEAMS

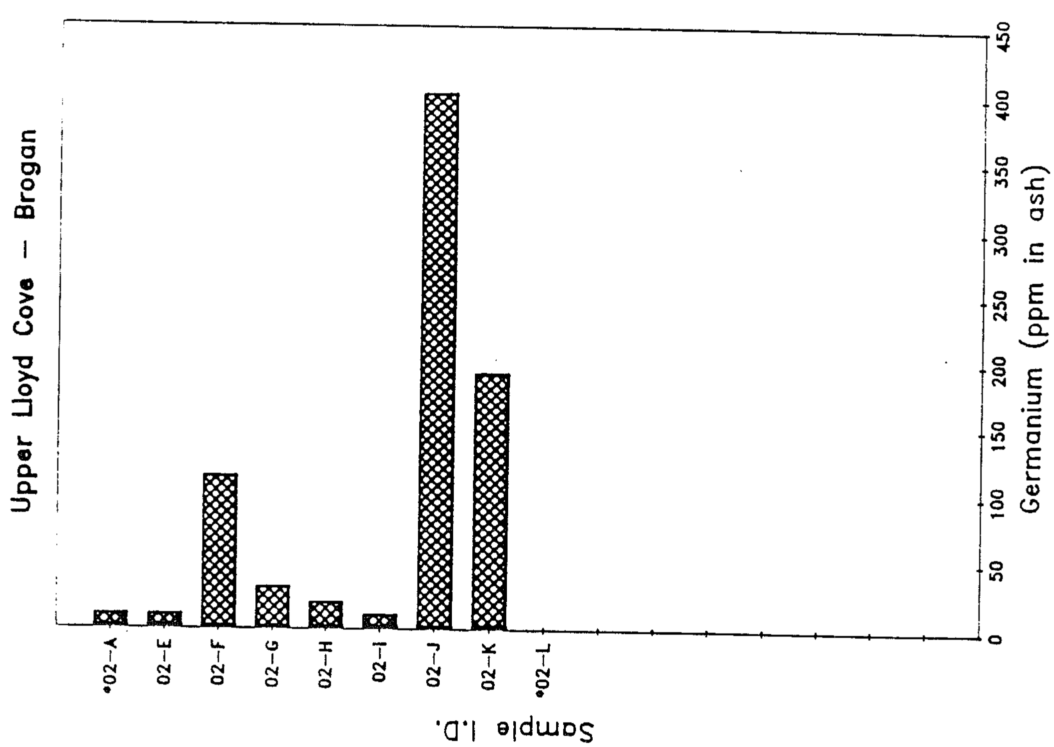
- Point Aconi Seam
- Lloyd Cove Upper Seam (Brogan)
- Lloyd Cove Lower Seam (Brogan
- Hub Seam (Prince)
- Harbour Seam (Novaco)
- Harbour Seam (Lingan)
- Indian Cove (NSDME CORE SM-17)
- Indian Cove (NSDME CORE SM-18)
- Phalen Seam (Phalen Colliery)
- Emery Seam (Steele's Hill)
- Thin seam directly below Emery Seam (Rider/Steele's Hill)
- Spencer Seam (NSDME CORE PM-45)
- Spencer Seam (NSDME CORE PM-48)
- Gardiner Seam
- Mullins Seam (NSDME CORE NW-13)
- Mullins Seam (NSDME CORE NW-16)
- Tracy Seam (NSDME CORE PM-65)
- McAuley Seam (Near Round Island)

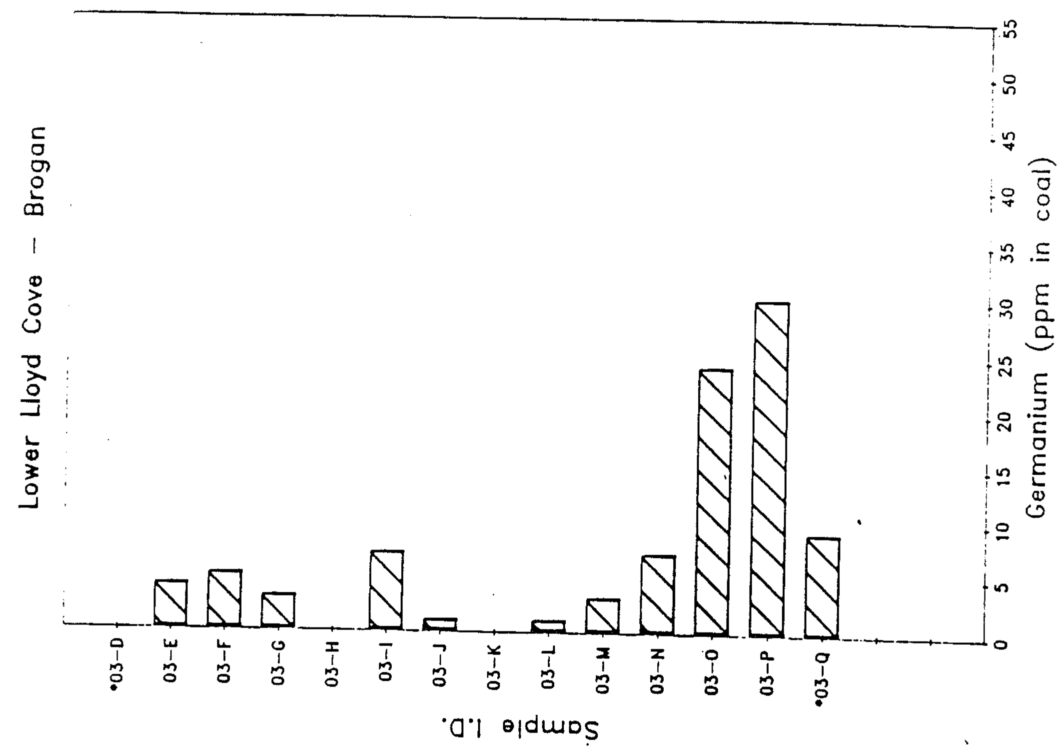

Point Aconi Seam outcrop
Germanium (ppm in coal)
0
5
10
15
20
25
30
35
40
45
50
55
Sample I.D.
•33-01
33-02
33-03
33-04
33-05
•33-06

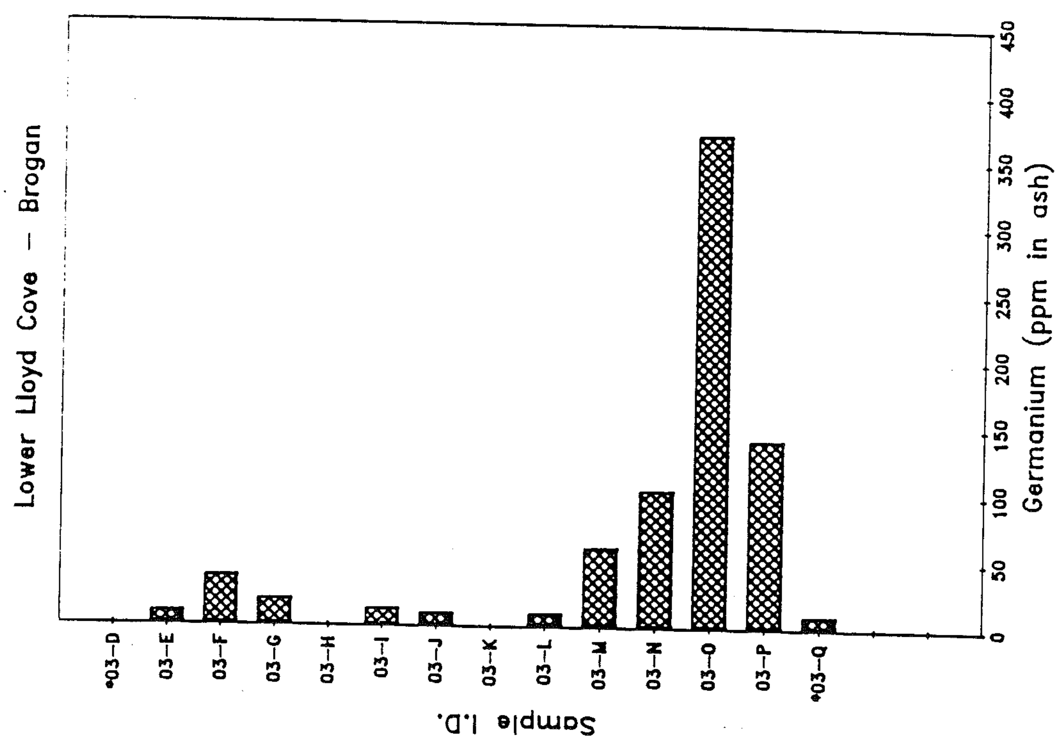

Point Aconi Seam outcrop
Germanium (ppm in ash)
0
50
100
150
200
250
300
350
400
450
Sample I.D.
•33-01
33-02
33-03
33-04
33-05
•33-06

APPENDIX II (C)

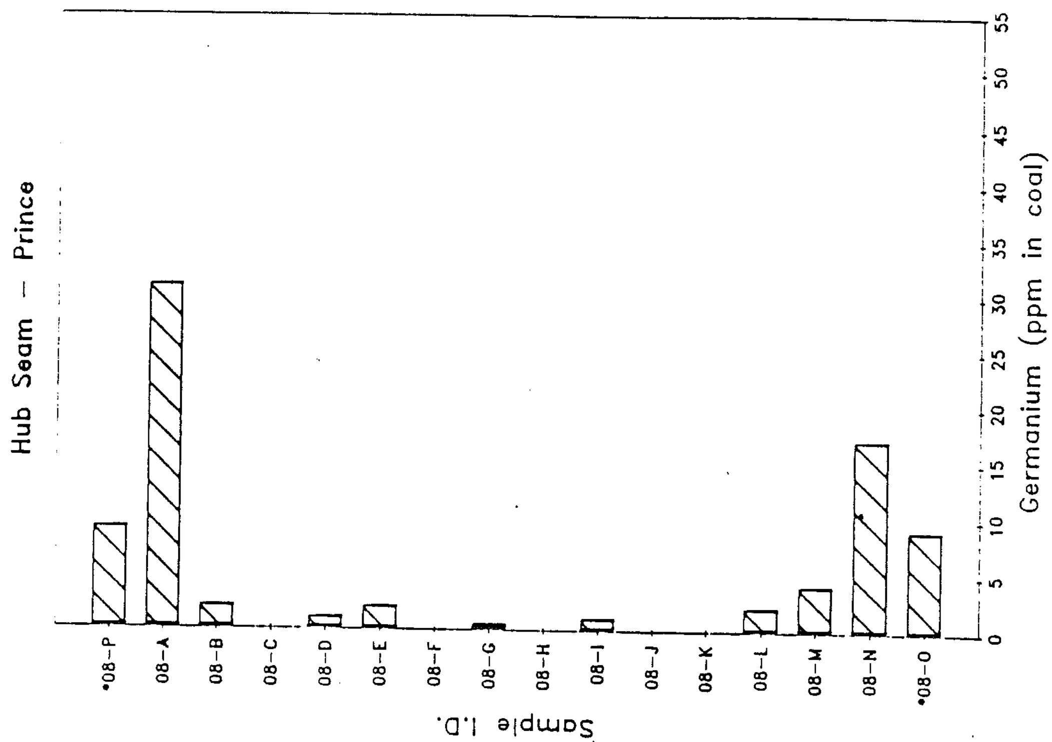


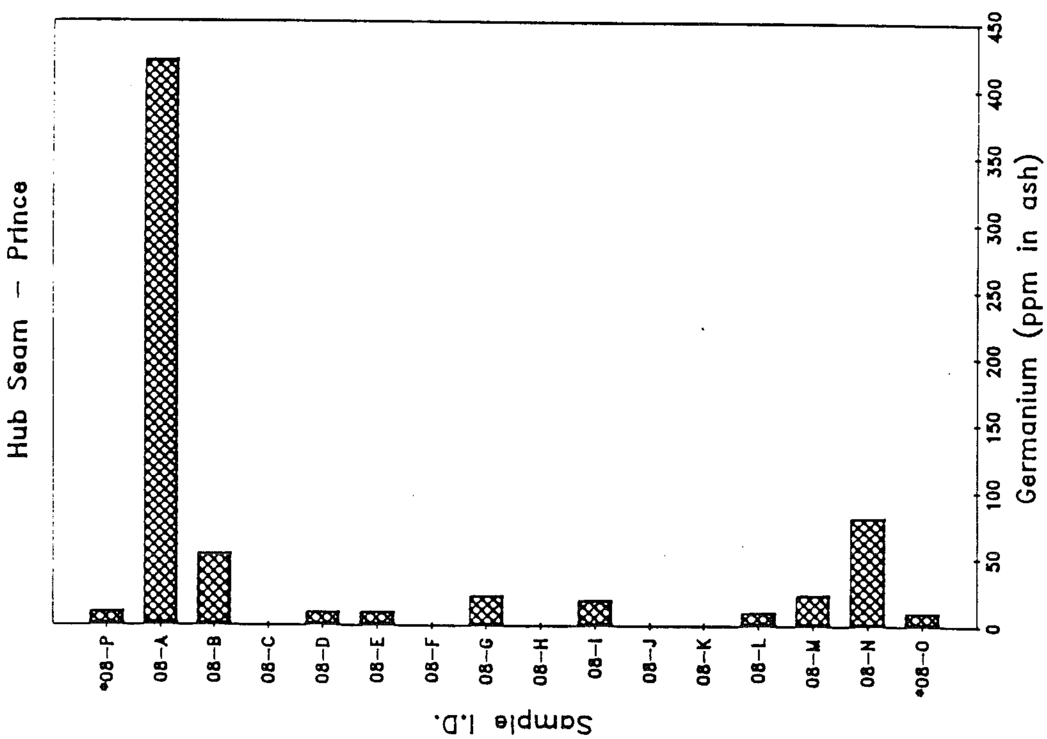


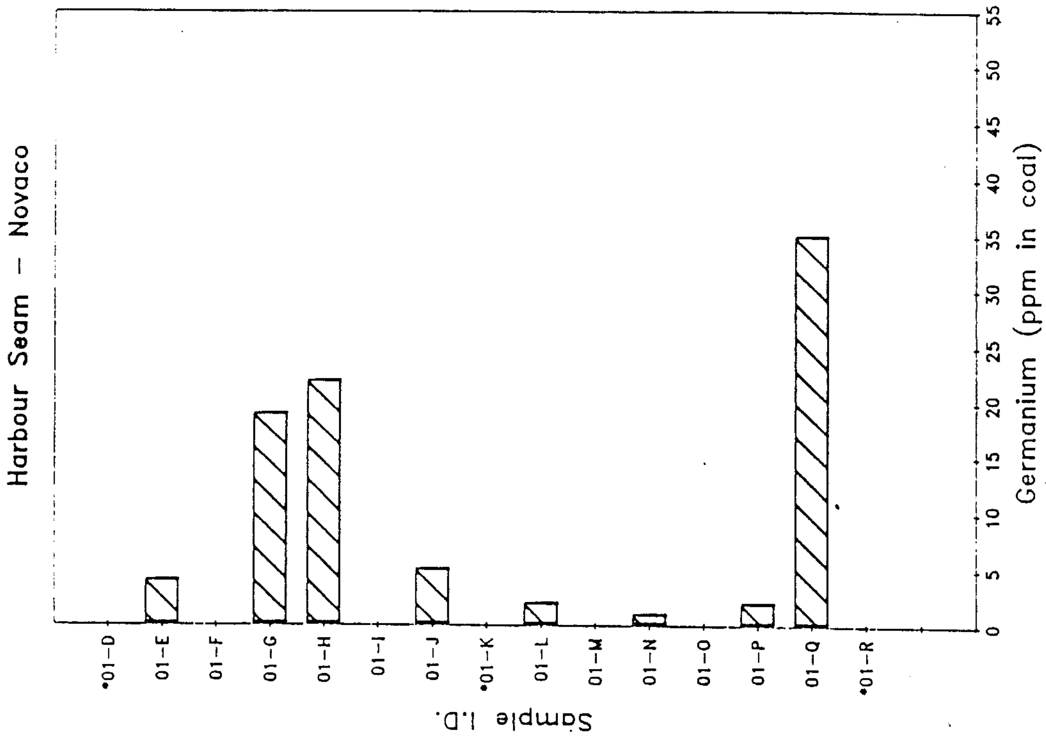

Lower Lloyd Cove — Brogan
Germanium (ppm in coal)
0
5
10
15
20
25
30
35
40
45
50
55
Sample I.D.
*03-D
03-E
03-F
03-G
03-H
03-I
03-J
03-K
03-L
03-M
03-N
03-O
03-P
*03-Q

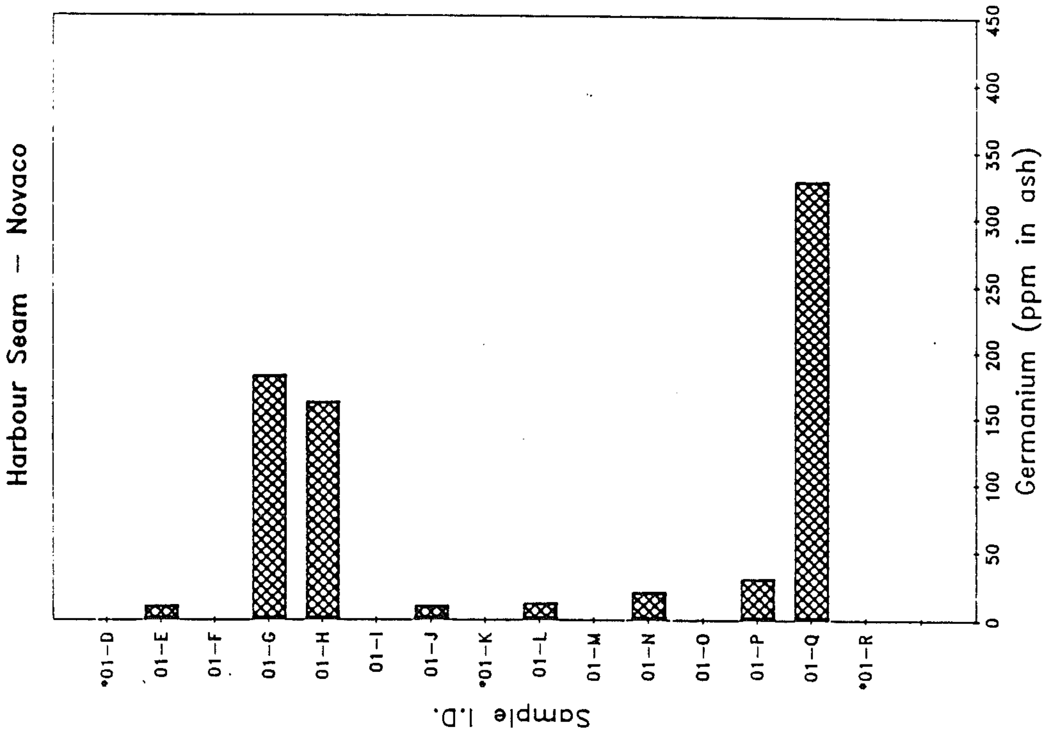

Lower Lloyd Cove — Brogan
Germanium (ppm in ash)
0
50
100
150
200
250
300
350
400
450
Sample I.D.
*03-D
03-E
03-F
03-G
03-H
03-I
03-J
03-K
03-L
03-M
03-N
03-O
03-P
*03-Q

APPENDIX II (C)

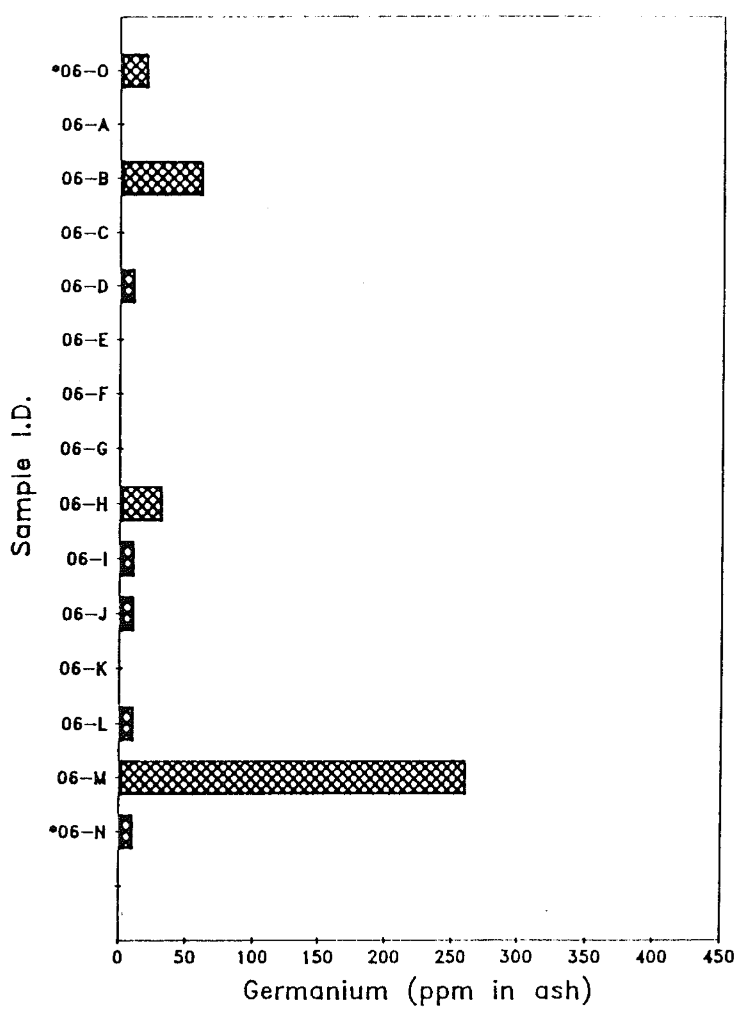




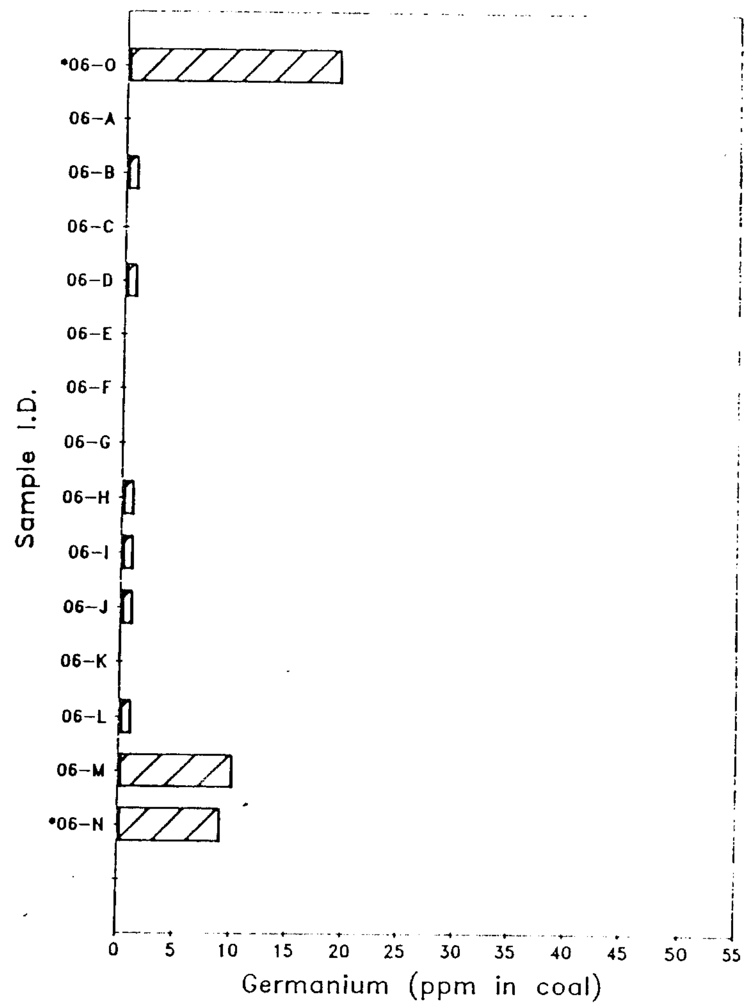

Harbour Seam – Novaco
Germanium (ppm in coal)
0 5 10 15 20 25 30 35 40 45 50 55
Sample I.D.
•01-D
01-E
01-F
01-G
01-H
01-I
01-J
•01-K
01-L
01-M
01-N
01-O
01-P
01-Q
•01-R

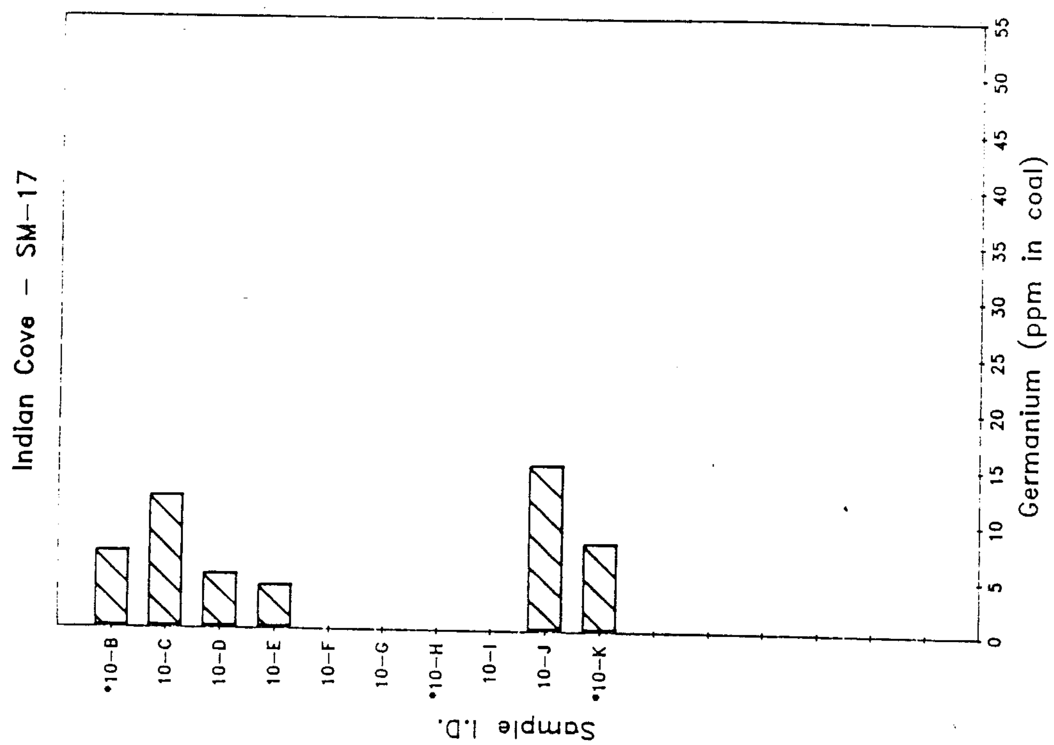

Harbour Seam – Novaco
Germanium (ppm in ash)
0 50 100 150 200 250 300 350 400 450
Sample I.D.
•01-D
01-E
01-F
01-G
01-H
01-I
01-J
•01-K
01-L
01-M
01-N
01-O
01-P
01-Q
•01-R

Harbour Seam – Lingan

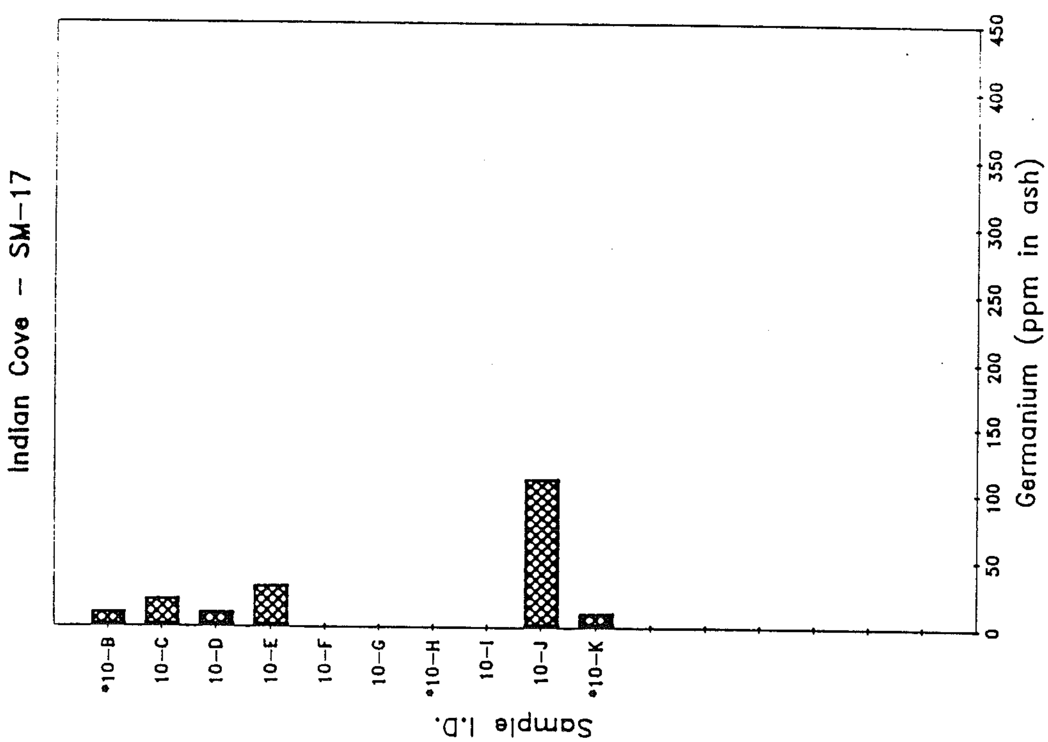


Harbour Seam – Lingan



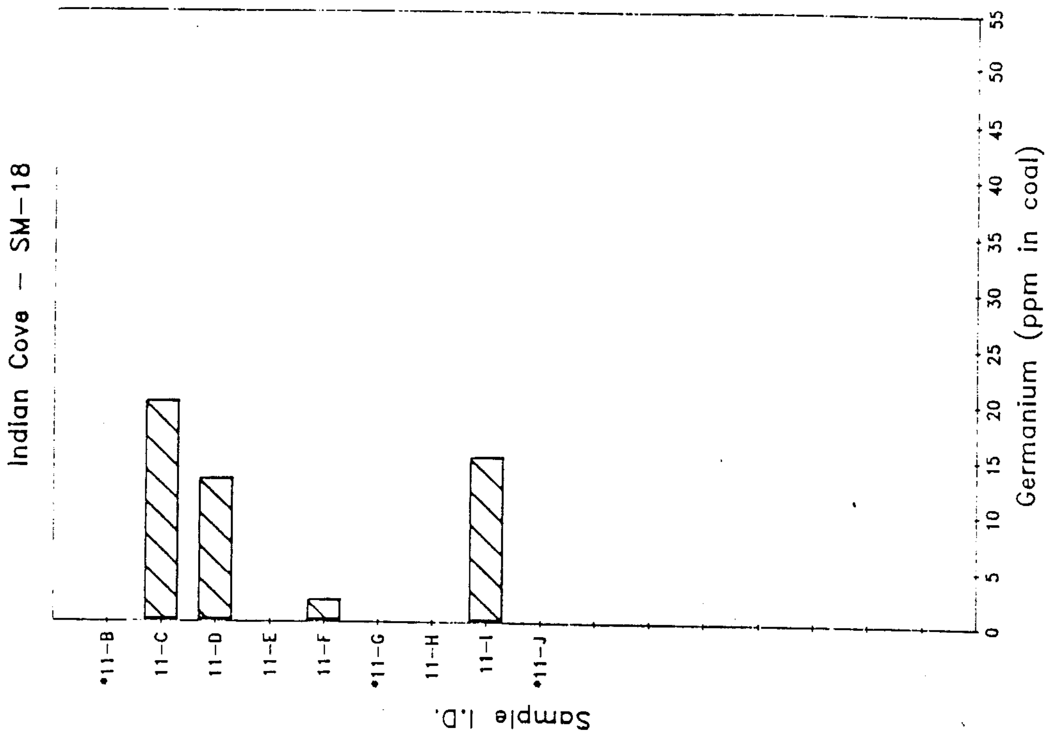


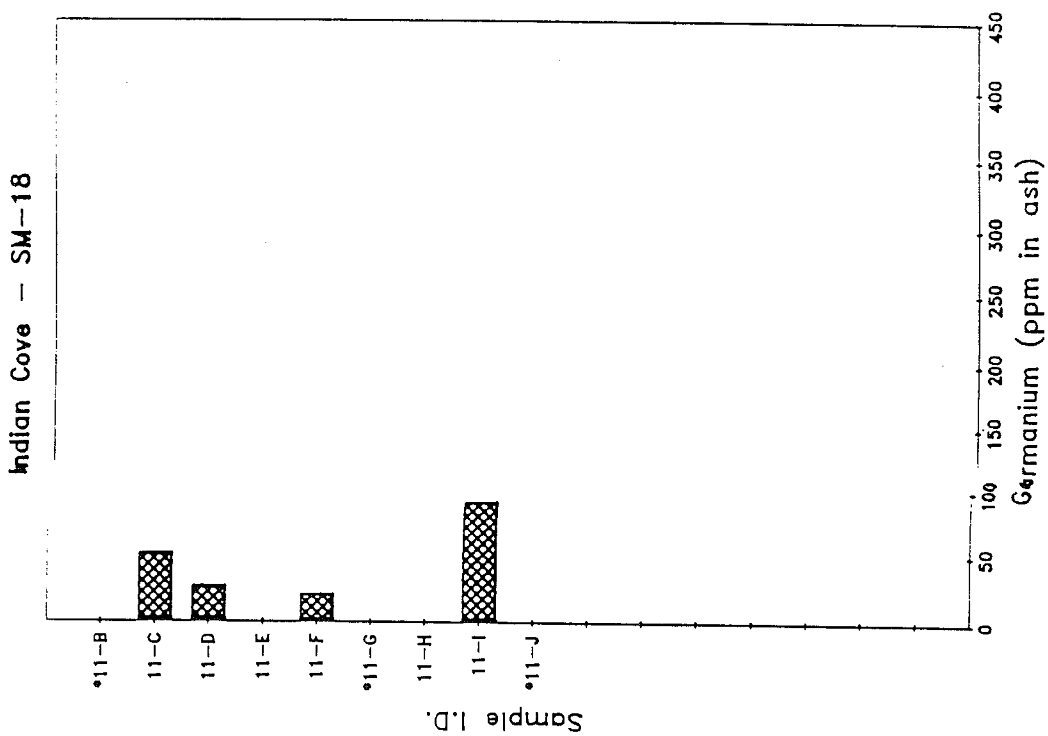
Indian Cove - SM-17
Germanium (ppm in coal)
0 5 10 15 20 25 30 35 40 45 50 55
Sample I.D.
*10-B
10-C
10-D
10-E
10-F
10-G
*10-H
10-I
10-J
*10-K



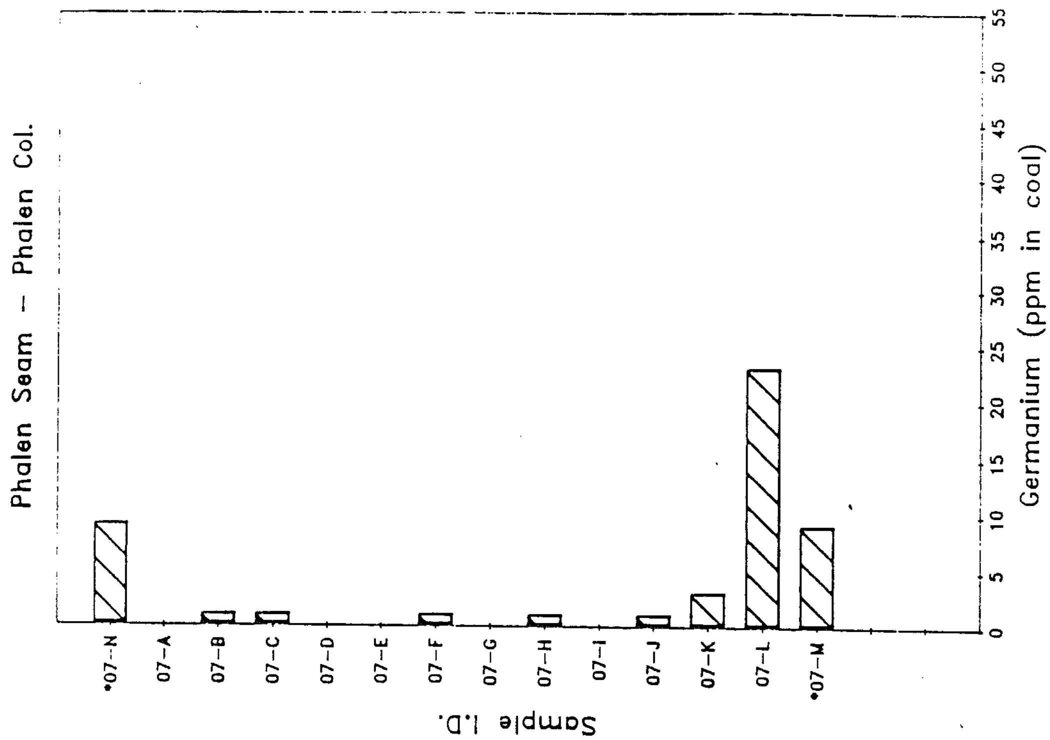
Indian Cove - SM-17
Germanium (ppm in ash)
0 50 100 150 200 250 300 350 400 450
Sample I.D.
*10-B
10-C
10-D
10-E
10-F
10-G
*10-H
10-I
10-J
*10-K

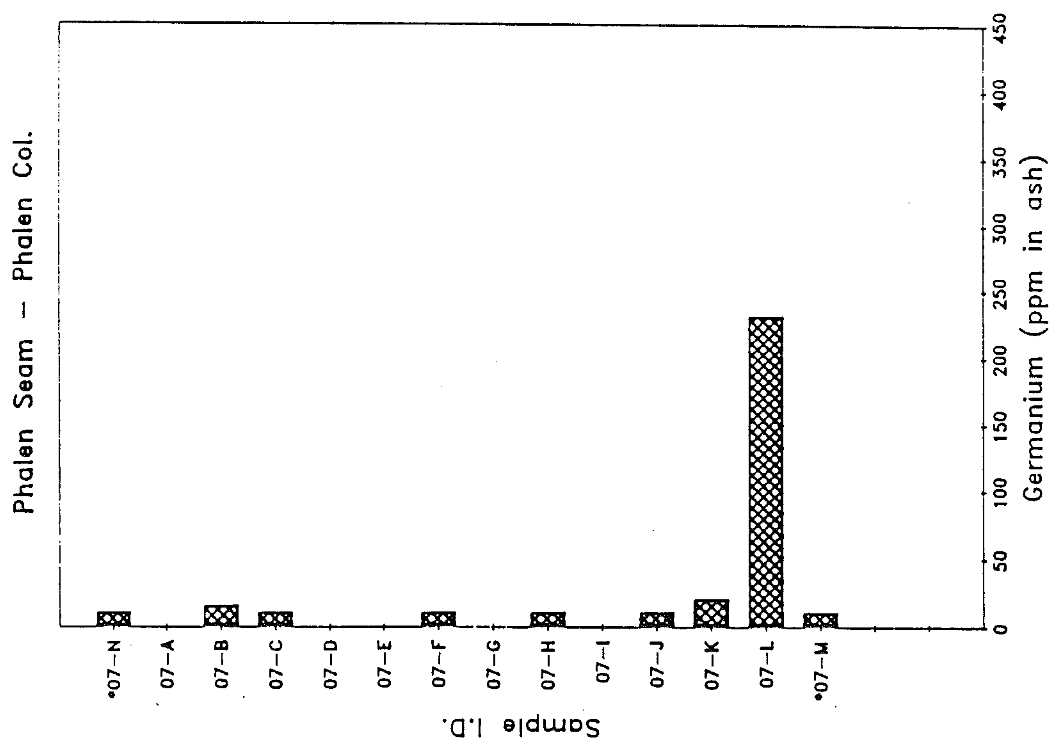
APPENDIX II (C)



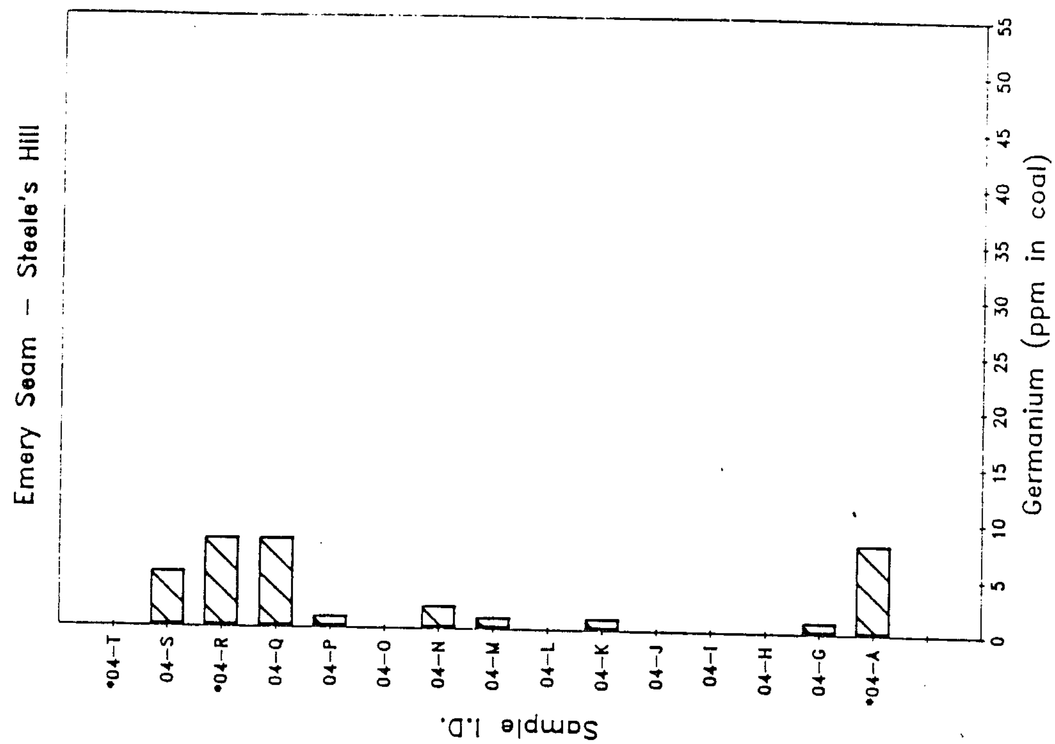


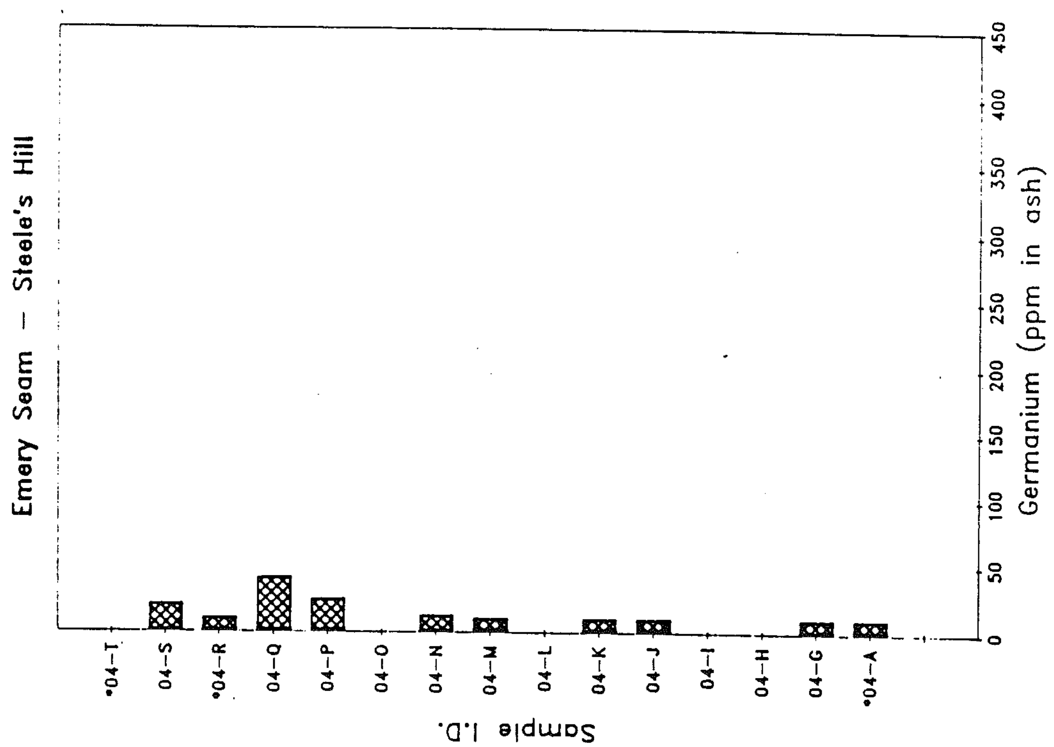
APPENDIX II (C)



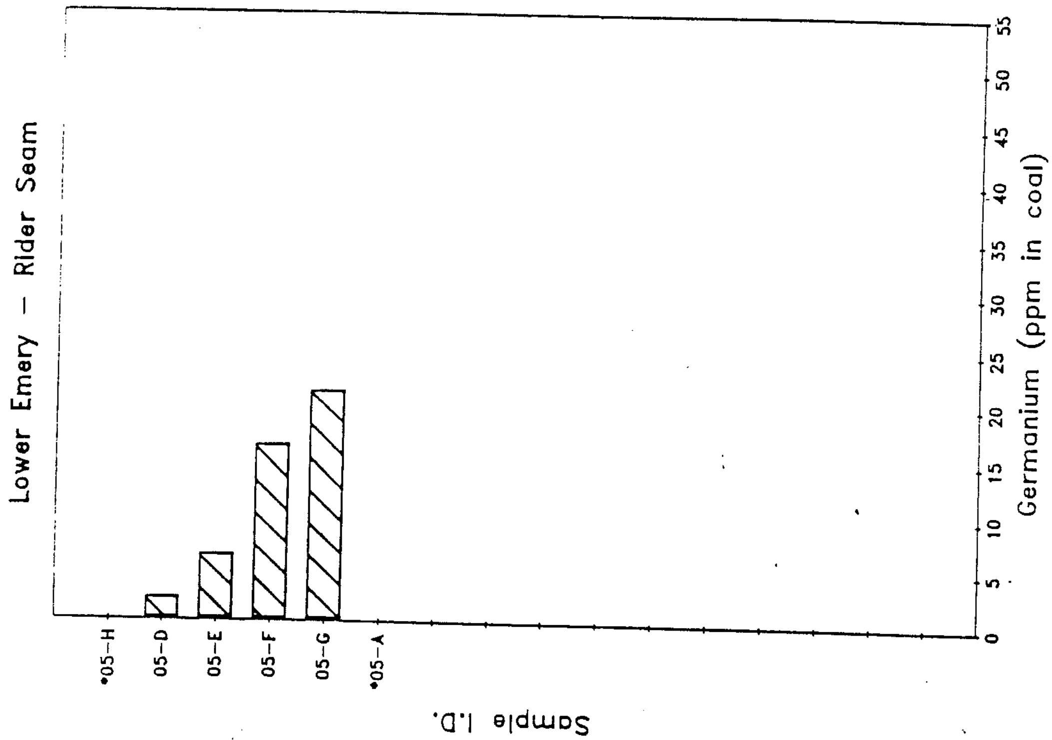


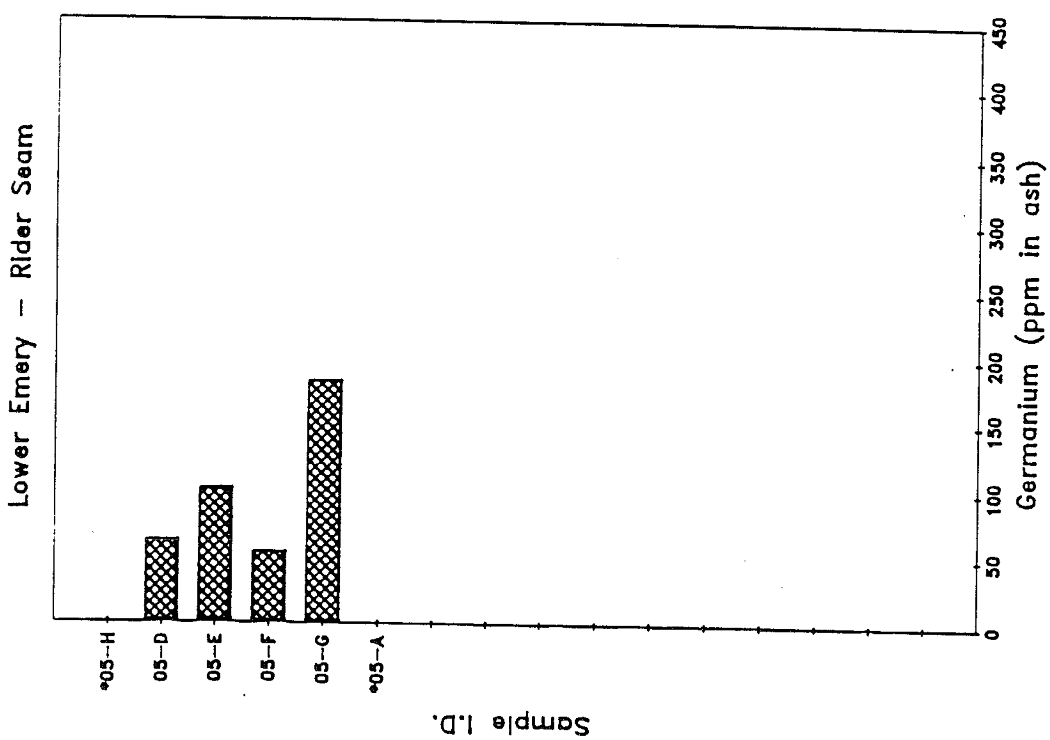
APPENDIX II (C)



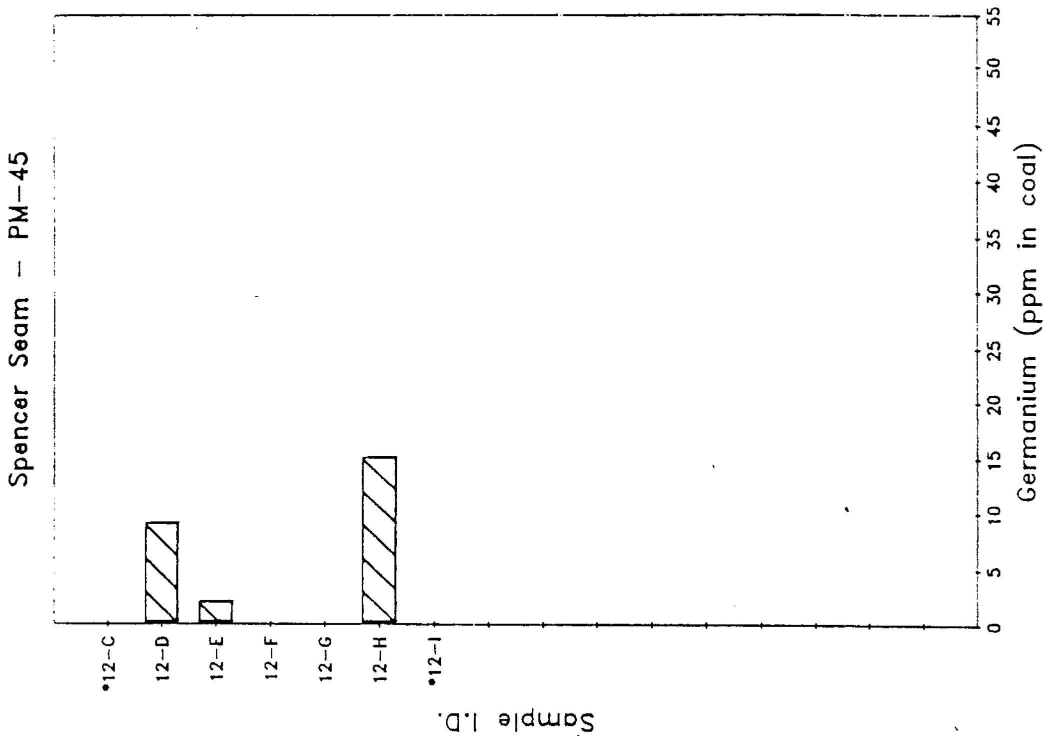


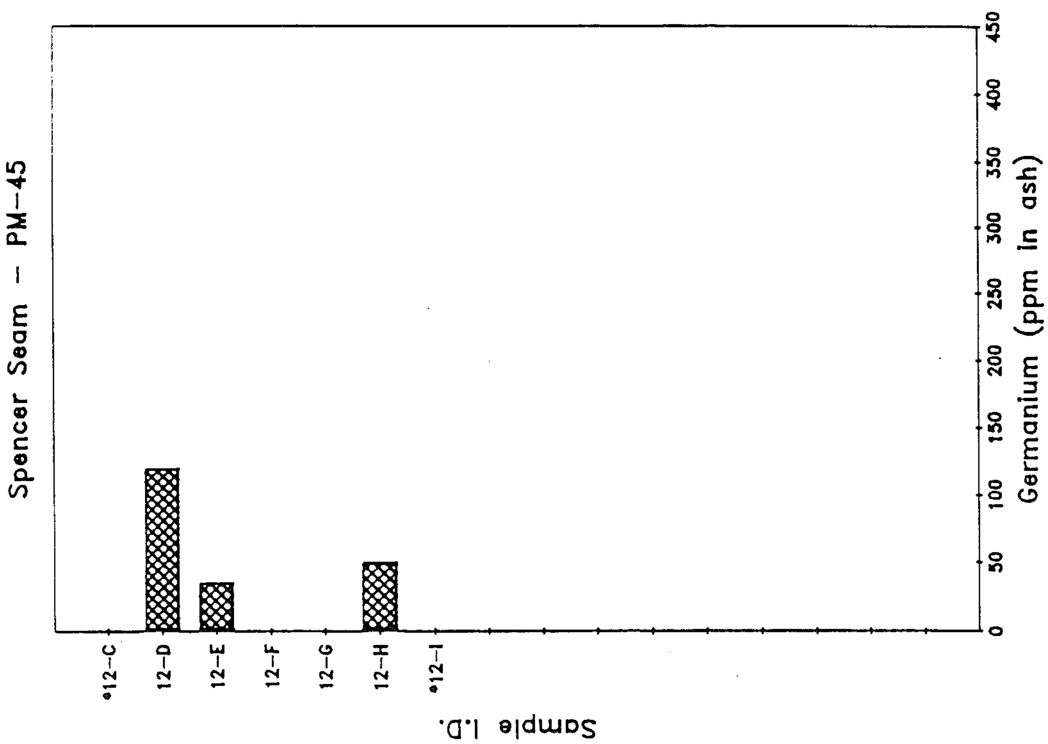
APPENDIX II (C)

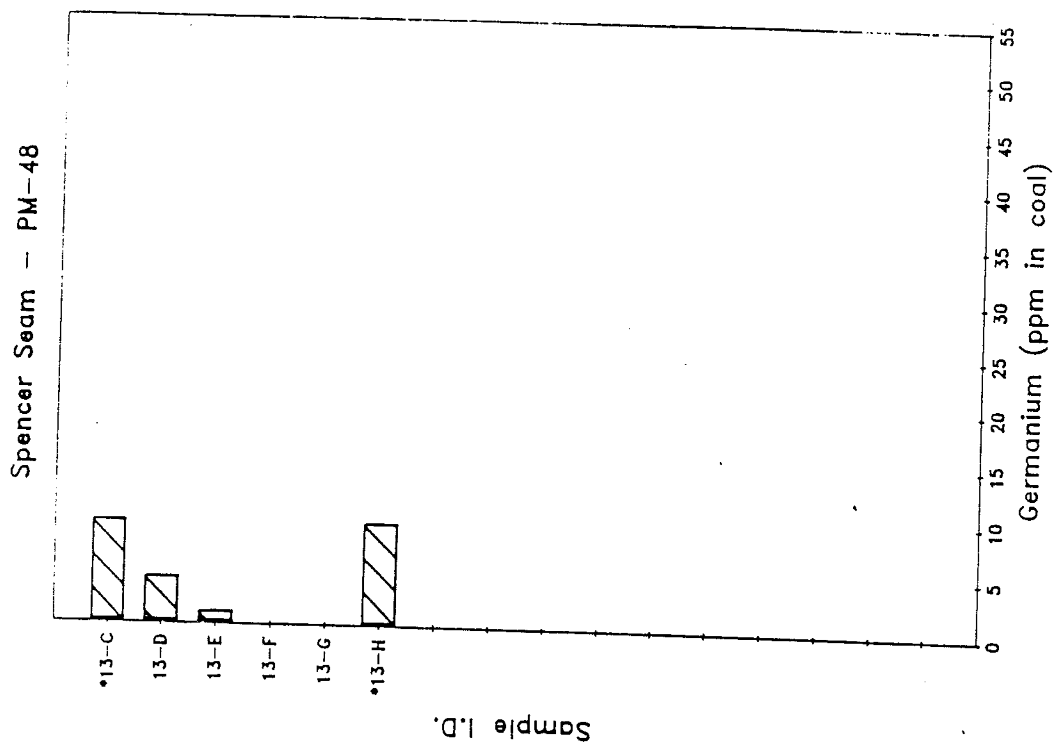


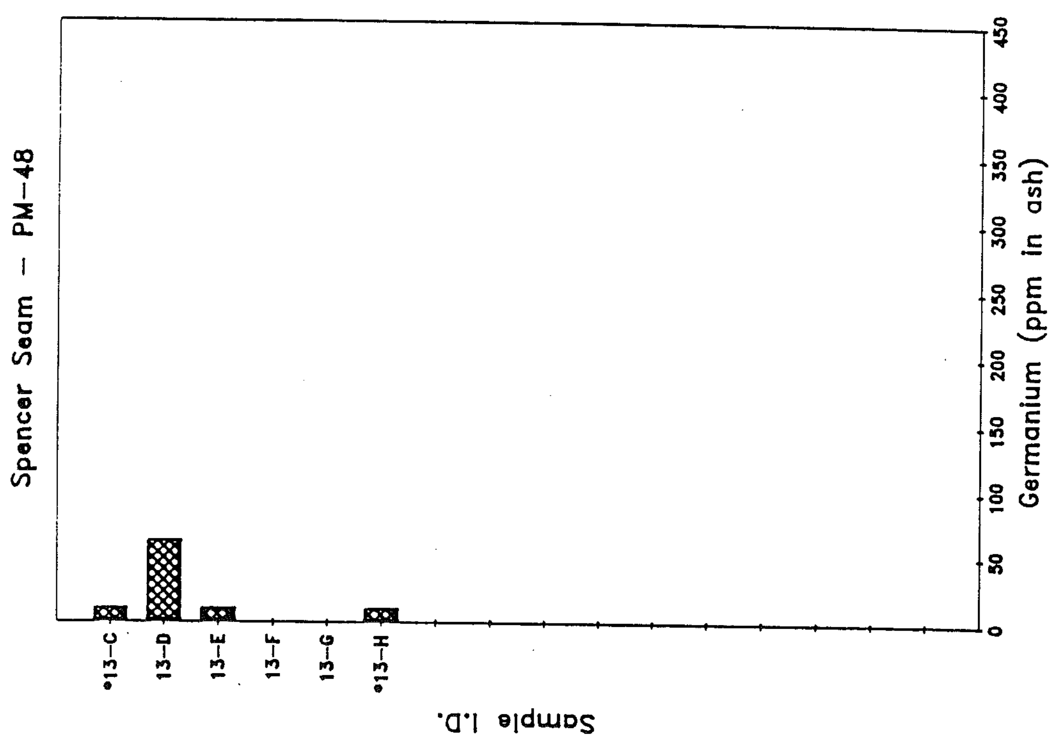


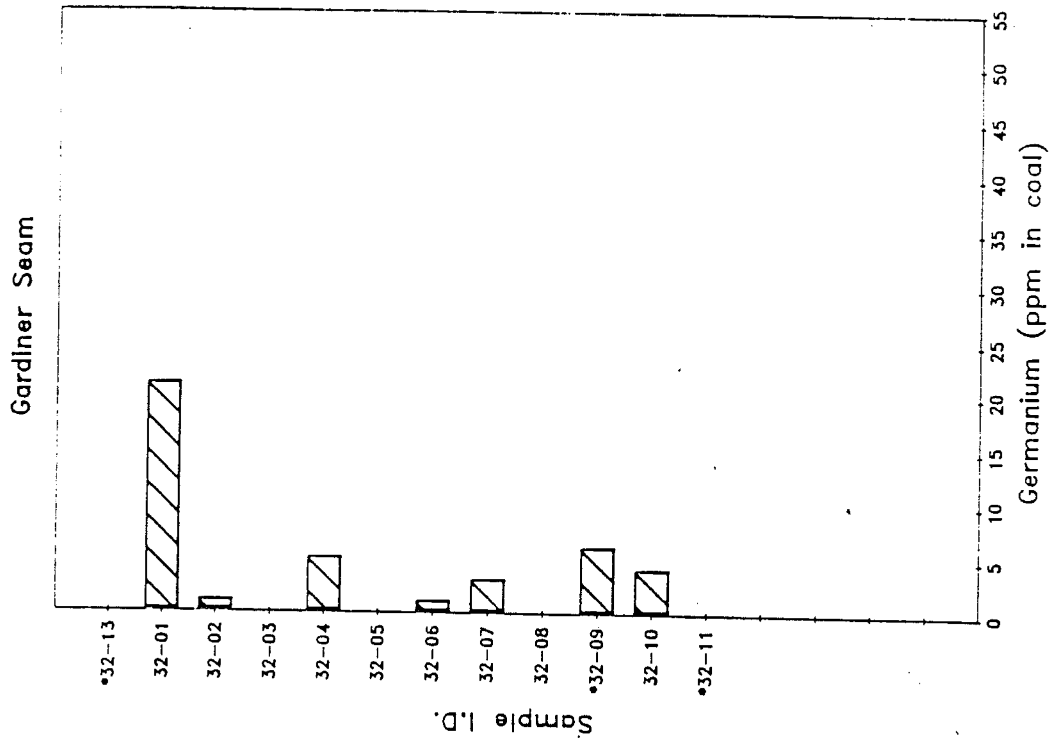
APPENDIX II (C)

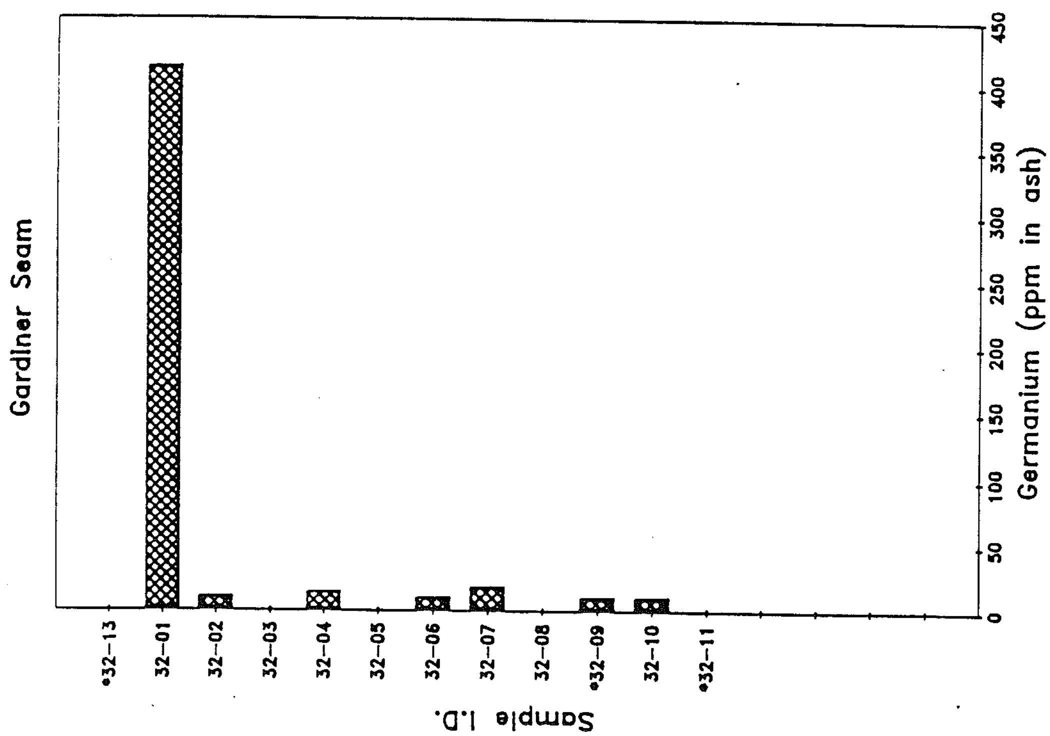




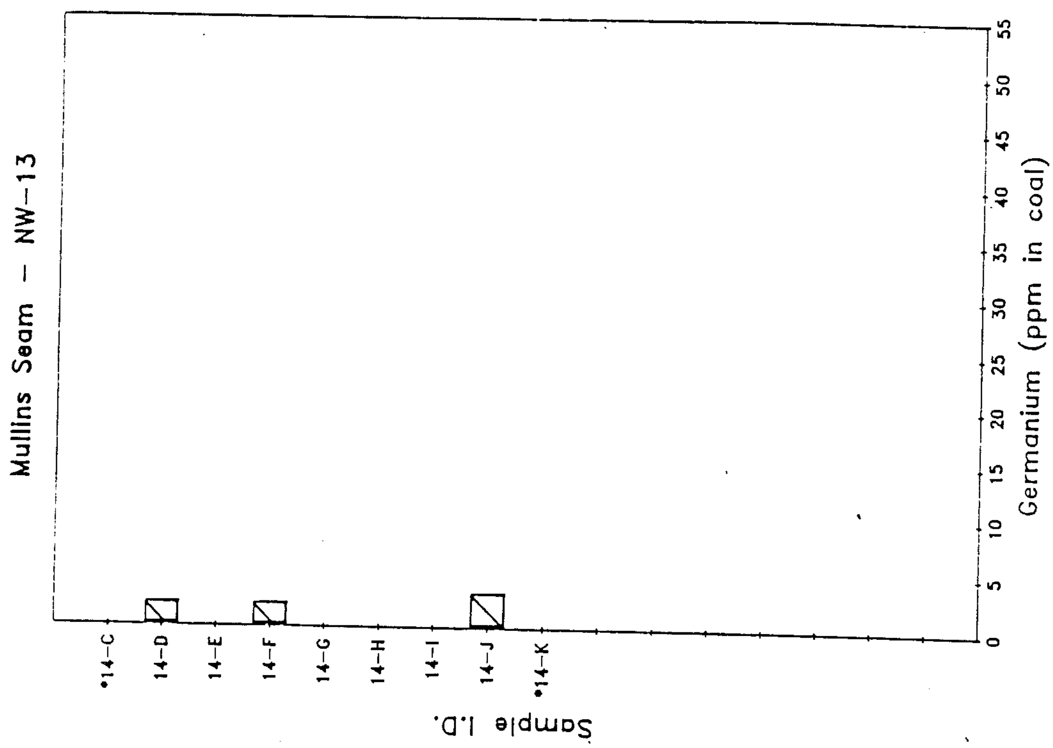

Spencer Seam – PM-48
Germanium (ppm in coal)
0
5
10
15
20
25
30
35
40
45
50
55
Sample I.D.
*13-C
13-D
13-E
13-F
13-G
*13-H

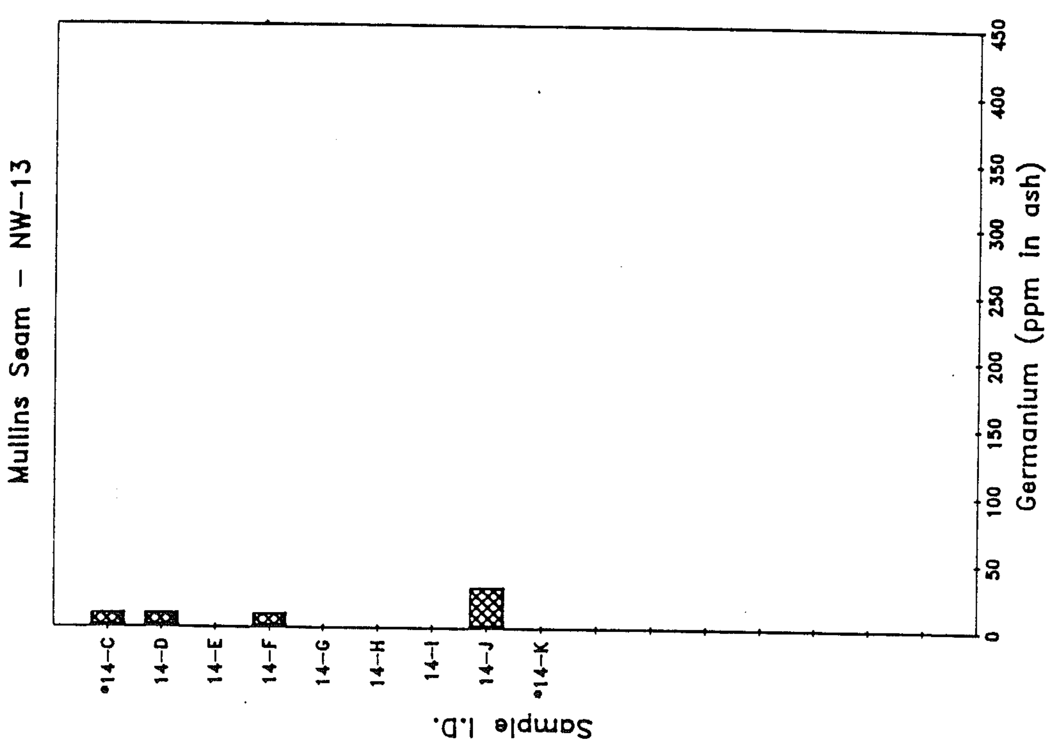

Spencer Seam – PM-48
Germanium (ppm in ash)
0
50
100
150
200
250
300
350
400
450
Sample I.D.
*13-C
13-D
13-E
13-F
13-G
*13-H

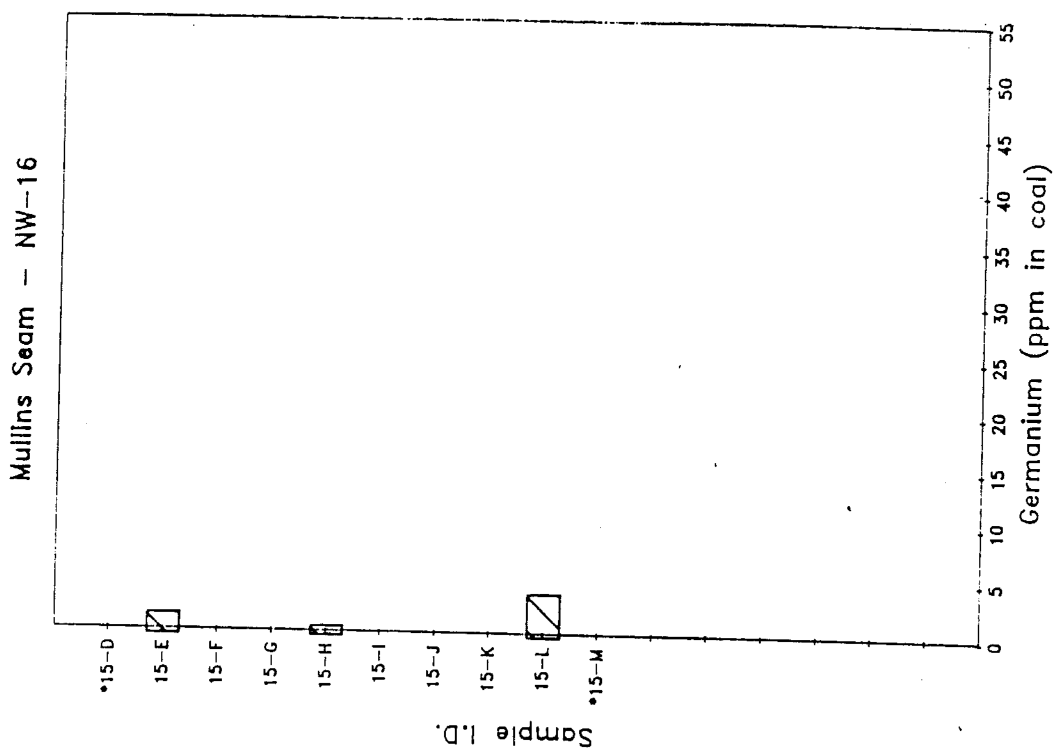

Gardiner Seam
Germanium (ppm in coal)
0 5 10 15 20 25 30 35 40 45 50 55
Sample I.D.
•32-13
32-01
32-02
32-03
32-04
32-05
32-06
32-07
32-08
•32-09
32-10
•32-11

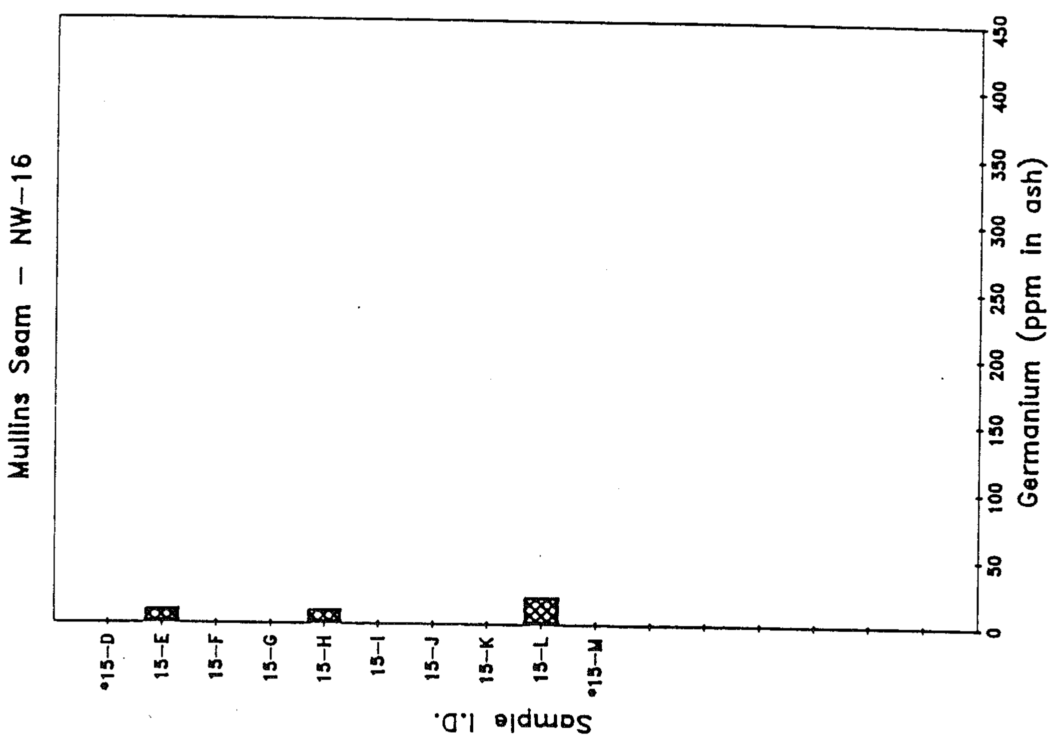

Gardiner Seam
Germanium (ppm in ash)
0 50 100 150 200 250 300 350 400 450
Sample I.D.
•32-13
32-01
32-02
32-03
32-04
32-05
32-06
32-07
32-08
•32-09
32-10
•32-11

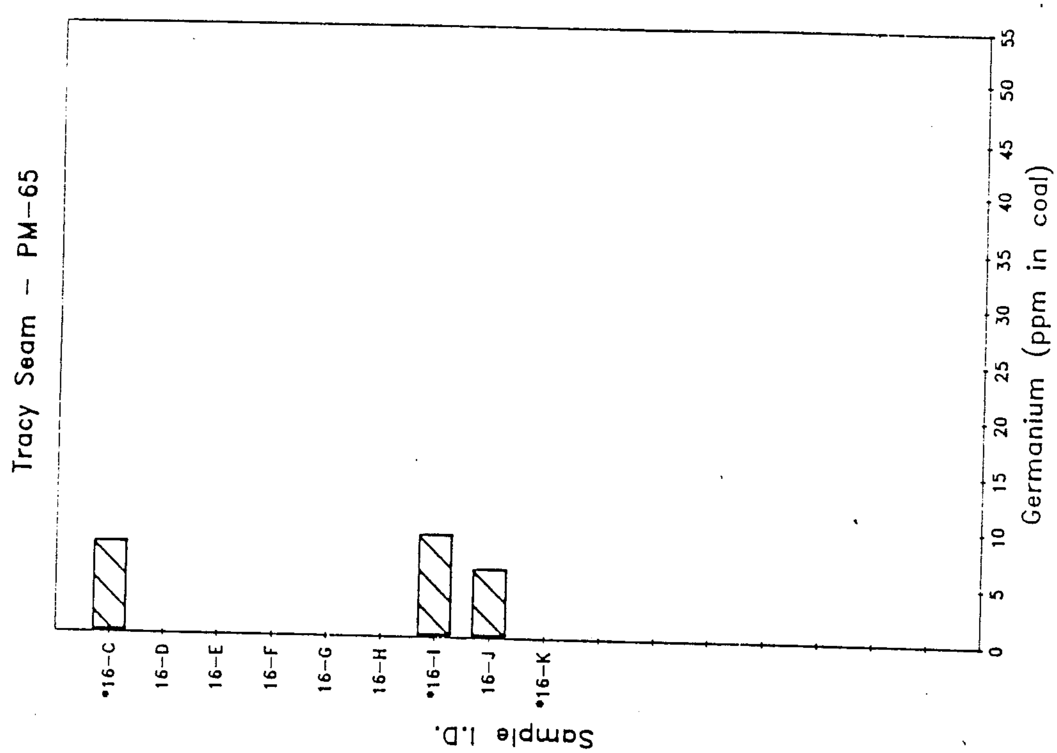
APPENDIX II (C)

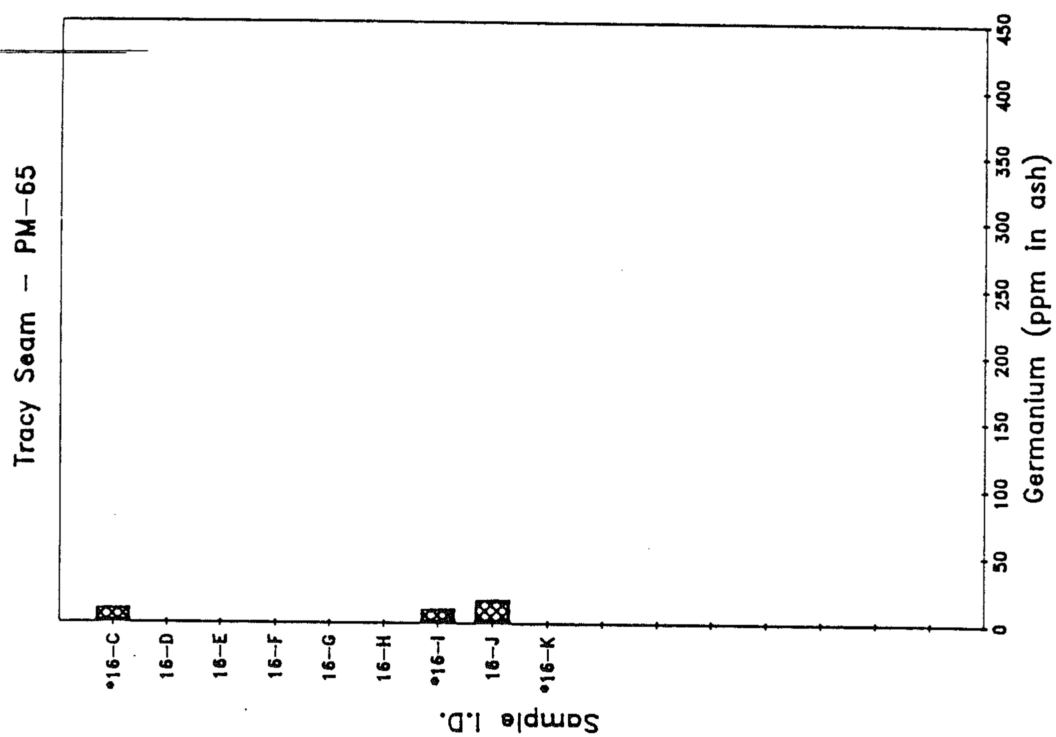




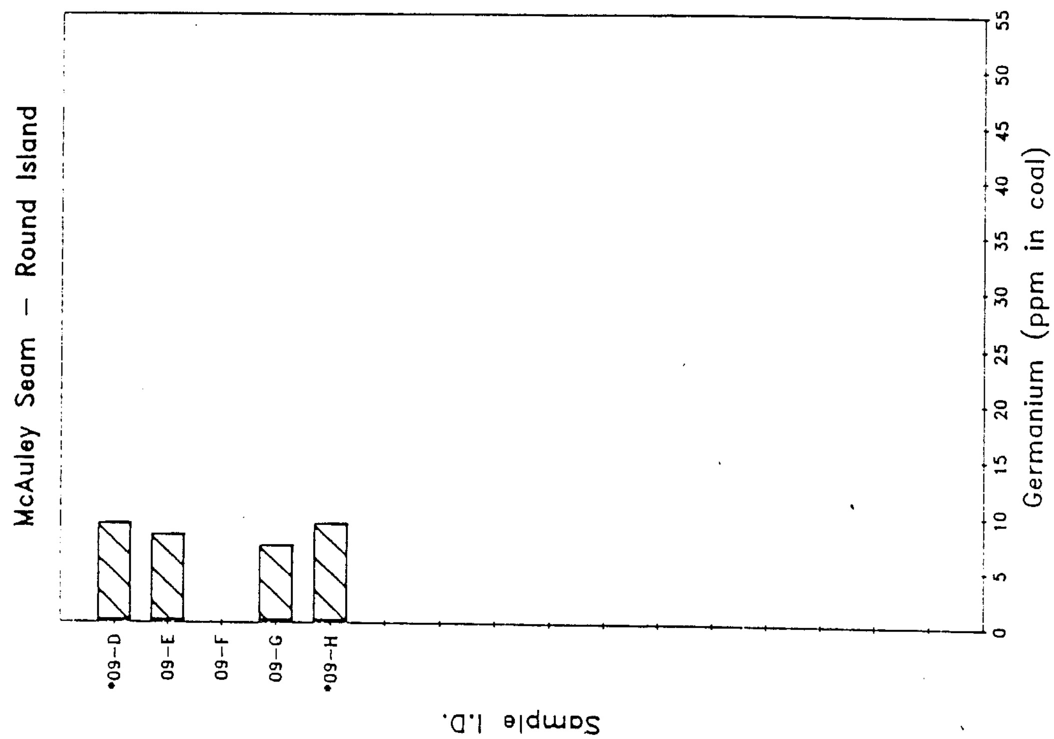

Mullins Seam – NW-16
Germanium (ppm in coal)
0
5
10
15
20
25
30
35
40
45
50
55
Sample I.D.
•15-D
15-E
15-F
15-G
15-H
15-I
15-J
15-K
15-L
•15-M

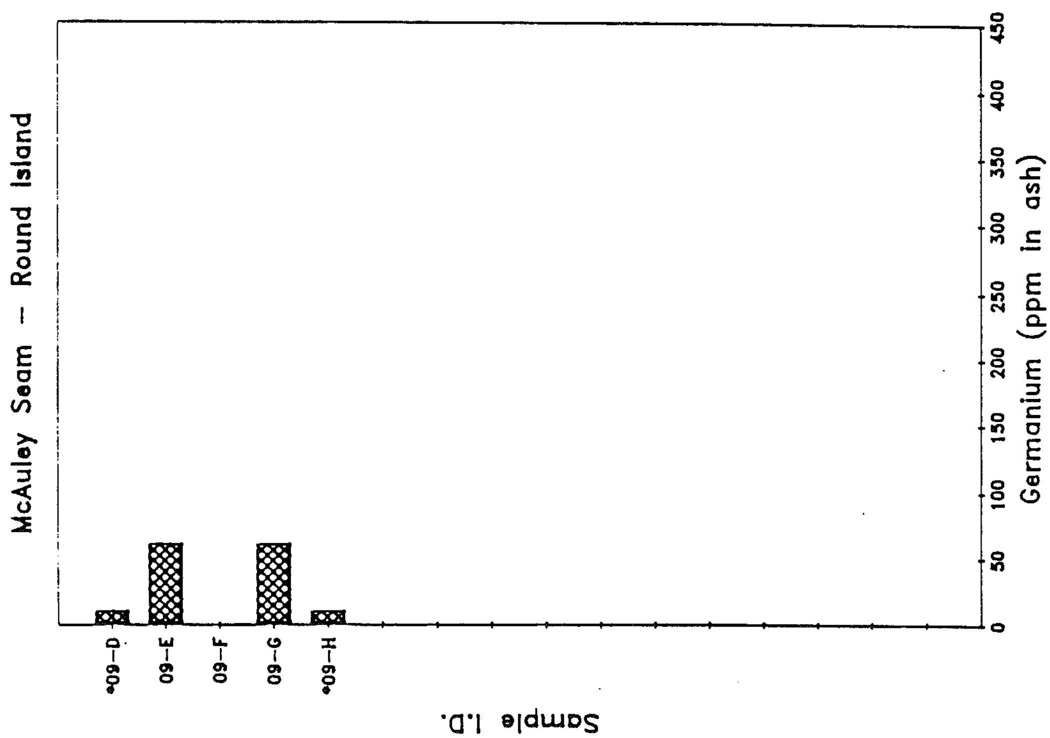

Mullins Seam – NW-16
Germanium (ppm in ash)
0
50
100
150
200
250
300
350
400
450
Sample I.D.
•15-D
15-E
15-F
15-G
15-H
15-I
15-J
15-K
15-L
•15-M


Tracy Seam - PM-65
Germanium (ppm in coal)
0
5
10
15
20
25
30
35
40
45
50
55
Sample I.D.
*16-C
16-D
16-E
16-F
16-G
16-H
*16-I
16-J
*16-K


Tracy Seam - PM-65
Germanium (ppm in ash)
0
50
100
150
200
250
300
350
400
450
Sample I.D.
*16-C
16-D
16-E
16-F
16-G
16-H
*16-I
16-J
*16-K

APPENDIX II (C)

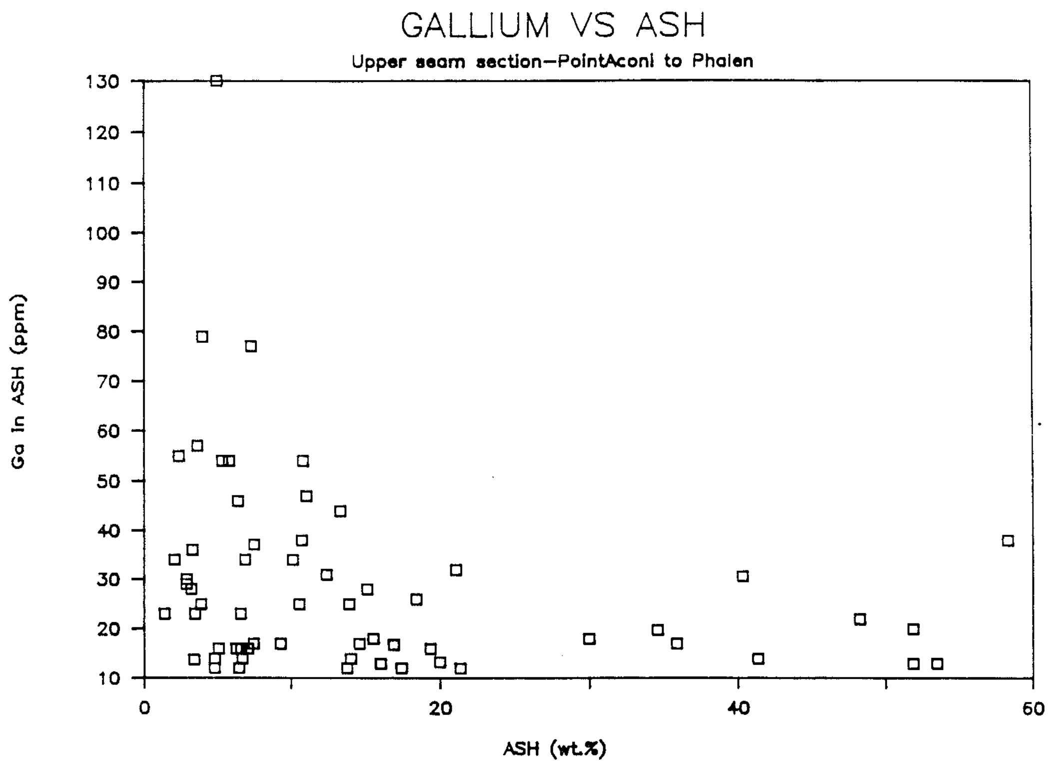


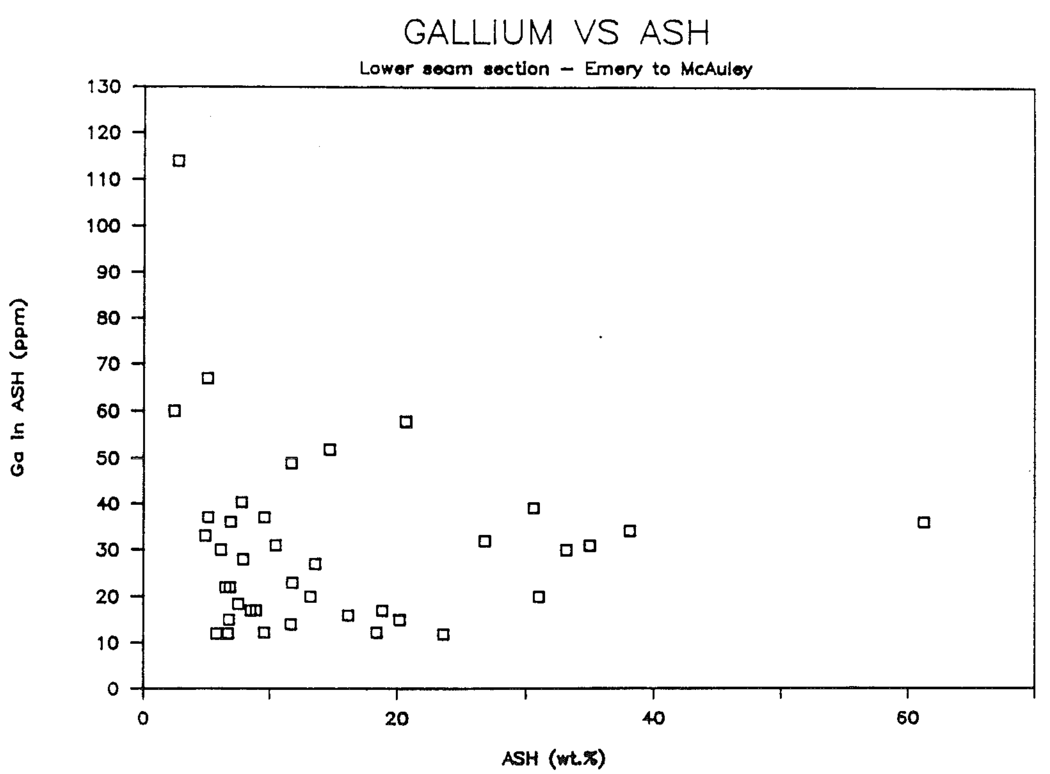


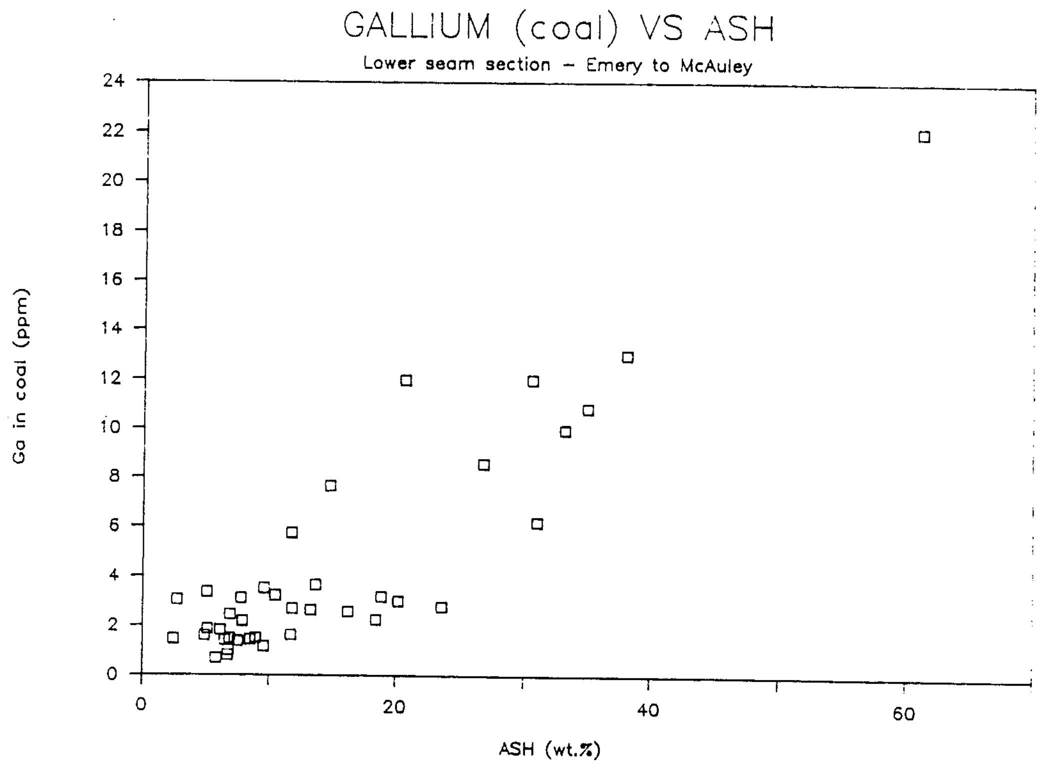
APPENDIX II (D)

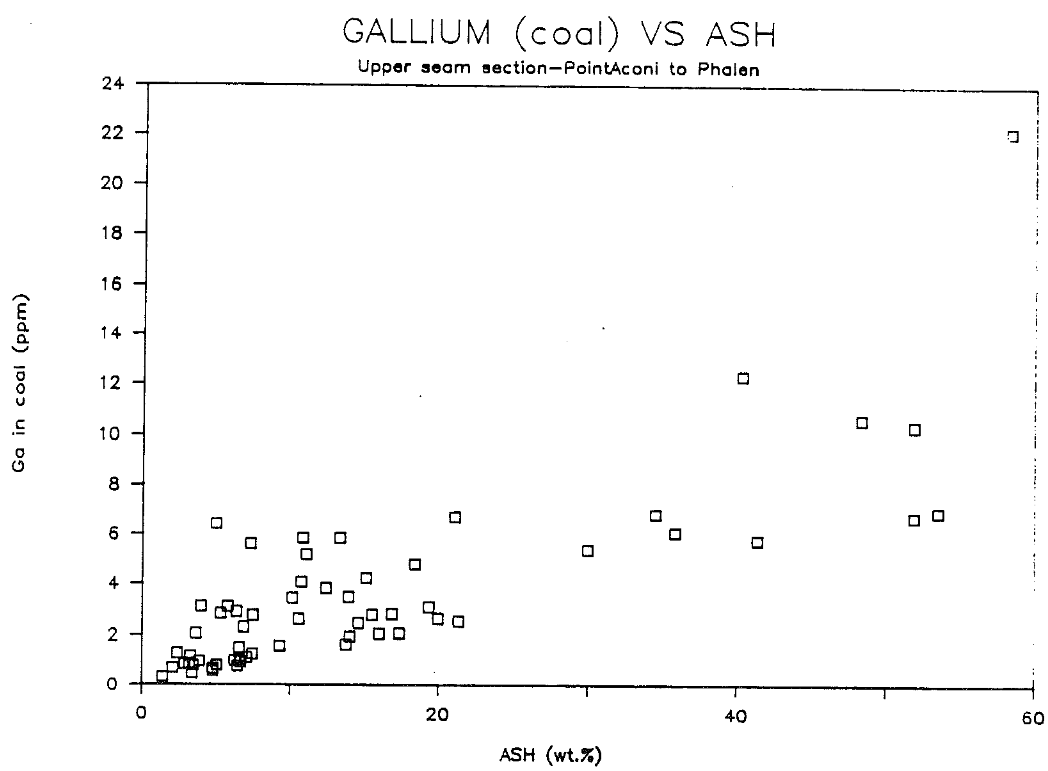
BINARY PLOTS

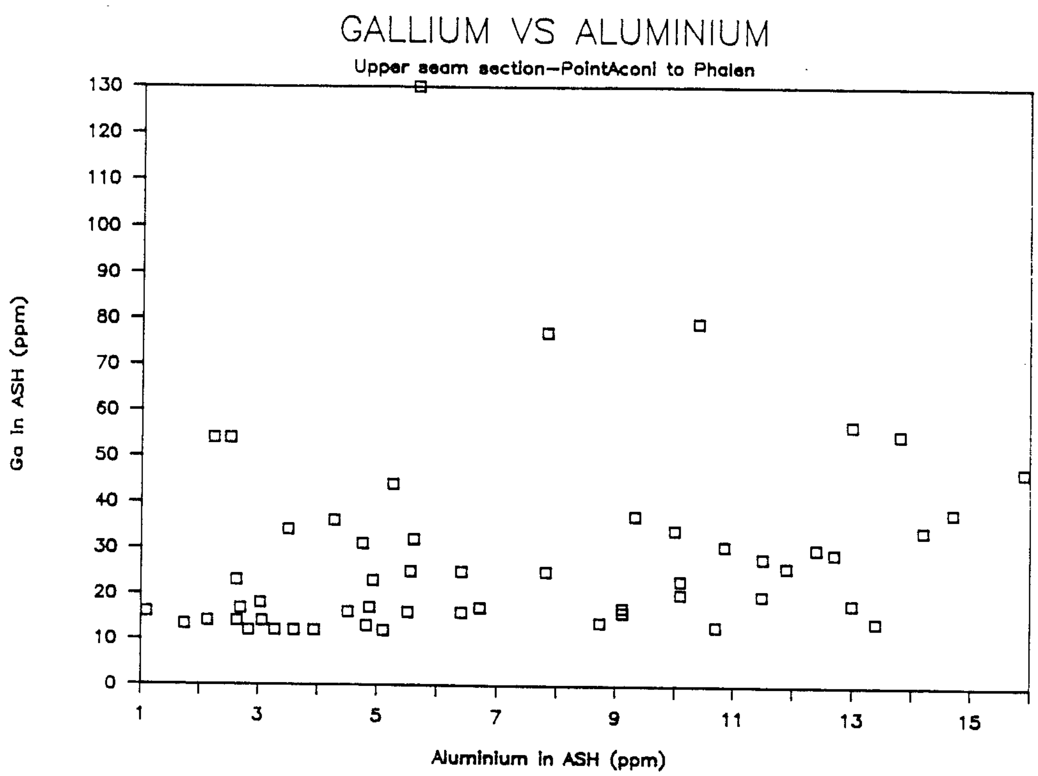
GALLIUM in ash (ppm)	vs	ASH (wt%)
GALLIUM in coal (ppm)	vs	ASH (wt%)
GALLIUM in ash (ppm)	vs	ALUMINUM in ash (ppm)
GALLIUM in ash (ppm)	vs	ZINC in ash (ppm)
GALLIUM in ash (ppm)	vs	SULPHUR (wt%)
GERMANIUM in ash (ppm)	vs	ASH (wt%)
GERMANIUM in coal (ppm)	vs	ASH (wt%)

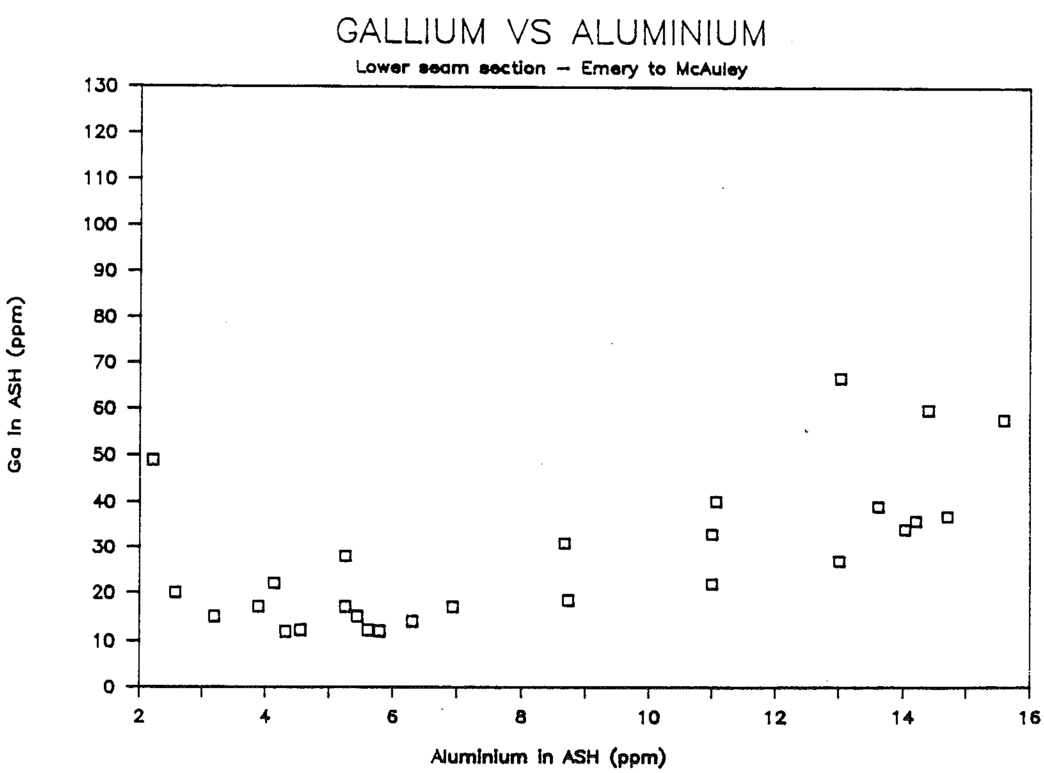

GALLIUM VS ASH
Upper seam section—PointAconi to Phalen
Ga in ASH (ppm)
ASH (wt.%)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20
40
60

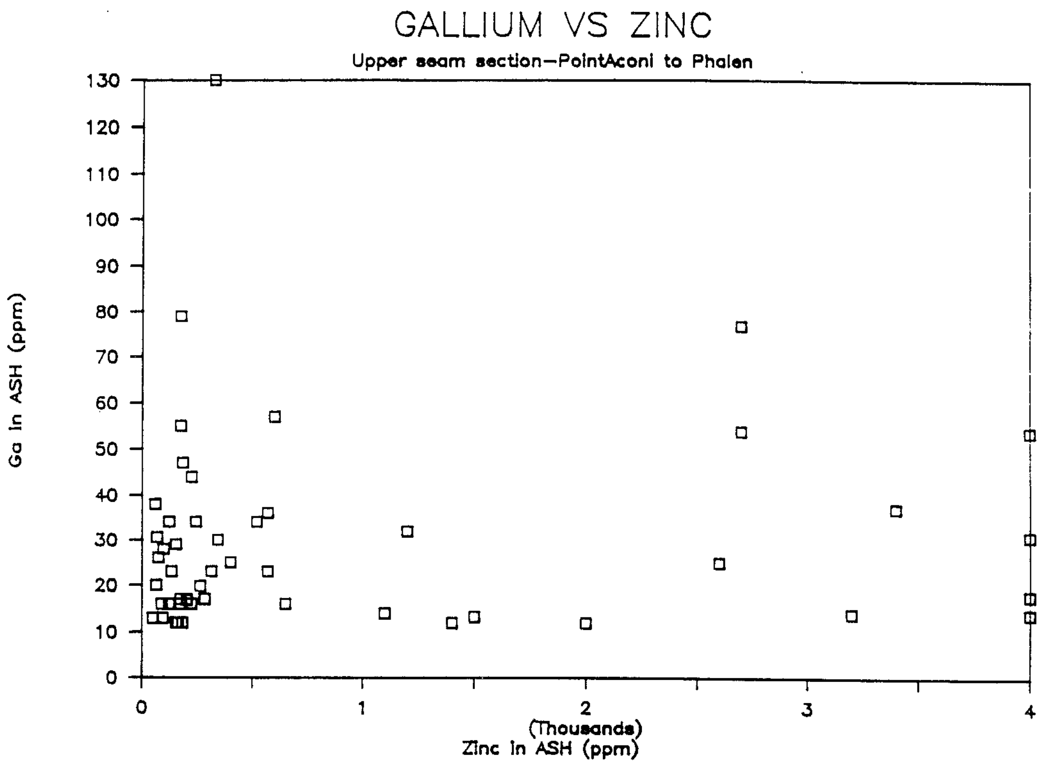

GALLIUM VS ASH
Lower seam section – Emery to McAuley
Ga in ASH (ppm)
ASH (wt.%)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60

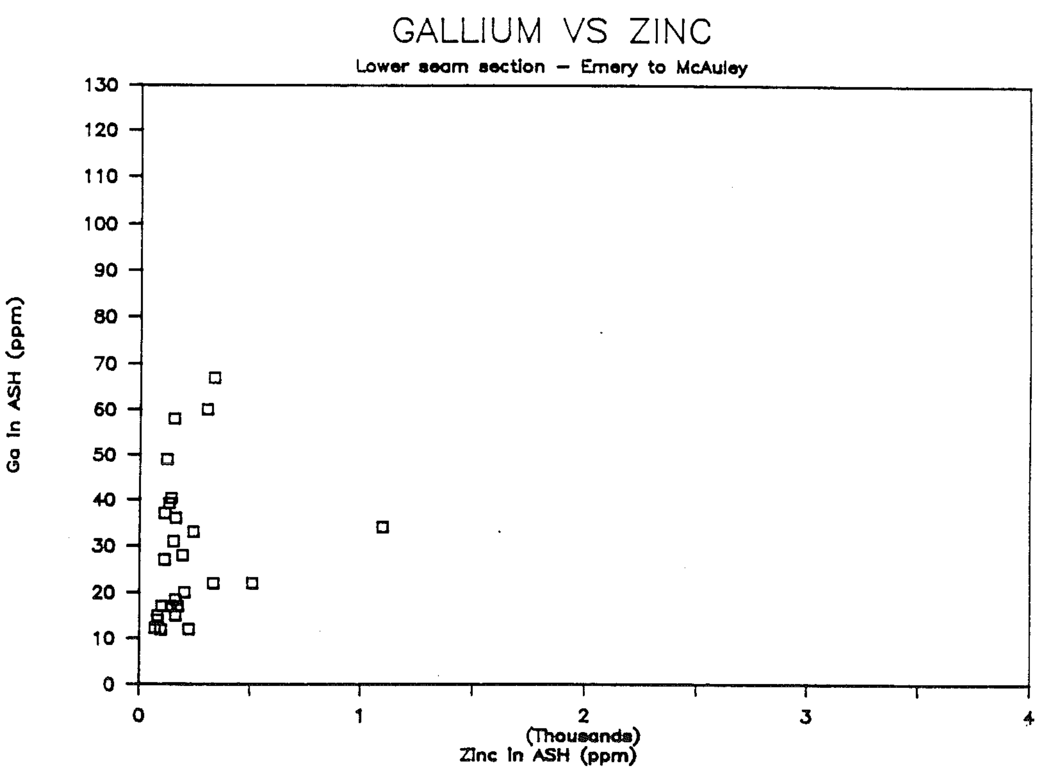

GALLIUM (coal) VS ASH
Lower seam section – Emery to McAuley
Ga in coal (ppm)
ASH (wt.%)
0
2
4
6
8
10
12
14
16
18
20
22
24
0
20
40
60

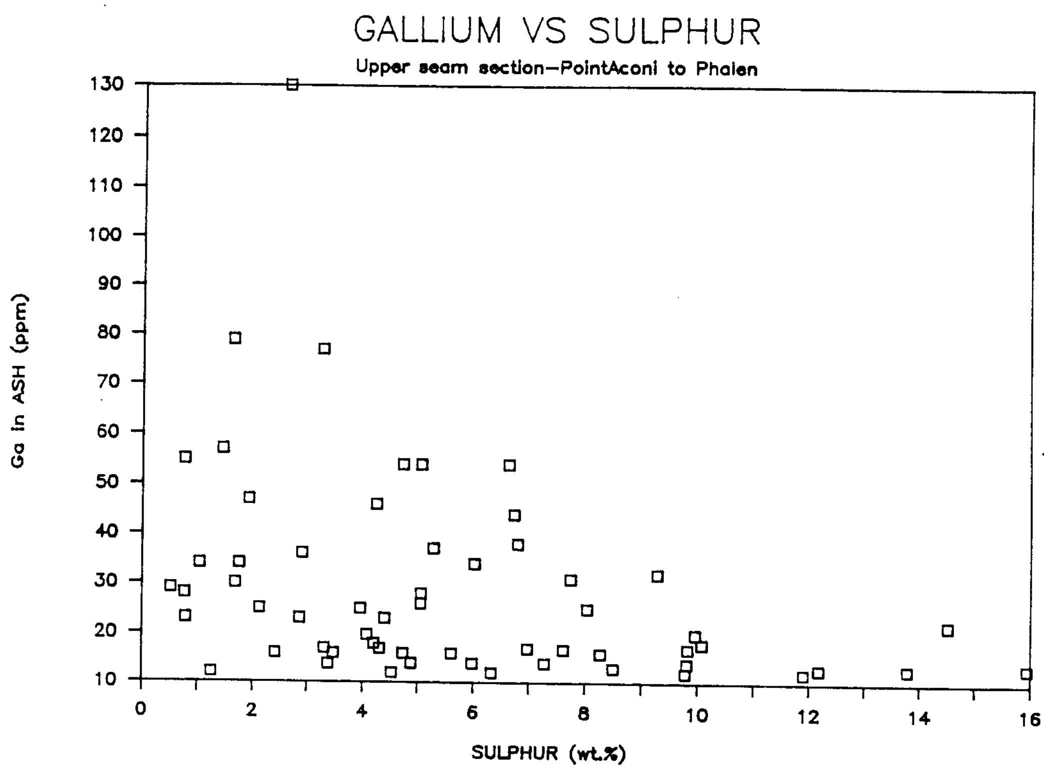

GALLIUM (coal) VS ASH
Upper seam section–PointAconi to Phalen
Ga in coal (ppm)
ASH (wt.%)
0
2
4
6
8
10
12
14
16
18
20
22
24
0
20
40
60

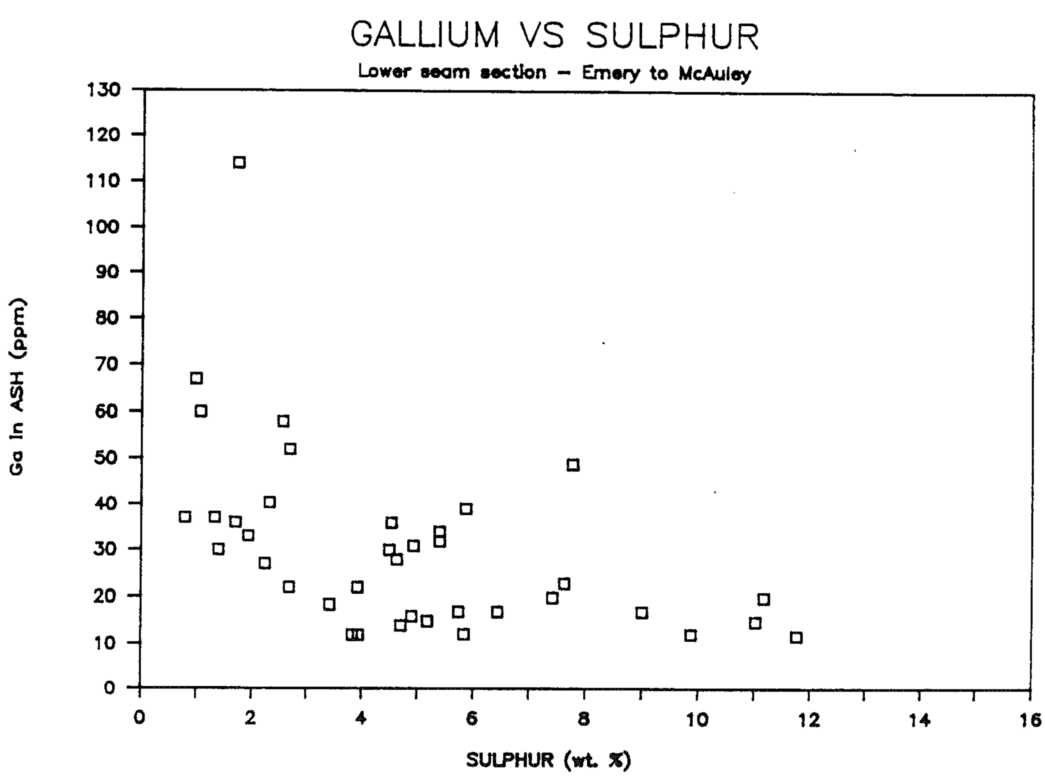

GALLIUM VS ALUMINIUM
Upper seam section—PointAconi to Phalen
Ga in ASH (ppm)
Aluminium in ASH (ppm)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
3
5
7
9
11
13
15

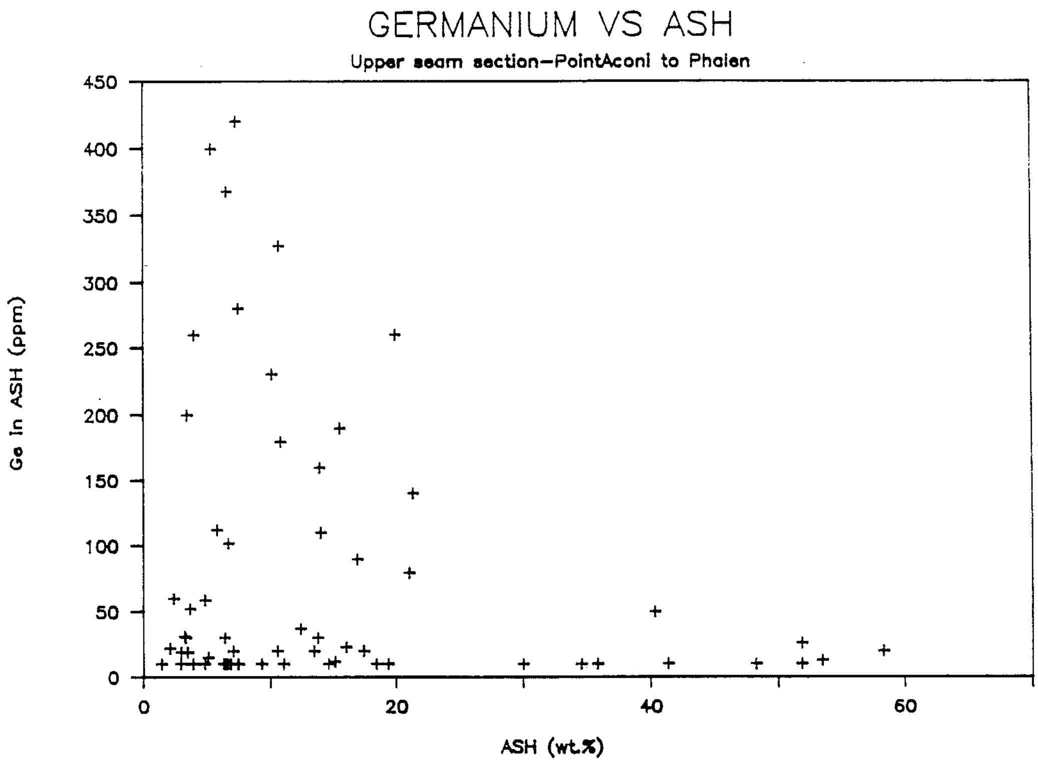

GALLIUM VS ALUMINIUM
Lower seam section – Emery to McAuley
Ga in ASH (ppm)
Aluminium in ASH (ppm)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16

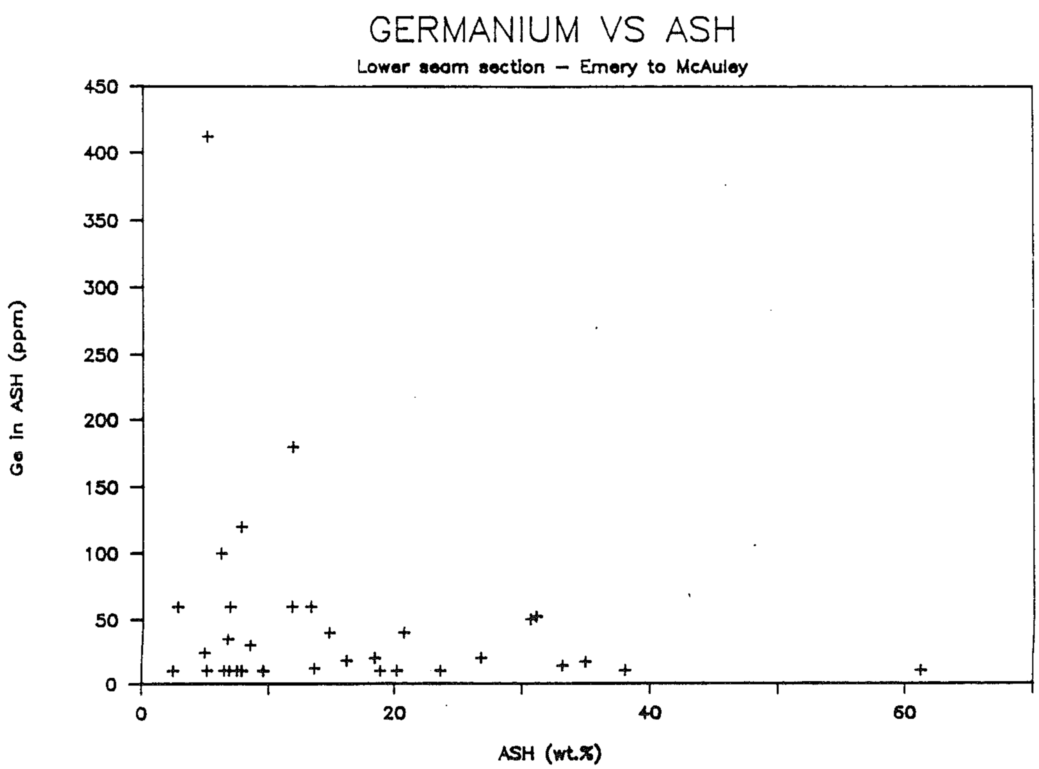

GALLIUM VS ZINC
Upper seam section—PointAconi to Phalen
Ga in ASH (ppm)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
1
2
3
4
(Thousands)
Zinc in ASH (ppm)

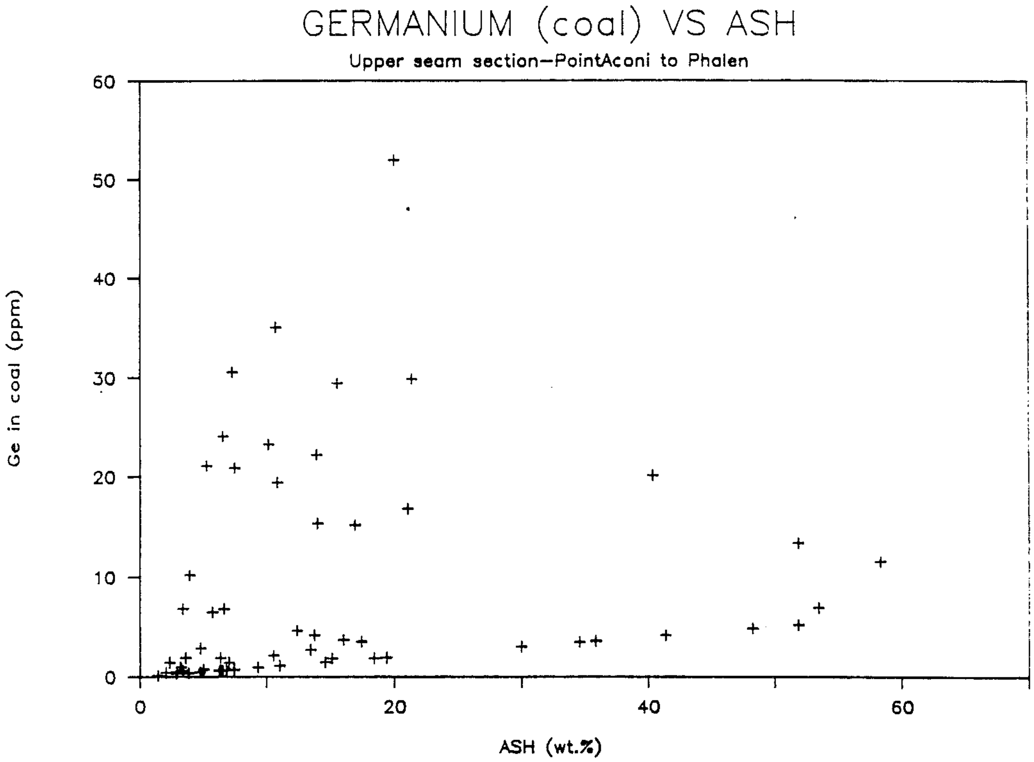

GALLIUM VS ZINC
Lower seam section – Emery to McAuley
Ga in ASH (ppm)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
1
2
3
4
(Thousands)
Zinc in ASH (ppm)

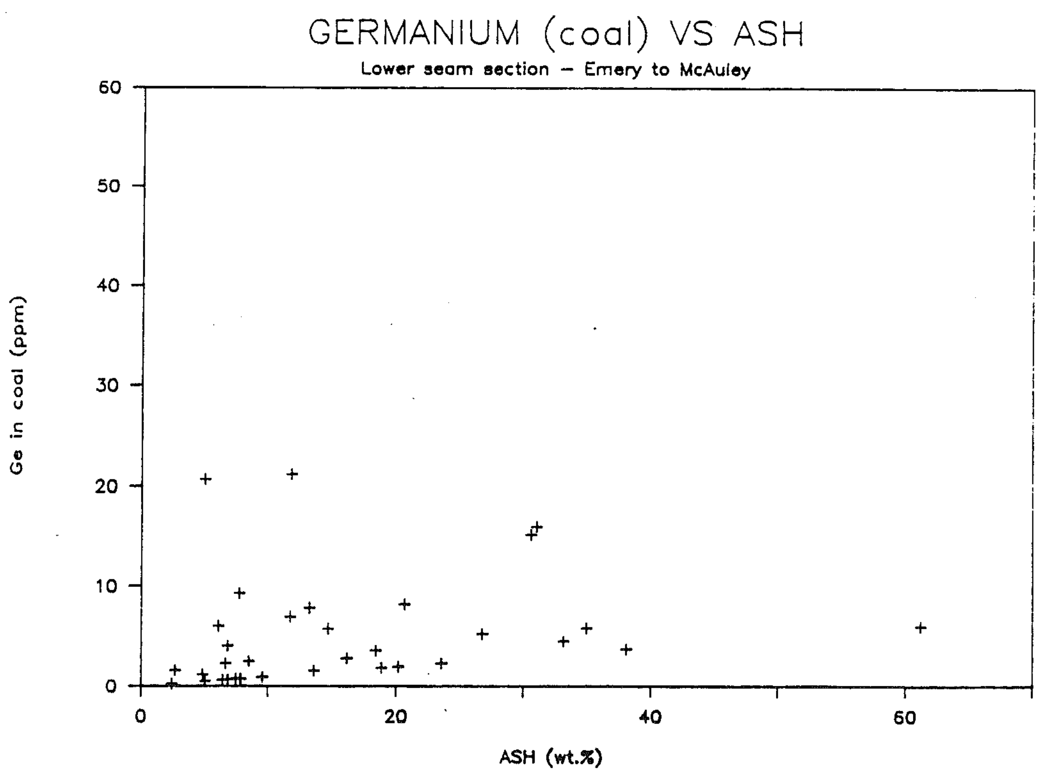

GALLIUM VS SULPHUR
Upper seam section—PointAconi to Phalen
Ga in ASH (ppm)
SULPHUR (wt.%)
0 2 4 6 8 10 12 14 16
10 20 30 40 50 60 70 80 90 100 110 120 130


GALLIUM VS SULPHUR
Lower seam section – Emery to McAuley
Ga in ASH (ppm)
SULPHUR (wt. %)
0 2 4 6 8 10 12 14 16
0 10 20 30 40 50 60 70 80 90 100 110 120 130


GERMANIUM VS ASH
Upper seam section–PointAconi to Phalen
Ge in ASH (ppm)
450
400
350
300
250
200
150
100
50
0
0
20
40
60
ASH (wt.%)


GERMANIUM VS ASH
Lower seam section – Emery to McAuley
Ge in ASH (ppm)
450
400
350
300
250
200
150
100
50
0
0
20
40
60
ASH (wt.%)


GERMANIUM (coal) VS ASH
Upper seam section—PointAconi to Phalen
Ge in coal (ppm)
ASH (wt.%)
0
10
20
30
40
50
60
0
20
40
60


GERMANIUM (coal) VS ASH
Lower seam section – Emery to McAuley
Ge in coal (ppm)
ASH (wt.%)
0
10
20
30
40
50
60
0
20
40
60

APPENDIX III (A)

AUTOMATED S.E.M. - C.M.A. DATA TABLE

APPENDIX III (A)

AUTOMATED S.E.M. - C.M.A. DATA TABLE

Table 1A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SAMPLE # POINT ACONI - 0.07 - 0.15 m (ACI-87-233-03)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
KAOLINITE	0.0	0.1	3.3	6.2	4.0	1.2	14.8
PYRITE	0.0	0.4	2.9	4.6	20.7	12.9	41.5
FE-SUL	0.0	0.0	0.0	0.4	2.9	9.6	13.0
QUARORG.	0.5	1.1	3.2	1.0	0.3	0.6	6.8
QUARPYR.	0.1	0.2	0.6	0.9	0.8	2.9	5.5
MIXSIL.	0.0	0.0	0.8	2.1	2.9	7.5	13.1
MISC.	0.3	0.2	0.7	0.9	1.5	1.6	5.2

Table 1B

: 86-233-03

1 DISK 149 FILE 115 - 119 PARTICLES RUN/T 128.00

: DATE 1/29/88 SUMMARY 118 TOTAL 599 MASS 4.1E+00 UG/CM2 ANAL./T101.00

30 TIME 9:25 OFF-PT. > 50U 1 > 50U 2.3E-01 UG/CM2 DEAD/T 26.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	47	47	0	7	2.6E+02	0.0
KAOLINITE	0	9	49	35	6	1	8.3E+03	1.5
ILLITE...	0	0	63	32	5	0	3.8E+02	0.1
ORGSULF..	99	1	0	0	0	0	9.9E+04	17.4
JAROSITE.	0	0	0	0	100	0	1.8E+01	0.0
PYJAR....	0	26	52	17	5	0	7.3E+02	0.1
PYRITE...	14	11	36	12	22	4	5.1E+03	0.9
SIDERITE.	0	0	0	0	0	100	1.8E+01	0.0
FE-SUL...	0	28	0	18	33	22	6.8E+02	0.1
QUARORG..	89	6	5	1	0	0	9.1E+04	16.0
QUARPYR..	68	14	12	4	1	1	8.7E+03	1.5
MIXSIL...	0	0	39	39	12	10	1.8E+03	0.3
MIXSUL...	99	1	0	0	0	0	3.0E+04	5.4
NOT-INT..	93	5	2	0	0	0	3.2E+05	56.4
UNKNOWN..	75	11	0	7	4	2	1.6E+03	0.3
TOTAL....	90	4	3	1	1	0	5.7E+05	100.0

Table 2A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SAMPLE # POINT ACONI - 0.50 - 0.65 m (ACI-87-233-04)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
KAOLINITE	0.0	0.0	0.2	3.6	0.5	0.0	4.3
ORGSULF.	0.6	0.2	0.1	0.9	0.3	0.0	2.0
PYJAR.	0.3	0.2	0.3	1.2	0.9	0.0	3.1
PYRITE	0.6	0.6	3.1	13.0	24.1	20.4	61.9
FE-SUL.	0.0	0.0	0.2	0.0	1.3	19.8	21.3
QUARPYR.	0.0	0.1	0.5	2.4	0.6	0.0	3.6
MISC.	0.3	0.3	0.9	1.6	0.8	0.0	3.9

Table 2B

: 87-233F-04

! DISK 149 FILE 150 - 154 PARTICLES RUN/T !12.00

! DATE 2/ 3/88 SUMMARY 153 TOTAL 542 MASS 2.8E+00 UG/CM2 ANAL./T249.00

28 TIME 13:51 OFF-PT.) 50U 5) 50U 3.0E-01 UG/CM2 DEAD/T !63.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	22	64	8	6	0	7.0E+02	0.1
KAOLINITE	0	0	9	87	4	0	1.2E+03	0.2
ILLITE...	0	0	100	0	0	0	5.6E+01	0.0
ORGSULF..	99	0	0	0	0	0	2.3E+05	48.2
JAROSITE.	0	0	0	0	100	0	1.3E+01	0.0
PYJAR....	96	2	1	1	0	0	3.6E+04	7.4
PYRITE...	83	3	5	6	3	1	2.9E+04	6.1
FE-SUL...	0	29	11	0	13	47	5.2E+02	0.1
QUARORG..	92	3	3	2	0	0	1.3E+04	2.8
QUARPYR..	73	6	8	11	1	0	5.4E+03	1.1
MIXSIL...	0	0	35	65	0	0	1.7E+02	0.0
MIXSUL...	98	1	0	1	0	0	1.5E+04	3.3
NOT-INT..	91	7	2	0	0	0	1.4E+05	30.4
UNKNOWN..	0	0	25	63	7	4	4.4E+02	0.1
TOTAL....	94	3	1	1	0	0	4.8E+05	100.0

Table 3A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SAMPLE # POINT ACONI - 0.85 - 1.00 m (ACI-87-233-05)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
PYJAR.	0.1	0.1	0.6	0.8	0.7	0.6	2.8
PYRITE	0.0	1.5	5.4	18.5	23.1	28.5	77.0
FE-SUL.	0.0	0.0	0.1	1.0	1.8	10.9	13.8
QUARORG.	0.2	0.3	0.3	0.2	0.3	0.6	1.8
QUARPYR.	0.0	0.0	0.2	0.5	0.2	1.0	2.0
MISC.	0.2	0.3	0.7	0.8	0.1	0.5	2.6

Table 3B

: 87-233F-05

1 DISK 150 FILE 155 - 159 PARTICLES RUN/T 233.00

: DATE 2/ 8/88 SUMMARY 158 TOTAL 596 MASS 1.5E+01 UG/CM2 ANAL./T129.00

30 TIME 10:22 OFF-PT. > 50U 4 > 50U 1.5E+00 UG/CM2 DEAD/T 103.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	75	25	0	0	1.0E+03	0.1
KAOLINITE	0	0	100	0	0	0	3.1E+02	0.0
ILLITE...	0	52	48	0	0	0	5.2E+02	0.1
ORGSULF..	98	1	1	0	0	0	2.1E+05	28.5
PYJAR....	63	10	17	8	2	0	1.6E+04	2.2
PYRITE...	73	7	9	8	3	1	2.0E+05	26.1
SIDERITE.	0	0	0	100	0	0	2.5E+02	0.0
FE-SUL...	87	0	2	5	2	5	2.6E+04	3.5
QUARORG..	95	4	1	0	0	0	1.8E+05	23.5
QUARPYR..	68	12	8	8	2	2	1.2E+04	1.6
MIXSIL...	0	0	100	0	0	0	2.5E+02	0.0
MIXSUL...	99	0	0	0	1	0	5.9E+03	0.8
NOT-INT..	85	11	4	0	0	0	1.0E+05	13.5
UNKNOWN..	0	0	0	100	0	0	2.5E+02	0.0
TOTAL....	87	5	4	3	1	0	7.7E+05	100.0

APPENDIX III (A)

Table 4A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
BROGAN/LLOYD COVE (UPPER SEAM) - 0.63 - 0.77 m (ACI-87-260-02J)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
PYJAR.	0.1	0.3	1.0	0.7	0.4	1.1	3.5
PYRITE	0.0	0.8	13.6	32.0	18.4	15.2	80.0
SIDERITE	0.0	0.0	0.0	0.0	0.0	1.9	1.9
FE-SUL.	0.0	0.1	0.3	0.6	2.6	2.6	6.3
QUARPYR.	0.1	0.2	0.8	0.3	0.5	0.6	2.4
MISC.	0.1	0.5	2.4	1.5	0.8	0.5	5.9

Table 4B

: 87-260-02J

1	DISK 151	FILE 180 - 184	PARTICLES					RUN/T 244.00
1	DATE 2/12/88	SUMMARY	183	TOTAL	524	MASS 4.4E+00	UG/CM2	ANAL./T 77.00
27	TIME 9:24	OFF-PT.	> 50U		4	> 50U 4.0E-01	UG/CM2	DEAD/T 166.99

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	12	75	12	1	0	1.1E+03	1.1
KAOLINITE	0	18	60	19	2	0	7.0E+02	0.7
ILLITE...	0	65	0	35	0	0	3.9E+02	0.4
ORGSULF..	91	4	4	0	0	0	1.3E+04	13.5
PYJAR....	52	23	19	5	1	0	5.1E+03	5.3
PYRITE...	3	12	45	33	5	1	2.2E+04	22.9
SIDERITE.	0	85	0	0	0	15	1.5E+02	0.2
FE-SUL...	0	11	35	23	21	9	1.1E+03	1.2
QUARORG..	76	13	10	0	0	0	1.2E+04	13.0
QUARPYR..	84	7	8	1	0	0	1.6E+04	17.0
MIXSIL...	0	48	27	23	2	0	5.9E+02	0.6
MIXSUL...	65	0	27	0	6	2	5.1E+02	0.5
NOT-INT..	54	31	10	3	2	0	2.1E+04	21.7
UNKNOWN..	0	38	45	16	1	1	1.6E+03	1.7
TOTAL....	52	16	19	10	2	0	9.7E+04	100.0

Table 5A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
BROGAN/LLOYD COVE (UPPER SEAM) - 0.77 - 0.82 m (ACI-87-260-02K)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
PYJAR.	0.1	0.2	1.0	2.2	0.9	0.0	4.5
PYRITE	0.0	0.7	7.3	34.7	8.0	15.4	66.8
SIDERITE	0.0	0.0	0.0	1.6	0.0	3.5	5.1
FE-SUL.	0.0	0.0	0.4	3.6	0.9	7.8	12.8
QUARORG.	0.2	0.1	0.6	1.9	0.1	0.0	3.0
QUARPYR.	0.1	0.2	0.9	2.7	0.5	0.7	5.0
MISC.	0.1	0.1	0.4	1.0	0.7	0.5	2.8

Table 5B

: 87-260-02K

1 DISK 149 FILE 140 - 144 PARTICLES RUN/T 203.00

1 DATE 2/ 2/88 SUMMARY 143 TOTAL 546 MASS 1.0E+01 UG/CM2 ANAL./T175.99

28 TIME 14:10 OFF-PT. > 50U 10 > 50U 2.1E+00 UG/CM2 DEAD/T 27.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	0	0	100	0	5.9E+01	0.0
KAOLINITE	0	0	0	88	12	0	4.6E+02	0.0
ILLITE...	0	94	0	0	6	0	3.0E+02	0.0
ORGSULF..	98	1	1	1	0	0	8.1E+04	8.2
JAROSITE.	0	0	0	0	100	0	1.9E+01	0.0
PYJAR....	95	1	2	1	0	0	9.9E+04	10.1
PYRITE...	43	8	20	27	2	1	5.8E+04	6.0
SIDERITE.	0	0	0	88	0	12	9.4E+02	0.1
FE-SUL...	93	0	2	5	0	1	6.4E+04	6.5
QUARORG..	96	1	2	2	0	0	1.2E+05	12.9
QUARPYR..	93	2	2	3	0	0	1.0E+05	10.9
MIXSIL...	0	0	0	0	100	0	4.6E+01	0.0
MIXSUL...	98	0	1	1	0	0	6.3E+04	6.4
NOT-INT..	86	4	5	4	0	0	3.8E+05	38.8
UNKNOWN..	0	0	0	0	33	67	5.7E+01	0.0
TOTAL....	88	3	4	4	0	0	9.8E+05	100.0

Table 6A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
BROGAN/LLOYD COVE (LOWER SEAM) - 0.46 - 0.61 m (ACI-87-260-03J)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
KAOLINITE	0.0	0.2	1.1	2.3	1.5	0.3	5.3
PYJAR.	0.0	0.0	0.6	0.2	0.6	0.0	1.5
PYRITE	0.0	0.0	2.9	11.6	22.4	34.7	72.2
SIDERITE	0.0	0.0	0.0	0.0	0.0	1.6	1.6
FE-SUL.	0.0	0.0	0.0	0.0	3.1	5.9	9.0
QUARORG.	0.2	1.0	1.3	1.1	0.2	0.0	3.7
QUARPYR.	0.0	0.1	0.2	0.8	0.4	0.9	2.4
MISC.	0.1	0.4	0.7	0.2	1.5	1.4	4.3

Table 6B

: 260-03J

1 DISK 152 FILE 231 - 235 PARTICLES RUN/T 171.00

1 DATE 3/21/88 SUMMARY 234 TOTAL 572 MASS 7.0E+00 UG/CM2 ANAL./T 80.00

29 TIME 10:44 OFF-PT. > 50U 3 > 50U 7.4E-01 UG/CM2 DEAD/T 90.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	79	0	21	0	1.2E+02	0.1
KAOLINITE	0	28	39	28	5	0	6.4E+03	2.8
ILLITE...	0	0	100	0	0	0	1.2E+02	0.1
ORGSULF..	92	4	3	1	0	1	1.9E+04	8.4
PYJAR....	80	4	13	1	1	0	8.4E+03	3.7
PYRITE...	8	14	26	26	18	7	1.3E+04	5.9
SIDERITE.	0	0	0	0	0	100	7.9E+01	0.0
FE-SUL...	0	0	0	0	58	42	8.1E+02	0.4
QUARORG..	85	11	3	1	0	0	1.0E+05	43.6
QUARPYR..	85	7	3	3	1	0	1.5E+04	6.7
MIXSIL...	0	0	65	0	35	0	3.0E+02	0.1
MIXSUL...	68	10	16	7	0	0	1.5E+03	0.7
NOT-INT..	87	11	2	0	0	0	6.3E+04	27.6
UNKNOWN..	0	0	0	0	67	33	7.9E+01	0.0
TOTAL....	79	10	6	3	2	1	2.3E+05	100.0

Table 7A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
BROGAN/LLOYD COVE (LOWER SEAM)- 1.28 - 1.31 m (ACI-87-260-03P)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.0	0.2	0.4	0.5	4.1	5.3
PYRITE	0.0	0.0	4.5	11.6	16.8	31.0	64.6
FE-SUL.	0.0	0.0	0.0	0.5	3.0	14.2	17.7
QUARORG.	0.3	1.0	0.8	0.3	0.8	0.2	3.4
QUARPYR.	0.0	0.1	0.3	0.5	0.9	1.0	2.9
MISC.	0.1	0.1	1.0	1.5	2.9	0.5	6.2

Table 7B

: 87-260-03P

1 DISK 152 FILE 200 - 204 PARTICLES RUN/T !88.00

1 DATE 2/15/88 SUMMARY 203 TOTAL 593 MASS 1.1E+01 UG/CM2 ANAL./T 93.99

30 TIME 15:28 OFF-PT.) 50U 7) 50U 2.4E+00 UG/CM2 DEAD/T 994.00

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	33	0	29	22	9	7	2.2E+03	0.5
KAOLINITE	0	43	29	29	0	0	5.7E+02	0.1
ILLITE...	0	0	77	19	5	0	1.7E+03	0.4
ORGSULF..	98	2	0	0	0	0	8.7E+04	19.7
PYJAR....	64	6	24	0	6	0	4.4E+03	1.0
PYRITE...	60	5	17	11	5	2	5.3E+04	12.0
FE-SUL...	0	0	10	17	32	42	1.9E+03	0.4
QUARORG..	90	8	1	0	0	0	1.8E+05	41.8
QUARPYR..	75	9	8	5	2	1	1.3E+04	3.1
MIXSIL...	0	0	57	28	11	4	1.1E+03	0.3
MIXSUL...	75	0	5	14	6	0	3.4E+03	0.8
APATITE..	0	0	0	0	100	0	8.4E+01	0.0
NOT-INT..	56	29	12	1	2	1	5.9E+04	13.3
UNKNOWN..	98	0	2	0	0	0	2.9E+04	6.6
TOTAL....	82	9	5	2	1	1	4.4E+05	100.0

Table 8A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
PRINCE/HUB - 0.07 - 0.15 m (ACI-87-260-08A)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.1	0.2	2.9	1.9	1.5	1.5	7.9
KAOLINITE	0.2	1.0	1.2	3.2	2.1	0.2	7.9
ILLITE	0.2	0.5	0.7	1.0	0.8	0.0	3.2
PYJAR.	0.0	0.3	1.3	0.9	0.1	0.0	2.6
PYRITE	0.0	3.0	9.1	25.4	7.9	14.5	60.4
FE-SUL.	0.0	0.1	0.0	1.4	1.0	1.6	4.1
QUARORG.	0.5	1.0	0.9	1.2	0.2	0.0	3.8
QUARPYR.	0.2	0.3	1.1	0.5	0.1	1.4	3.5
MIXSIL.	0.2	0.3	2.3	1.0	1.3	0.4	5.6
MISC.	0.0	0.1	0.0	0.4	0.1	0.4	0.9

TABLE 8B

: 87-260-08A

1 DISK 150 FILE 165 - 169 PARTICLES RUN/T 126.00

1 DATE 2/10/88 SUMMARY 168 TOTAL 515 MASS 1.7E+00 UG/CM2 ANAL./T 97.99

27 TIME 12:54 OFF-PT.) 50U 19) 50U 2.6E+00 UG/CM2 DEAD/T 28.00

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	25	13	48	12	2	0	3.2E+03	2.3
KAOLINITE	57	29	7	6	1	0	9.7E+03	7.1
ILLITE...	46	25	20	7	1	0	3.0E+03	2.2
ORGSULF..	0	0	0	100	0	0	7.6E+01	0.1
PYJAR....	0	58	28	14	0	0	1.0E+03	0.8
PYRITE...	8	39	27	23	2	1	8.2E+03	6.0
CALCITE..	0	0	0	0	100	0	4.1E+00	0.0
MONTMORIL	0	0	0	0	0	100	4.1E+00	0.0
FE-SUL...	0	50	0	40	7	4	3.8E+02	0.3
QUARORG..	72	21	6	1	0	0	1.0E+04	7.5
QUARPYR..	87	6	6	1	0	0	1.2E+04	9.3
MIXSIL...	78	6	14	2	1	0	9.8E+03	7.2
MIXSUL...	0	100	0	0	0	0	1.9E+02	0.1
NOT-INT..	81	14	4	1	0	0	5.9E+04	43.0
UNKNOWN..	92	5	2	1	0	0	1.9E+04	14.0
TOTAL....	73	15	8	4	0	0	1.3E+05	100.0

TABLE 9A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
PRINCE/HUB - 1.95 - 2.15 m (ACI-87-260-08N)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.1	0.7	1.1	0.1	0.3	2.3
KAOLINITE	0.0	0.1	0.8	0.4	0.3	0.0	1.6
ILLITE	0.0	0.3	1.6	5.5	1.1	1.6	10.2
PYJAR.	0.0	0.1	0.6	1.4	1.1	1.4	4.7
PYRITE	0.0	0.5	2.5	6.6	15.2	25.9	50.7
FE-SUL.	0.0	0.0	0.0	0.5	0.3	2.8	3.6
QUARORG.	0.2	0.4	2.2	3.5	0.6	0.3	7.2
QUARPYR.	0.0	0.2	1.9	4.8	1.4	2.2	10.5
MIXSIL.	0.0	0.2	1.6	1.1	1.2	2.9	7.1
MISC.	0.0	0.0	0.1	0.0	0.0	2.0	2.1

: 87-260-08N

TABLE 9B

1 DISK 156 FILE 239 - 243 PARTICLES RUN/T 108.00

1 DATE 3/22/88 SUMMARY 242 TOTAL 595 MASS 1.0E+01 UG/CM2 ANAL./T 83.00

30 TIME 9:50 OFF-PT.) 50U 5) 50U 7.7E-01 UG/CM2 DEAD/T 24.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	24	56	18	1	1	4.1E+03	1.6
KAOLINITE	0	21	68	8	3	0	4.6E+03	1.8
ILLITE...	20	22	26	30	2	1	2.0E+04	7.9
ORGSULF..	0	51	49	0	0	0	7.8E+02	0.3
JAROSITE.	0	0	0	0	0	100	2.8E+01	0.0
PYJAR....	34	23	26	14	2	1	8.0E+03	3.0
PYRITE...	12	18	28	25	11	6	1.7E+04	6.5
SIDERITE.	0	0	0	0	0	100	2.8E+01	0.0
FE-SUL...	0	24	0	48	7	21	8.1E+02	0.3
QUARORG..	80	7	8	4	0	0	1.2E+05	47.1
QUARPYR..	11	16	40	29	2	1	1.9E+04	7.4
MIXSIL...	50	18	25	5	1	1	2.3E+04	8.7
MIXSUL...	100	0	0	0	0	0	1.4E+03	0.5
NOT-INT..	49	17	32	1	0	0	3.7E+04	14.1
UNKNOWN..	0	13	39	39	6	3	1.9E+03	0.7
TOTAL....	54	13	21	10	1	1	2.6E+05	100.0

TABLE 10A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
NOVACO/HARBOUR - 0.32 - 0.47 m (ACI-87-260-01H)

MINERAL	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
	SIZE / BIN						
KAOLINITE	0.0	0.6	4.0	2.9	4.2	3.7	15.5
PYRITE	0.0	0.0	3.9	4.4	12.7	34.3	55.3
FE-SUL.	0.0	0.0	0.0	0.0	0.8	4.0	4.8
QUARORG.	1.0	0.7	0.8	0.6	0.3	0.2	3.6
QUARPYR.	0.2	0.1	0.6	1.3	0.9	0.3	3.4
MIXSIL.	0.0	0.5	1.1	1.7	2.6	7.3	13.2
MISC.	0.3	0.3	0.8	0.7	0.8	1.4	4.2

TABLE 10B

: ACI-87-260-01H

1 DISK 149 FILE 120 - 124 PARTICLES RUN/T 155.00

1 DATE 1/29/88 SUMMARY 123 TOTAL 578 MASS 3.2E+00 UG/CM2 ANAL./T130.99

30 TIME 13:24 OFF-PT.) 50U 22) 50U 4.2E+00 UG/CM2 DEAD/T 24.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	94	0	0	6	0	2.7E+02	0.0
KAOLINITE	4	26	53	13	3	1	8.4E+03	1.3
ILLITE...	0	0	97	0	0	3	3.7E+02	0.1
ORGSULF..	99	1	0	0	0	0	7.5E+04	11.9
JAROSITE.	0	0	90	0	10	0	9.8E+01	0.0
PYJAR....	56	12	22	10	0	0	1.6E+03	0.3
PYRITE...	91	1	5	1	1	1	3.8E+04	6.0
SIDERITE.	0	0	0	0	0	100	1.0E+01	0.0
CALCITE..	0	100	0	0	0	0	4.0E+02	0.1
MONTMORIL	0	0	0	0	100	0	1.0E+01	0.0
FE-SUL...	0	0	0	0	36	64	1.1E+02	0.0
QUARORG..	97	2	1	0	0	0	2.0E+05	32.0
QUARPYR..	90	3	4	2	0	0	1.8E+04	2.9
MIXSIL...	0	44	35	14	4	3	3.7E+03	0.6
MIXSUL...	100	0	0	0	0	0	1.1E+03	0.2
NOT-INT..	91	7	2	0	0	0	2.7E+05	43.4
UNKNOWN..	100	0	0	0	0	0	8.7E+03	1.4
TOTAL....	92	4	2	1	0	0	6.3E+05	100.0

TABLE 11A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
NOVACO/HARBOUR - 1.37 - 1.47 m (ACI-87-260-01Q)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.0	0.2	0.3	1.3	0.8	2.6
KAOLINITE	0.0	0.1	0.9	2.5	1.5	2.1	7.0
ILLITE	0.0	0.3	1.1	1.4	3.7	2.1	8.7
PYJAR.	0.1	0.1	2.1	0.3	0.0	0.0	2.6
PYRITE	0.0	0.5	4.1	15.9	11.3	19.0	51.3
SIDERITE	0.0	0.0	0.0	0.0	0.0	4.6	4.6
FE-SUL.	0.0	0.0	0.0	0.0	0.6	2.7	3.4
QUARORG.	0.3	0.4	1.1	1.5	0.7	0.0	4.1
QUARPYR.	0.1	0.2	0.6	0.9	1.1	0.5	3.4
MIXSIL.	0.0	0.1	0.2	0.8	2.3	6.2	9.6
MISC.	0.2	0.2	0.4	1.0	0.5	0.4	2.7

TABLE 11B

: 87-260-01Q

1 DISK 151	FILE 190 - 194 PARTICLES					RUN/T 137.00
1 DATE 2/15/88	SUMMARY 193	TOTAL 597		MASS 6.4E+00	UG/CM2	ANAL./T 92.00
30 TIME 10:24	OFF-PT.	> 50U 3		> 50U 2.7E-01	UG/CM2	DEAD/T 44.99

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	20	39	19	17	4	9.7E+02	0.2
KAOLINITE	0	12	46	34	6	1	5.0E+03	0.9
ILLITE...	9	34	31	15	10	1	7.4E+03	1.3
ORGSULF..	98	1	1	0	0	0	1.0E+05	17.2
PYJAR....	92	1	6	0	0	0	4.2E+04	7.3
PYRITE...	59	9	13	16	2	1	3.2E+04	5.7
SIDERITE.	0	0	0	0	0	100	8.1E+01	0.0
MONTMORIL	0	0	0	0	100	0	2.0E+01	0.0
FE-SUL...	0	50	0	0	20	30	4.0E+02	0.1
QUARORG..	91	5	3	1	0	0	1.0E+05	18.0
QUARPYR..	87	6	4	2	1	0	3.0E+04	5.3
MIXSIL...	90	2	2	4	2	1	2.0E+04	3.6
MIXSUL...	95	1	2	2	0	0	1.8E+04	3.2
NOT-INT..	88	7	3	1	0	0	2.0E+05	35.9
UNKNOWN..	93	2	2	2	0	0	8.6E+03	1.5
TOTAL....	87	5	4	2	1	0	5.8E+05	100.0

TABLE 12 A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
LINGAN/HARBOUR - 1.05 - 1.20 m (ACI-87-260-06H)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.0	3.0	2.6	0.9	1.3	7.7
KAOLINITE	0.0	0.1	1.0	0.0	1.9	1.0	4.0
ILLITE	0.0	0.1	3.5	2.3	0.5	1.5	7.7
CHAMOSITE	0.0	1.1	0.2	13.1	3.4	3.4	21.1
PYJAR.	0.1	0.2	1.0	1.9	0.1	0.0	3.3
PYRITE	0.3	1.5	4.4	12.6	2.8	4.1	25.7
QUARPYR.	0.1	0.2	0.1	1.4	0.2	0.7	2.7
MIXSIL.	0.0	1.0	3.3	5.5	7.4	6.4	23.8
MISC.	0.1	0.0	0.5	2.1	0.6	0.6	4.0

TABLE 12B

.: 87-260-06H

-179 DISK 149 FILE 130 - 134 PARTICLES RUN/T 282.00

1 . DATE 2/ 1/88 SUMMARY 133 TOTAL 598 MASS 4.3E+00 UG/CM2 ANAL./T110.00

30 TIME 10:52 OFF-PT. > 50U 2 > 50U 1.2E-01 UG/CM2 DEAD/T 171.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	77	21	2	1	5.5E+03	2.7
KAOLINITE	33	10	50	0	7	1	3.3E+03	1.7
ILLITE...	0	2	79	18	0	0	7.7E+03	3.8
CHAMOSITE	4	49	5	39	3	1	1.0E+04	5.0
ORGSULF..	0	100	0	0	0	0	1.6E+02	0.1
PYJAR....	35	12	36	17	0	0	2.6E+03	1.3
PYRITE...	41	26	16	17	1	0	1.8E+04	8.9
HALITE...	0	0	0	0	100	0	2.6E+01	0.0
SIDERITE.	0	0	0	95	5	0	2.4E+02	0.1
MONTMORIL	0	0	90	0	0	10	2.5E+02	0.1
FE-SUL...	0	35	61	0	4	0	4.6E+02	0.2
QUARORG..	92	2	4	3	0	0	1.7E+04	8.7
QUARPYR..	44	29	9	16	1	0	2.8E+03	1.4
MIXSIL...	38	23	24	10	3	1	2.2E+04	10.9
UNKCHLOR.	100	0	0	0	0	0	5.3E+03	2.6
NOT-INT..	73	14	9	3	0	0	7.8E+04	38.4
UNKNOWN..	81	10	4	4	1	0	2.8E+04	14.0
TOTAL....	60	15	16	8	1	0	2.0E+05	100.0

TABLE 13A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
LINGAN/HARBOUR - 1.80 - 2.00 m (ACI-87-260-06M)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.7	3.5	2.0	1.2	2.3	9.7
KAOLINITE	0.1	0.4	0.6	3.4	2.4	0.0	6.9
ILLITE	0.0	0.4	1.3	0.8	0.3	0.0	2.8
PYJAR.	0.2	1.6	0.8	0.7	1.3	0.0	4.6
PYRITE	1.2	6.1	9.2	19.6	16.6	9.2	61.3
FE-SUL.	0.1	0.1	0.0	0.0	3.3	2.0	5.3
MIXSIL.	0.3	0.3	3.3	0.8	1.7	0.6	7.0
MISC.	0.5	0.6	0.3	0.0	0.3	0.8	2.4

TABLE 13B

: 87-260-06M

1 DISK 152 FILE 205 - 209 PARTICLES RUN/T 162.00

1 DATE 2/16/88 SUMMARY 208 TOTAL 596 MASS 2.3E+00 UG/CM2 ANAL./T 77.00

30 TIME 11:23 OFF-PT.) 50U 4) 50U 1.6E-01 UG/CM2 DEAD/T 84.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	33	54	11	1	1	5.5E+03	3.2
KAOLINITE	19	30	18	27	6	0	3.0E+03	1.7
ILLITE...	0	56	36	7	1	0	2.8E+03	1.6
ORGSULF..	0	100	0	0	0	0	5.1E+02	0.3
PYJAR....	32	59	7	2	1	0	6.1E+03	3.5
PYRITE...	49	32	10	6	2	0	2.6E+04	15.3
FE-SUL...	54	26	0	0	17	4	8.8E+02	0.5
QUARORG..	96	3	1	0	0	0	1.7E+04	10.0
QUARPYR..	96	4	0	0	0	0	5.8E+03	3.3
MIXSIL...	77	6	15	1	1	0	1.7E+04	9.8
MIXSUL...	68	32	0	0	0	0	2.8E+03	1.6
UNKCHLOR.	0	0	93	0	0	7	1.1E+02	0.1
NOT-INT..	71	23	6	0	0	0	8.3E+04	47.3
UNKNOWN..	26	0	60	13	1	0	3.0E+03	1.7
TOTAL....	65	22	10	2	1	0	1.7E+05	100.0

TABLE 14A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
INDIAN COVE - 0.90 - 1.15 m (ACI-87-260-10G)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
ILLITE	0.0	0.0	0.0	1.2	0.4	1.0	2.6
PYJAR.	0.1	0.5	1.3	3.6	1.1	3.5	10.2
PYRITE	0.0	1.2	9.0	25.2	13.8	10.8	60.0
FE-SUL.	0.0	0.0	0.2	0.2	1.4	2.2	4.1
QUARORG.	0.6	0.9	1.3	5.1	0.9	1.0	9.8
QUARPYR.	0.1	0.4	1.3	4.5	0.6	2.8	9.5
MISC.	0.2	0.1	0.4	1.7	0.5	0.9	3.8

TABLE 14B

: 87-260-10G

1 DISK 149 FILE 135 - 139 PARTICLES RUN/T 296.00

1 DATE 2/ 2/88 SUMMARY 138 TOTAL 592 MASS 1.0E+01 UG/CM2 ANAL./T183.00

30 TIME 8:49 OFF-PT. > 50U 8 > 50U 2.8E+00 UG/CM2 DEAD/T 113.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	91	0	0	9	0	3.3E+02	0.0
ILLITE...	0	0	0	85	10	5	1.3E+03	0.2
ORGSULF..	100	0	0	0	0	0	7.0E+04	10.2
PYJAR....	71	11	11	6	1	0	3.9E+04	5.8
PYRITE...	0	15	42	36	5	1	3.7E+04	5.5
SIDERITE.	0	0	0	0	0	100	3.0E+01	0.0
FE-SUL...	0	0	50	24	15	11	1.5E+03	0.2
QUARORG..	93	4	1	2	0	0	3.5E+05	50.7
QUARPYR..	41	17	18	22	1	1	2.6E+04	3.8
MIXSIL...	61	0	19	19	1	0	3.9E+03	0.6
MIXSUL...	97	0	1	2	0	0	3.5E+04	5.1
NOT-INT..	66	18	10	4	1	1	9.7E+04	14.1
UNKNOWN..	97	1	0	1	0	0	2.5E+04	3.7
TOTAL....	81	7	6	5	1	0	6.9E+05	100.0

TABLE 15A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
PHALEN COL./PHALEN - 0.00 - 0.15 m (ACI-87-260-07A)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.1	0.5	0.8	1.2	0.0	2.6
KAOLINITE	0.1	0.2	1.4	3.7	0.7	0.9	6.9
ILLITE	0.0	0.2	0.9	0.4	0.4	0.0	1.9
PYRITE	0.0	0.7	5.2	14.2	26.1	28.3	74.5
FE-SUL.	0.0	0.0	0.0	0.2	1.9	3.4	5.5
MIXSIL.	0.1	0.1	0.5	0.2	0.8	0.3	1.9
MISC.	0.1	0.4	1.8	1.9	0.9	1.7	6.8

TABLE 15B

: 87-260-07A

1	DISK	149	FILE 101 - 104	PARTICLES			RUN/T	67.00
1	DATE	1/28/88	SUMMARY 103	TOTAL 429	MASS 2.1E+00	UG/CM2	ANAL./T	58.00
22	TIME	9:23	OFF-PT.	> 50U 4	> 50U 2.8E-01	UG/CM2	DEAD/T	8.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	19	59	16	7	0	1.0E+03	1.9
KAOLINITE	72	7	12	9	1	0	9.3E+03	16.3
ILLITE...	0	28	62	8	2	0	1.4E+03	2.6
GYPSUM...	0	0	100	0	0	0	5.8E+01	0.1
ORGSULF..	0	0	0	100	0	0	5.8E+01	0.1
PYJAR....	0	0	83	17	0	0	3.4E+02	0.6
PYRITE...	0	15	37	30	14	4	5.4E+03	9.5
HALITE...	0	0	0	0	0	100	7.6E+00	0.0
SIDERITE.	0	0	0	0	50	50	1.4E+01	0.0
CALCITE..	0	0	0	0	100	0	2.2E+01	0.0
FE-SUL...	0	0	0	29	45	25	1.9E+02	0.3
QUARORG..	64	24	9	2	0	0	2.5E+03	4.4
QUARPYR..	49	31	14	6	0	0	2.0E+03	3.6
MIXSIL...	96	1	2	0	0	0	1.9E+04	33.7
MIXSUL...	53	0	21	26	0	0	1.3E+03	2.4
UNKCHLOR.	0	0	100	0	0	0	5.8E+01	0.1
NOT-INT..	0	56	32	10	2	1	3.0E+03	5.3
UNKNOWN..	91	0	6	2	0	0	1.0E+04	19.0
TOTAL....	67	9	14	7	2	1	5.7E+04	100.0

TABLE 16A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
PHALEN COL./PHALEN - 1.65 - 1.83 m (ACI-87-260-07L)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
PYJAR.	0.0	0.3	3.3	0.2	0.2	0.3	4.4
PYRITE	0.0	2.6	28.1	23.0	17.9	12.8	85.2
FE-SUL.	0.0	0.0	0.0	0.0	1.9	3.5	5.4
MISC.	0.2	0.8	0.9	1.2	1.4	0.4	5.0

TABLE 16B

: 87-260-07L

1 DISK 151 FILE 175 - 179 PARTICLES RUN/T 112.99

1 DATE 2/11/88 SUMMARY 178 TOTAL 595 MASS 6.7E+00 UG/CM2 ANAL./T 92.00

30 TIME 14:28 OFF-PT. > 50U 5 > 50U 7.8E-01 UG/CM2 DEAD/T 20.99

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	0	0	100	0	6.2E+01	0.0
KAOLINITE	0	35	0	62	4	0	8.7E+02	0.5
ILLITE...	0	0	0	0	100	0	3.3E+01	0.0
ORGSULF..	75	25	0	0	0	0	6.1E+02	0.4
PYJAR....	43	17	38	2	0	0	1.5E+04	8.8
PYRITE...	13	19	51	14	3	0	7.0E+04	41.2
CALCITE..	80	0	0	20	0	0	1.3E+03	0.8
FE-SUL...	0	0	0	0	76	24	5.1E+02	0.3
QUARORG..	61	25	14	0	0	0	1.9E+03	1.1
QUARPYR..	83	10	0	7	1	0	3.9E+03	2.3
MIXSIL...	0	91	0	0	0	9	1.6E+02	0.1
MIXSUL...	94	6	0	0	0	0	1.4E+04	8.4
APATITE..	43	29	25	0	3	0	1.0E+03	0.6
NOT-INT..	78	19	3	0	0	0	3.6E+04	21.2
UNKNOWN..	94	4	2	0	0	0	2.4E+04	14.2
TOTAL....	51	15	25	6	2	0	1.7E+05	100.0

TABLE 17A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
EMERY/STEEL'S HILL - 0.00 - 0.13 m (ACI-87-260-04Q)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.4	1.1	1.7	3.2	1.1	7.5
KAOLINITE	0.1	0.9	3.2	2.1	2.0	2.0	10.3
ILLITE	0.6	1.9	4.4	3.6	2.8	5.9	19.0
PYRITE	0.0	0.4	4.2	3.9	13.7	13.7	35.0
SIDERITE	0.0	0.0	0.2	0.0	0.0	2.9	3.1
FE-SUL.	0.0	0.0	0.0	0.0	2.0	1.3	3.3
QUARORG.	0.4	0.5	0.7	0.7	0.3	0.6	3.2
QUARPYR.	0.2	0.3	1.2	0.9	0.3	1.6	4.4
MIXSIL.	0.4	0.9	3.0	2.3	1.8	3.8	12.2
MISC.	0.2	0.4	0.7	0.0	0.7	0.0	1.9

TABLE 17B

: 87-260-04Q

1 DISK 156	FILE 259 - 263	PARTICLES				RUN/T 149.00
1 DATE 3/24/88	SUMMARY 262	TOTAL 599		MASS 4.9E+00	UG/CM2	ANAL./T 82.00
30 TIME 13:58	OFF-PT.	> 50U	1	> 50U 9.6E-01	UG/CM2	DEAD/T 66.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	32	44	16	7	1	5.1E+03	1.1
KAOLINITE	40	30	25	4	1	0	2.2E+04	4.8
ILLITE...	80	10	8	2	0	0	1.1E+05	23.8
ORGSULF..	0	0	0	0	100	0	1.7E+01	0.0
PYJAR....	71	15	13	0	1	0	6.7E+03	1.5
PYRITE...	55	9	20	8	7	2	1.3E+04	2.8
SIDERITE.	0	0	85	0	0	15	2.3E+02	0.1
MONTMORIL	83	17	0	0	0	0	5.7E+03	1.2
FE-SUL...	0	0	0	0	75	25	2.0E+02	0.0
QUARORG..	94	4	1	0	0	0	1.1E+05	25.4
QUARPYR..	49	24	20	6	0	0	1.2E+04	2.7
MIXSIL...	91	4	4	1	0	0	1.3E+05	29.5
UNKCHLOR.	0	0	0	0	100	0	1.7E+01	0.0
NOT-INT..	15	69	14	1	1	0	2.9E+04	6.3
UNKNOWN..	34	32	14	13	2	6	3.1E+03	0.7
TOTAL....	78	12	7	2	1	0	4.6E+05	100.0

TABLE 18A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
EMERY/STEEL'S HILL - 1.08 - 1.23 m (ACI-87-260-04J)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.4	10.4	3.7	2.7	1.1	18.3
KAOLINITE	0.0	0.3	7.7	14.8	3.0	3.8	29.6
ILLITE	0.0	0.3	6.9	8.5	0.5	0.0	16.0
PYRITE	0.0	0.3	0.0	0.0	6.8	1.6	8.6
FE-SUL.	0.0	0.0	0.0	0.0	1.0	1.5	2.5
QUARORG.	0.3	0.7	1.1	1.2	0.3	0.0	3.6
QUARPYR.	0.1	0.2	1.1	0.0	0.1	1.2	2.8
MIXSIL.	0.0	0.4	8.4	2.8	2.8	3.2	17.5
MISC.	0.0	0.0	0.3	0.0	0.4	0.3	1.0

TABLE 18B

: 87-260-04J

1 DISK 157 FILE 265 - 268 PARTICLES RUN/T 124.00

1 DATE 3/25/88 SUMMARY 267 TOTAL 477 MASS 1.7E+00 UG/CM2 ANAL./T 71.00

24 TIME 9:17 OFF-PT. > 50U 0 > 50U 0.0E+00 UG/CM2 DEAD/T 52.99

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	12	75	11	2	0	7.3E+03	8.2
KAOLINITE	0	5	56	36	2	0	8.5E+03	9.6
ILLITE...	0	10	61	29	0	0	6.2E+03	7.0
ORGSULF..	0	0	100	0	0	0	1.6E+02	0.2
PYJAR....	0	0	0	0	100	0	9.7E+00	0.0
PYRITE...	0	74	0	0	24	2	6.2E+02	0.7
SIDERITE.	0	0	0	0	0	100	4.6E+00	0.0
MONTMORIL	0	0	100	0	0	0	1.7E+02	0.2
FE-SUL...	0	0	0	0	58	42	4.9E+01	0.1
QUARORG..	81	13	5	1	0	0	1.5E+04	17.4
QUARPYR..	67	8	24	0	0	0	3.6E+03	4.1
MIXSIL...	18	8	65	7	2	0	7.5E+03	8.4
MIXSUL...	0	0	0	0	100	0	6.6E+00	0.0
APATITE..	0	0	0	0	100	0	4.6E+00	0.0
NOT-INT..	55	19	23	2	0	0	2.5E+04	28.7
UNKNOWN..	96	1	1	1	0	0	1.3E+04	15.4
TOTAL....	49	12	30	8	1	0	8.9E+04	100.0

TABLE 19A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
LR EMERY/STEEL'S HILL - 0.00 - 0.15 m (ACI-87-260-05D)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.5	5.8	8.7	0.8	0.3	16.1
KAOLINITE	0.0	1.7	13.8	14.8	2.4	1.0	33.7
ILLITE	0.0	0.5	3.0	5.9	0.2	0.0	9.5
PYRITE	0.1	0.5	0.3	4.2	4.6	1.6	11.3
QUARORG.	0.5	1.8	3.2	1.7	0.1	0.0	7.2
QUARPYR.	0.1	0.4	1.6	0.0	0.2	0.4	2.6
MIXSIL.	0.0	1.3	7.9	3.9	3.8	0.9	17.9
MISC.	0.1	0.2	0.2	0.0	0.5	0.6	1.6

TABLE 19B

: 87-260-05D

1 DISK 149 FILE 145 - 149 PARTICLES RUN/T 150.00

1 DATE 2/ 3/88 SUMMARY 148 TOTAL 600 MASS 4.8E+00 UG/CM2 ANAL./T 73.99

30 TIME 9:42 OFF-PT. > 50U 0 > 50U 0.0E+00 UG/CM2 DEAD/T 76.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	16	61	22	1	0	1.4E+04	4.3
KAOLINITE	15	17	50	17	1	0	5.0E+04	15.2
ILLITE...	8	23	46	22	0	0	1.2E+04	3.8
PYJAR....	0	98	0	0	2	0	7.4E+02	0.2
PYRITE...	18	27	12	35	8	1	4.0E+03	1.2
SIDERITE.	0	0	0	0	0	100	8.1E+00	0.0
MONTMORIL	0	0	0	0	100	0	9.5E+00	0.0
FE-SUL...	0	0	0	0	80	20	3.9E+01	0.0
QUARORG..	74	16	8	1	0	0	1.0E+05	30.6
QUARPYR..	82	11	7	0	0	0	3.4E+04	10.5
MIXSIL...	22	29	42	6	2	0	3.2E+04	9.9
MIXSUL...	100	0	0	0	0	0	1.5E+04	4.5
NOT-INT..	44	37	17	1	0	0	6.4E+04	19.2
UNKNOWN..	38	37	24	0	1	0	1.9E+03	0.6
TOTAL....	49	21	23	6	0	0	3.3E+05	100.0

TABLE 20A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
LR EMERY/STEEL'S HILL - 0.25 - 0.30 m (ACI-87-260-05G)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
KAOLINITE	0.0	0.0	0.1	0.3	0.4	1.4	2.2
ILLITE	0.0	0.0	0.4	1.2	0.4	0.0	2.0
PYJAR.	0.1	0.3	0.7	1.6	2.2	0.0	5.0
PYRITE	0.0	0.7	7.0	23.7	23.0	15.3	69.6
SIDERITE	0.0	0.0	0.0	0.0	0.9	3.4	4.3
FE-SUL.	0.0	0.0	0.0	0.3	2.9	3.5	6.6
QUARORG.	0.1	0.3	0.5	0.8	0.3	0.0	2.0
QUARPYR.	0.0	0.1	0.4	0.9	1.6	1.5	4.5
MISC.	0.1	0.3	0.9	0.8	0.6	0.9	3.8

TABLE 20B

: 87-260-056

1 DISK 151 FILE 185 - 189 PARTICLES RUN/T 157.99

1 DATE 2/12/88 SUMMARY 188 TOTAL 571 MASS 1.0E+01 UG/CM2 ANAL./T133.00

29 TIME 14: 5 OFF-PT.) 50U 3) 50U 8.0E-01 UG/CM2 DEAD/T 24.99

SIZE DISTRIBUTION

TYPE	.2-1.	1.-2.5	2.5-5.	5.-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	82	15	3	0	1.4E+03	0.4
KAOLINITE	0	0	43	43	9	4	1.0E+03	0.3
ILLITE...	0	8	49	41	3	0	2.7E+03	0.8
ORGSULF..	96	4	0	0	0	0	1.0E+05	29.8
PYJAR....	84	6	5	3	1	0	3.9E+04	11.2
PYRITE...	6	18	31	33	10	2	3.4E+04	9.7
SIDERITE.	0	0	0	0	46	54	3.1E+02	0.1
MONTMORIL	0	100	0	0	0	0	2.0E+02	0.1
FE-SUL...	0	0	0	17	58	25	1.3E+03	0.4
QUARORG..	79	13	5	2	0	0	4.4E+04	12.6
QUARPYR..	85	4	5	5	2	0	2.8E+04	7.9
MIXSIL...	0	35	57	0	6	3	1.5E+03	0.4
MIXSUL...	95	4	1	0	0	0	1.5E+04	4.4
NOT-INT..	75	14	6	2	2	1	7.1E+04	20.8
UNKNOWN..	81	0	12	6	1	0	7.1E+03	2.0
TOTAL....	76	9	7	5	2	0	3.5E+05	100.0

TABLE 21A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SPENCER PM-45 - 0.00 - 0.30 m (ACI-87-260-12D)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.0	0.2	0.0	2.2	0.8	3.2
KAOLINITE	0.1	0.6	1.7	2.7	1.4	0.4	6.9
ILLITE	0.0	0.2	2.2	6.5	2.7	12.4	24.2
PYJAR.	0.1	0.9	0.9	2.8	1.1	0.4	6.2
PYRITE	0.3	3.7	2.0	7.2	7.7	7.7	28.7
SIDERITE	0.0	0.0	0.0	0.0	0.0	2.3	2.3
FE-SUL.	0.0	0.1	0.0	0.9	1.8	3.5	6.3
QUARORG.	1.7	2.1	1.9	0.6	0.6	1.1	8.1
QUARPYR.	0.3	1.9	0.6	1.3	1.1	0.1	5.3
MIXSIL.	0.0	0.4	1.5	2.5	1.0	1.9	7.4
MISC.	0.4	0.4	0.2	0.4	0.2	0.0	1.5

TABLE 21B

: 87-260-12D

1 DISK 156 FILE 244 - 248 PARTICLES RUN/T 191.00

1 DATE 3/22/88 SUMMARY 247 TOTAL 593 MASS 3.5E+00 UG/CM2 ANAL./T180.00

30 TIME 13: 7 OFF-PT.) 50U 7) 50U 1.9E+00 UG/CM2 DEAD/T 11.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	0	42	0	51	7	2.8E+02	0.0
KAOLINITE	49	20	18	12	1	0	1.1E+04	2.0
ILLITE...	15	17	34	29	2	2	8.3E+03	1.4
ORGSULF..	98	2	0	0	0	0	5.2E+04	8.9
PYJAR....	25	52	13	9	1	0	6.7E+03	1.1
PYRITE...	76	18	2	3	1	0	5.5E+04	9.4
SIDERITE.	0	0	0	0	0	100	2.0E+01	0.0
MONTMORIL	0	88	12	0	0	0	1.0E+03	0.2
FE-SUL...	0	79	0	9	8	3	1.3E+03	0.2
QUARORG..	95	4	1	0	0	0	2.6E+05	45.3
QUARPYR..	40	49	7	3	1	0	1.4E+04	2.5
MIXSIL...	0	50	30	18	2	1	5.5E+03	0.9
MIXSUL...	100	0	0	0	0	0	1.8E+03	0.3
NOT-INT..	71	25	2	1	0	0	1.5E+05	27.1
UNKNOWN..	86	0	7	7	0	0	3.6E+03	0.6
TOTAL....	82	14	3	2	0	0	5.9E+05	100.0

TABLE 22A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SPENCER PM-48 - 0.60 - 0.90 m (ACI-87-260-13F)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.2	1.7	4.6	1.4	1.7	9.7
KAOLINITE	0.1	0.2	0.2	0.5	0.8	1.8	3.6
ILLITE	0.1	0.6	1.0	0.7	0.1	0.8	3.3
PYJAR.	0.3	0.5	0.9	1.5	0.6	0.7	4.4
PYRITE	0.0	4.3	3.0	5.2	10.8	20.3	43.1
SIDERITE	0.0	0.0	0.0	0.0	0.0	3.7	3.7
FE-SUL.	0.0	0.0	0.0	0.0	1.7	3.9	5.6
QUARORG.	0.4	0.6	1.6	2.7	2.4	2.7	10.4
QUARPYR.	0.1	0.4	1.7	2.7	0.9	2.7	8.5
MIXSIL.	0.1	0.2	0.2	1.3	2.2	1.7	5.7
MISC.	0.2	0.4	0.6	0.0	0.1	0.6	2.0

TABLE 22B

: 87-260-13F

1 DISK 156 FILE 254 - 258 PARTICLES RUN/T 277.00

1 DATE 3/23/88 SUMMARY 257 TOTAL 512 MASS 1.4E+00 UG/CM2 ANAL./T207.99

26 TIME 13:49 OFF-PT. > 50U 1 > 50U 2.9E-01 UG/CM2 DEAD/T 69.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	21	43	32	3	1	1.4E+03	2.2
KAOLINITE	56	32	5	5	1	1	1.8E+03	2.7
ILLITE...	29	45	20	6	0	0	2.1E+03	3.1
CHAMOSITE	0	65	35	0	0	0	2.3E+02	0.4
ORGSULF..	91	8	1	0	0	0	5.6E+03	8.4
JAROSITE.	0	0	0	0	0	100	5.4E+00	0.0
PYJAR....	66	20	8	4	1	0	3.0E+03	4.5
PYRITE...	24	57	8	7	3	1	6.5E+03	9.7
SIDERITE.	0	0	0	0	0	100	1.0E+01	0.0
CALCITE..	0	0	100	0	0	0	4.2E+01	0.1
MONTMORIL	0	100	0	0	0	0	1.7E+02	0.3
FE-SUL...	0	0	0	0	64	36	5.4E+01	0.1
QUARORG..	87	7	4	2	0	0	1.8E+04	26.9
QUARPYR..	82	9	6	4	0	0	1.3E+04	19.3
MIXSIL...	57	24	7	9	3	1	1.9E+03	2.9
MIXSUL...	78	17	4	0	0	0	1.2E+03	1.8
NOT-INT..	11	59	18	8	2	1	8.4E+03	12.5
UNKNOWN..	62	17	11	7	2	1	3.5E+03	5.3
TOTAL....	62	23	8	5	1	0	6.7E+04	100.0

TABLE 23A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
SAMPLE # GARDINER 0.00 - 0.15 m (ACI-87-232-01)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.2	1.9	5.8	1.0	0.4	9.2
KAOLINITE	0.1	0.8	2.8	5.4	2.5	1.6	13.3
ILLITE	0.3	1.0	5.1	7.4	1.6	0.5	15.9
PYRITE	0.0	0.2	0.9	9.5	7.1	5.9	23.6
QUARORG.	1.1	0.7	3.5	1.2	0.2	0.0	6.6
QUARPYR.	0.3	0.5	1.6	0.4	0.1	0.0	2.9
MIXSIL.	0.3	1.0	4.3	6.5	4.0	9.0	25.1
MISC.	0.1	0.2	0.0	1.6	0.8	0.8	3.5

TABLE 23B

: 86-232-01

1 DISK 149 FILE 110 - 114 PARTICLES RUN/T 106.00

1 DATE 1/28/88 SUMMARY 113 TOTAL 598 MASS 3.1E+00 UG/CM2 ANAL./T 93.99

30 TIME 13:39 OFF-PT. > 50U 2 > 50U 8.7E-02 UG/CM2 DEAD/T 12.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	14	45	39	2	0	3.4E+03	0.7
KAOLINITE	56	16	16	11	1	0	1.4E+04	3.2
ILLITE...	86	5	6	3	0	0	6.1E+04	13.2
CHAMOSITE	0	100	0	0	0	0	4.6E+02	0.1
GYPSUM...	100	0	0	0	0	0	1.5E+03	0.3
PYRITE...	25	10	24	31	9	1	2.4E+03	0.5
SIDERITE.	0	0	0	0	100	0	1.7E+01	0.0
RUTILE...	0	0	0	100	0	0	1.9E+02	0.0
MONTMORIL	100	0	0	0	0	0	5.6E+03	1.2
FE-SUL...	0	0	0	0	78	22	3.9E+01	0.0
QUARORG..	93	3	3	0	0	0	7.8E+04	16.8
QUARPYR..	76	12	11	2	0	0	1.2E+04	2.6
MIXSIL...	79	8	8	4	1	0	4.4E+04	9.5
MIXSUL...	0	0	0	100	0	0	1.9E+02	0.0
NOT-INT..	85	8	5	1	0	0	2.3E+05	50.2
UNKNOWN..	66	18	11	3	2	0	6.7E+03	1.4
TOTAL....	84	7	6	2	0	0	4.6E+05	100.0

TABLE 24A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
MULLINS NW-13 - 0.70 - 0.95 m (ACI-87-260-14G)

MINERAL	SIZE / BIN						
	0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
KAOLINITE	0.0	0.2	0.3	1.6	0.7	0.0	2.8
ORGSULF.	0.1	0.2	0.1	1.6	0.0	0.2	2.2
PYJAR.	0.0	0.3	3.5	1.3	1.6	1.4	8.0
PYRITE	0.0	0.5	7.8	6.8	15.6	17.5	48.7
SIDERITE	0.0	0.0	0.0	0.0	0.0	3.8	3.8
FE-SUL.	0.0	0.0	0.1	0.9	1.2	7.0	9.2
QUARORG.	0.3	1.4	2.3	1.9	0.9	0.7	7.4
QUARPYR.	0.0	0.2	2.1	2.7	1.8	5.4	12.2
MISC.	0.1	0.2	2.1	0.8	1.9	0.8	5.8

TABLE 24B

: 87-260-14G

1 DISK 156 FILE 249 - 253 PARTICLES RUN/T 138.00

1 DATE 3/23/88 SUMMARY 252 TOTAL 581 MASS 3.7E+00 UG/CM2 ANAL./T 93.99

30 TIME 9:28 OFF-PT.) 50U 5) 50U 1.0E+00 UG/CM2 DEAD/T 44.00

SIZE DISTRIBUTION

TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	63	0	0	37	0	3.3E+02	0.2
KAOLINITE	12	41	20	23	4	0	2.8E+03	1.9
ILLITE...	0	56	41	0	2	0	2.1E+03	1.4
ORGSULF..	94	4	0	1	0	0	5.2E+04	34.3
PYJAR....	8	20	60	10	2	0	4.8E+03	3.2
PYRITE...	16	15	45	14	8	2	1.0E+04	6.7
SIDERITE.	0	0	0	0	0	100	2.3E+01	0.0
FE-SUL...	0	0	30	30	15	25	5.5E+02	0.4
QUARORG..	62	26	10	2	0	0	3.5E+04	23.3
QUARPYR..	0	34	45	16	2	2	6.0E+03	4.0
MIXSIL...	0	0	93	0	5	1	8.8E+02	0.6
MIXSUL...	95	0	4	1	0	0	2.0E+04	13.1
NOT-INT..	4	20	61	14	1	0	1.6E+04	10.8
UNKNOWN..	0	0	76	0	11	13	4.3E+02	0.3
TOTAL....	61	14	18	5	1	0	1.5E+05	100.0

TABLE 2 5A

C.M.A. - NORMALIZED WEIGHT DISTRIBUTION
MULLINS NW-16 - 0.75 - 1.00 m (ACI-87-260-15H)

MINERAL	SIZE / BIN 0.2-.1 um	1-2.5 um	2.5-5 um	5-10 um	10-20 um	>20 um	TOTAL
QUARTZ	0.0	0.1	0.8	1.6	2.2	0.5	5.2
KAOLINITE	0.0	0.0	0.6	2.9	1.0	2.1	6.7
ILLITE	0.0	0.2	0.9	3.1	0.1	0.0	4.3
ORGSULF.	0.2	0.2	2.0	2.7	0.1	0.3	5.4
PYJAR.	0.0	0.2	0.9	0.3	1.0	0.6	3.1
PYRITE	0.0	1.0	8.4	16.2	16.2	9.9	52.3
FE-SUL.	0.0	0.0	0.2	0.0	2.6	2.9	5.7
QUARORG.	0.4	0.9	1.8	3.0	2.3	0.5	9.0
QUARPYR.	0.1	0.2	0.6	1.6	1.3	1.4	5.1
MISC.	0.1	0.3	0.1	0.9	1.6	0.3	3.2

TABLE 2 5B

: 87-260-15H

1 DISK 157	FILE 269 - 273	PARTICLES					RUN/T	267.00
1 DATE 3/25/88	SUMMARY	272	TOTAL	549	MASS 3.7E+00	UG/CM2	ANAL./T	261.99
28 TIME 13:53	OFF-PT.		) 50U	6	) 50U 1.7E+00	UG/CM2	DEAD/T	5.00

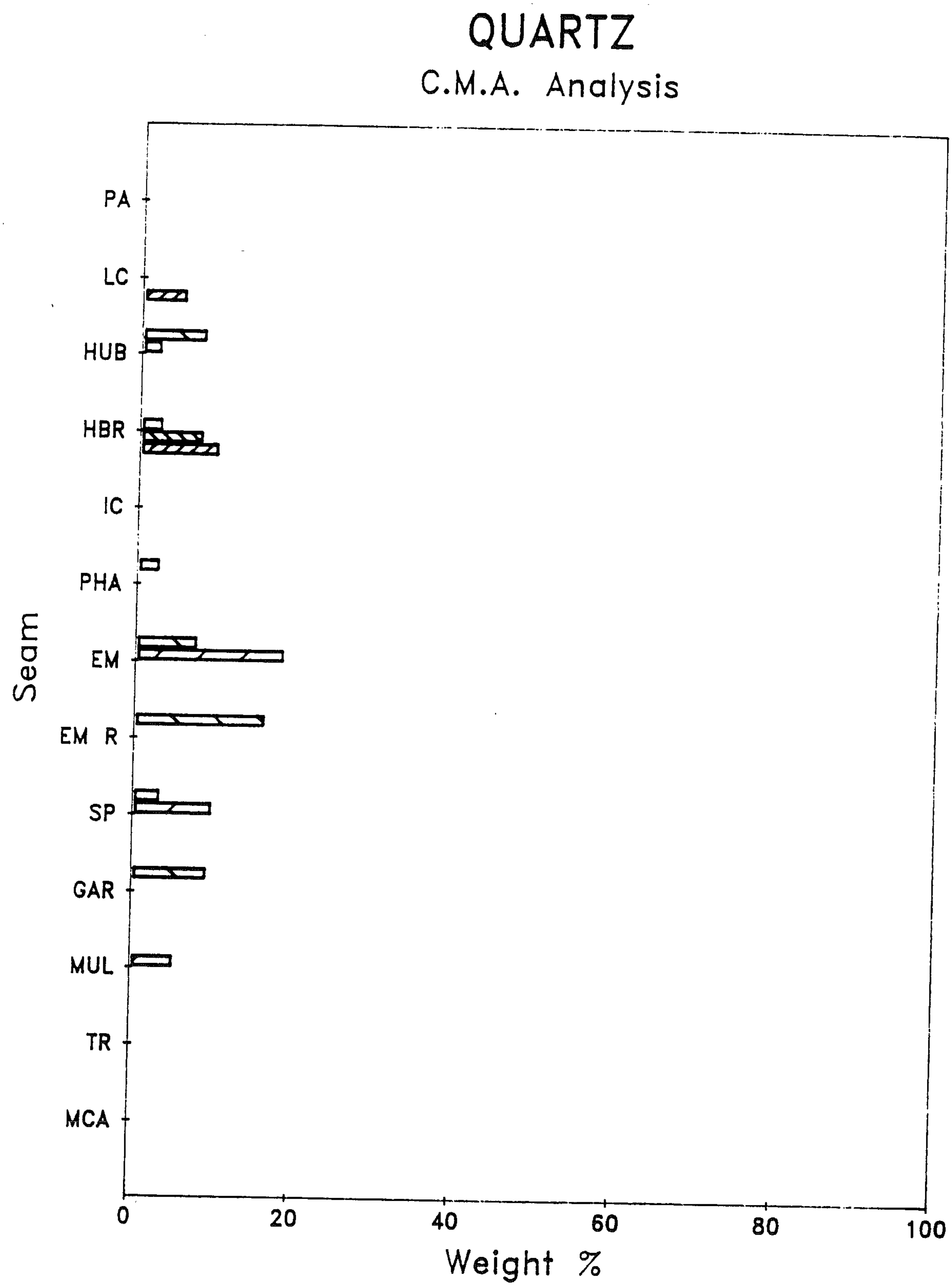
SIZE DISTRIBUTION

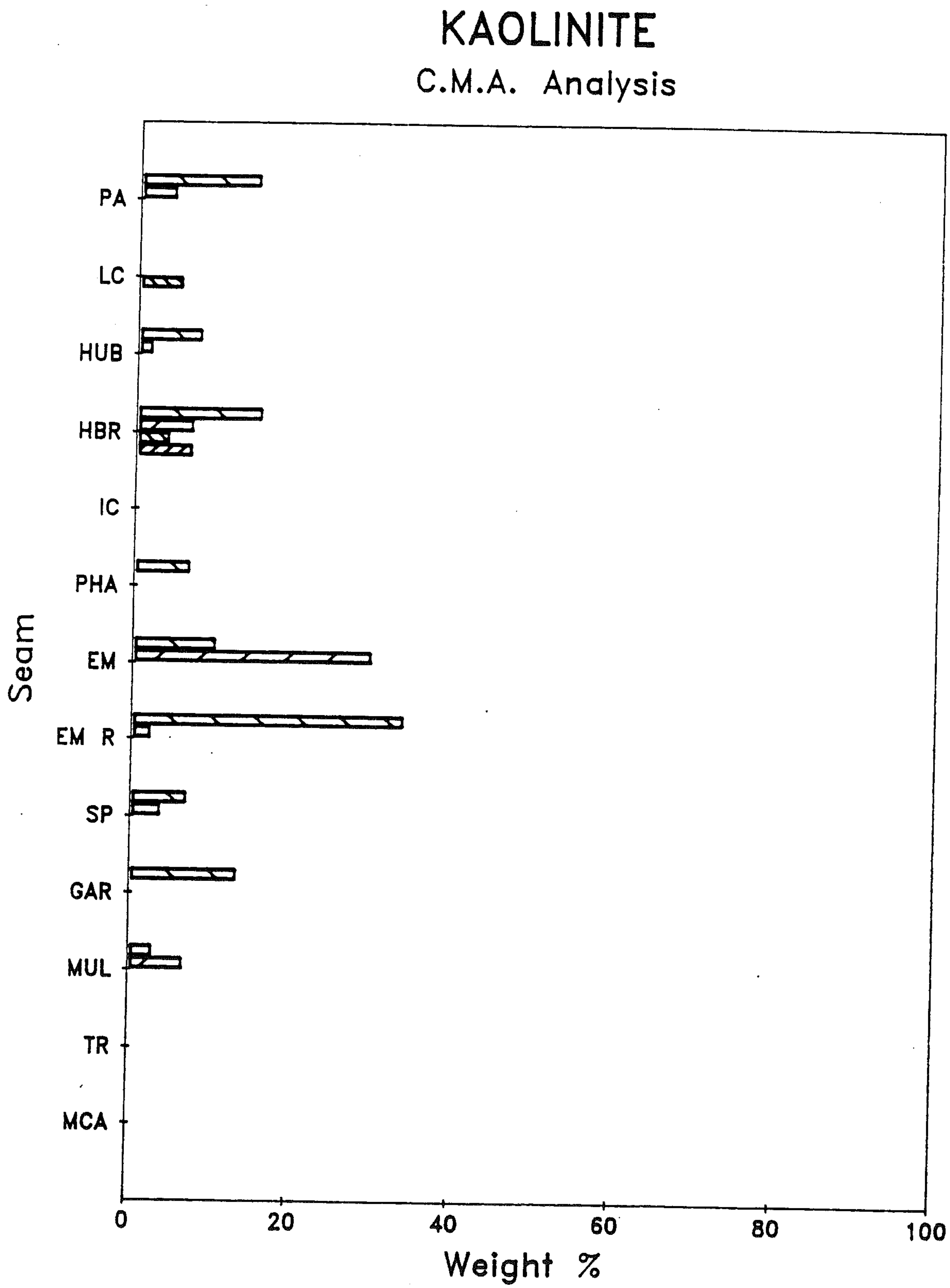
TYPE	0.2-1	1-2.5	2.5-5	5-10	10-20	+20	PART/CM2	%TOTAL
QUARTZ...	0	15	52	22	10	1	1.9E+03	1.0
KAOLINITE	0	0	38	52	6	3	1.9E+03	1.0
ILLITE...	0	23	31	45	0	0	3.2E+03	1.7
ORGSULF..	89	4	5	2	0	0	6.3E+04	31.9
PYJAR....	14	44	30	7	4	1	2.0E+03	1.0
PYRITE...	37	16	24	17	5	1	1.9E+04	9.8
SIDERITE.	0	0	0	0	100	0	1.6E+01	0.0
MONTMORIL	0	90	0	0	10	0	1.7E+02	0.1
FE-SUL...	0	0	52	0	36	12	5.6E+02	0.3
QUARORG..	83	9	5	3	1	0	4.9E+04	24.9
QUARPYR..	30	20	33	10	6	2	3.0E+03	1.6
MIXSIL...	0	67	0	21	11	0	6.8E+02	0.3
MIXSUL...	0	0	0	90	10	0	1.6E+02	0.1
NOT-INT..	71	15	11	0	2	0	4.1E+04	21.1
UNKNOWN..	95	3	1	0	0	0	1.0E+04	5.3
TOTAL....	73	10	10	5	2	0	1.9E+05	100.0

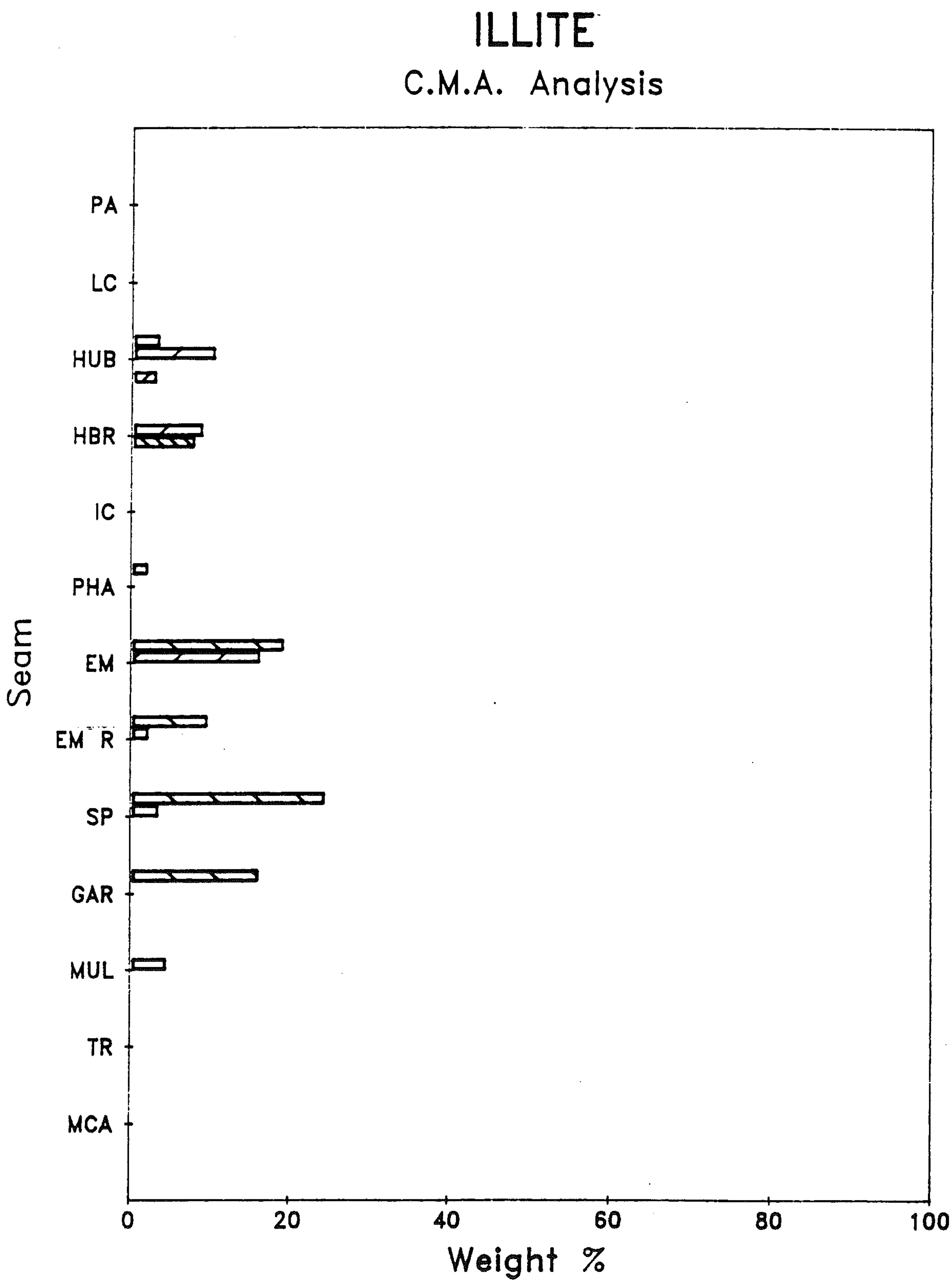
APPENDIX III (B)

AUTOMATED S.E.M. - C.M.A. PLOTS

Weight % QUARTZ	vs	SEAMS
Weight % KAOLINITE	vs	SEAMS
Weight % ILLITE	vs	SEAMS
Weight % MIXSIL (Mixed Silicates)	vs	SEAMS
Weight % QUARORG (Organics + Quartz)	vs	SEAMS
Weight % PYRITE	vs	SEAMS
Weight % PYRJAR PYRITE-JAROSITE	vs	SEAMS
Weight % Fe-SUL (Iron sulphides)	vs	SEAMS
Weight % QUARPYR (fine pyrites in clay	vs	SEAMS
Weight % C.M.A Clays	vs	GALLIUM in ash (ppm)
Weight % C.M.A. S-bearing minerals/fractions	vs	GALLIUM in ash (ppm)

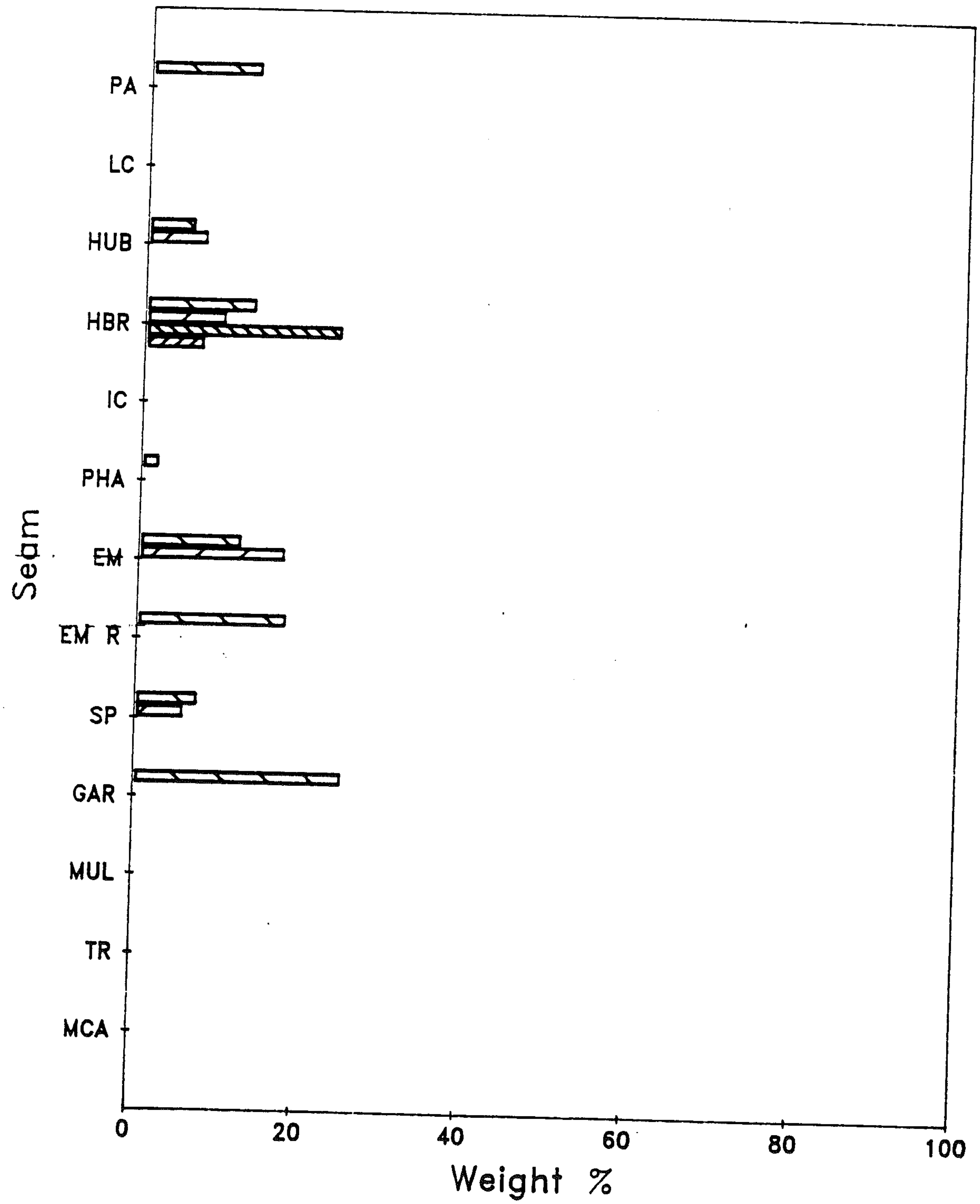

QUARTZ
C.M.A. Analysis
PA
LC
HUB
HBR
IC
PHA
EM
EM R
SP
GAR
MUL
TR
MCA
Seam
0
20
40
60
80
100
Weight %


KAOLINITE
C.M.A. Analysis
Seam
PA
LC
HUB
HBR
IC
PHA
EM
EM R
SP
GAR
MUL
TR
MCA
0
20
40
60
80
100
Weight %


ILLITE
C.M.A. Analysis
PA
LC
HUB
HBR
IC
PHA
EM
EM R
SP
GAR
MUL
TR
MCA
Seam
0
20
40
60
80
100
Weight %

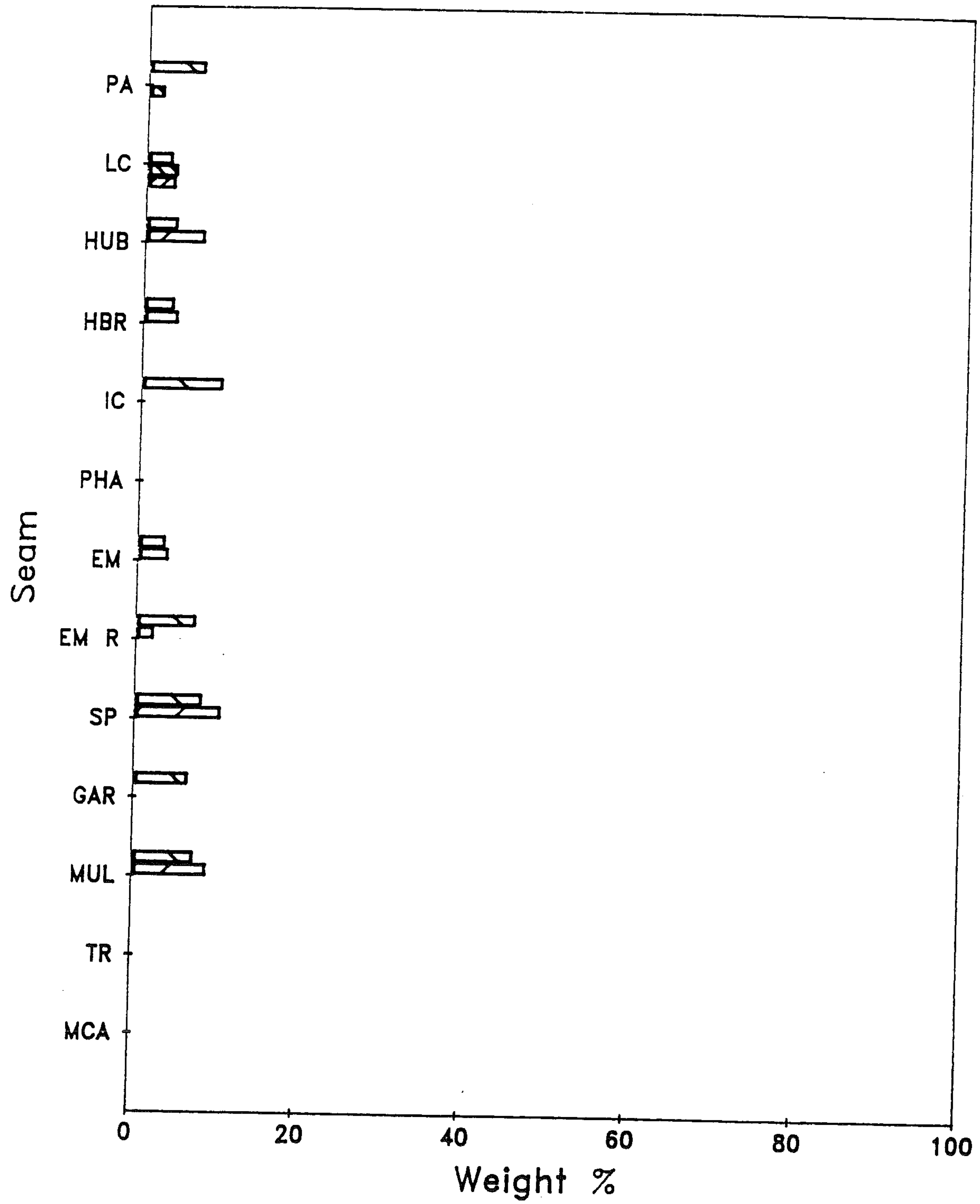
MIXSIL

C.M.A. Analysis



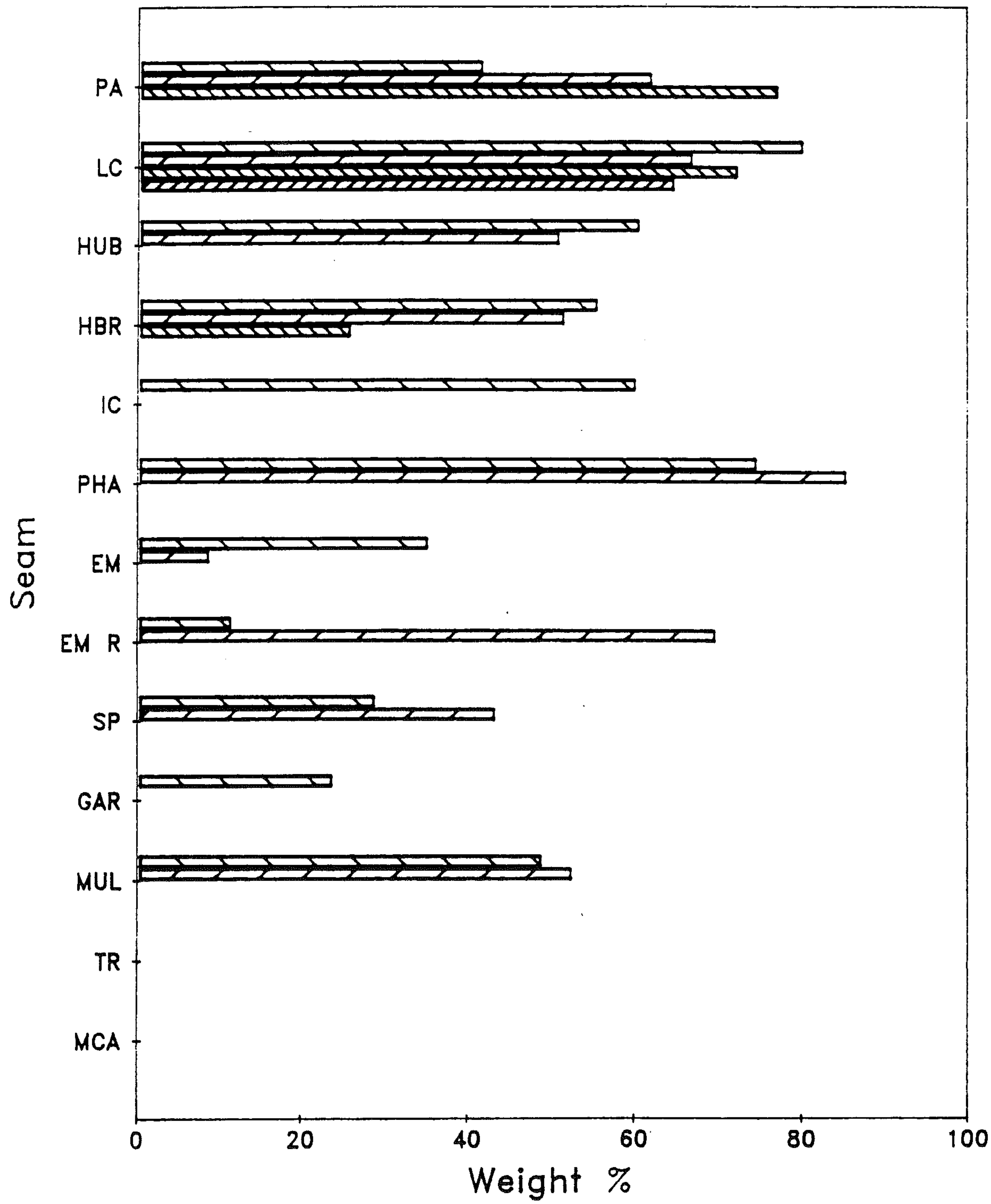
QUARORG

C.M.A. Analysis



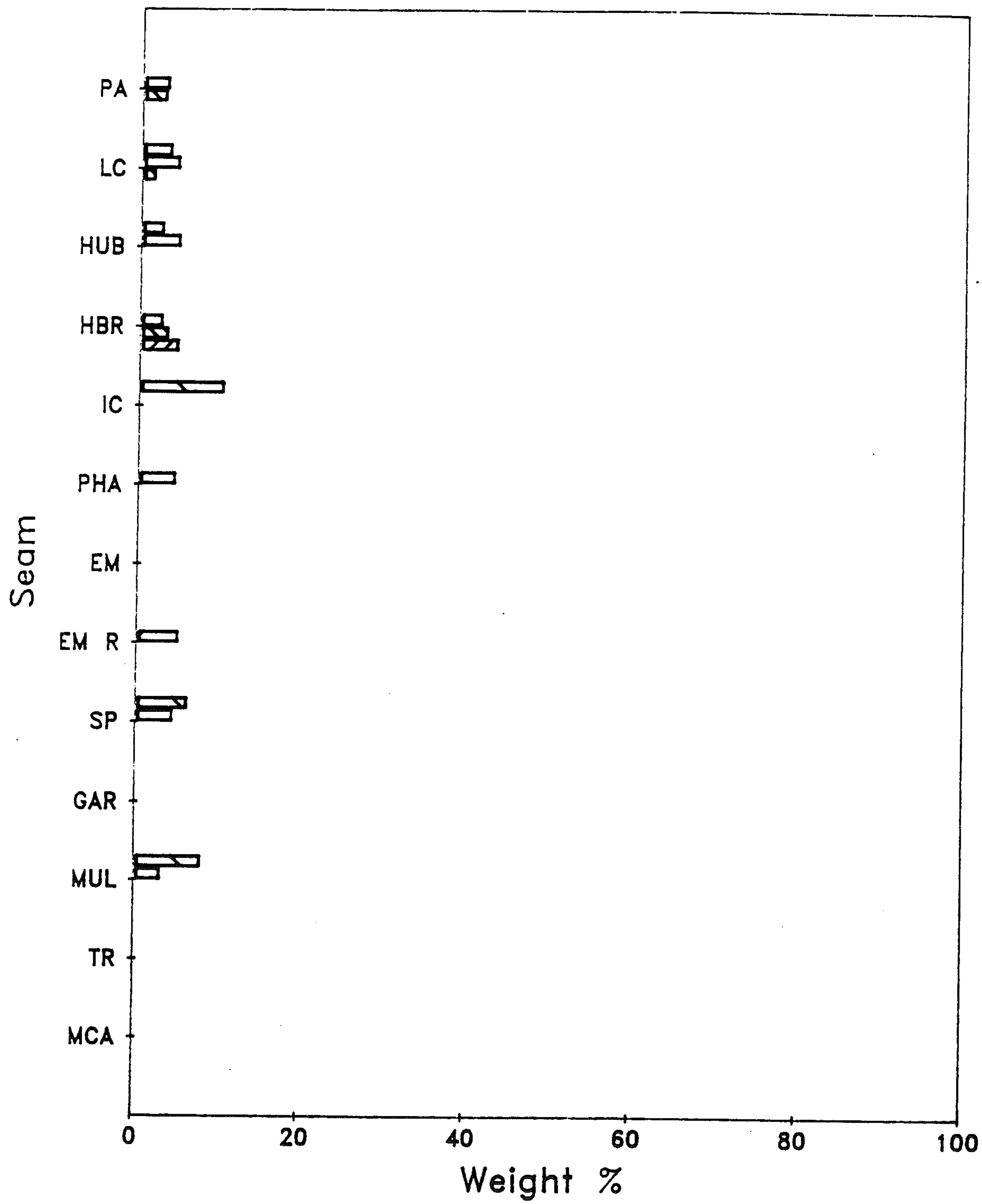
PYRITE

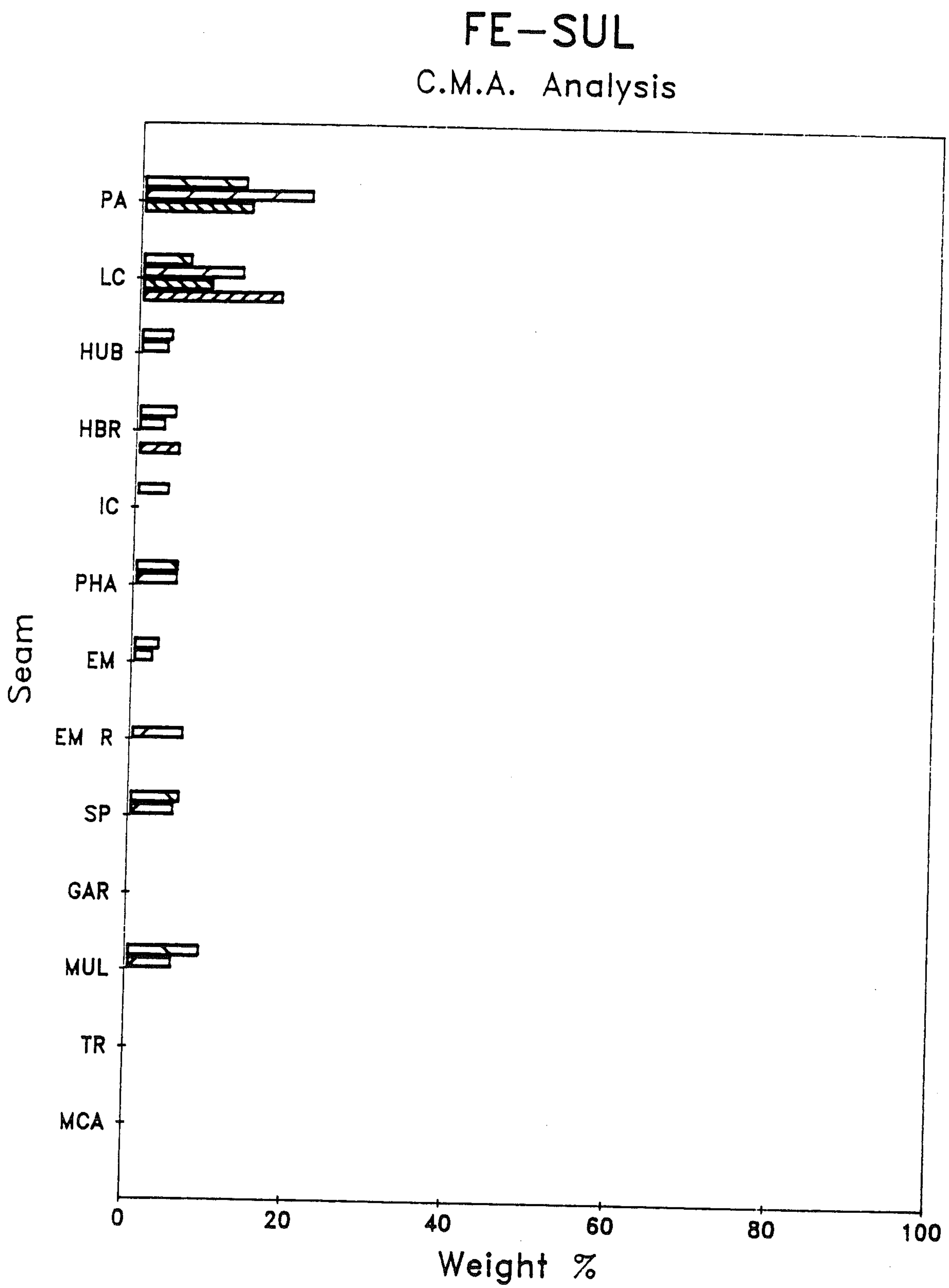
C.M.A. Analysis

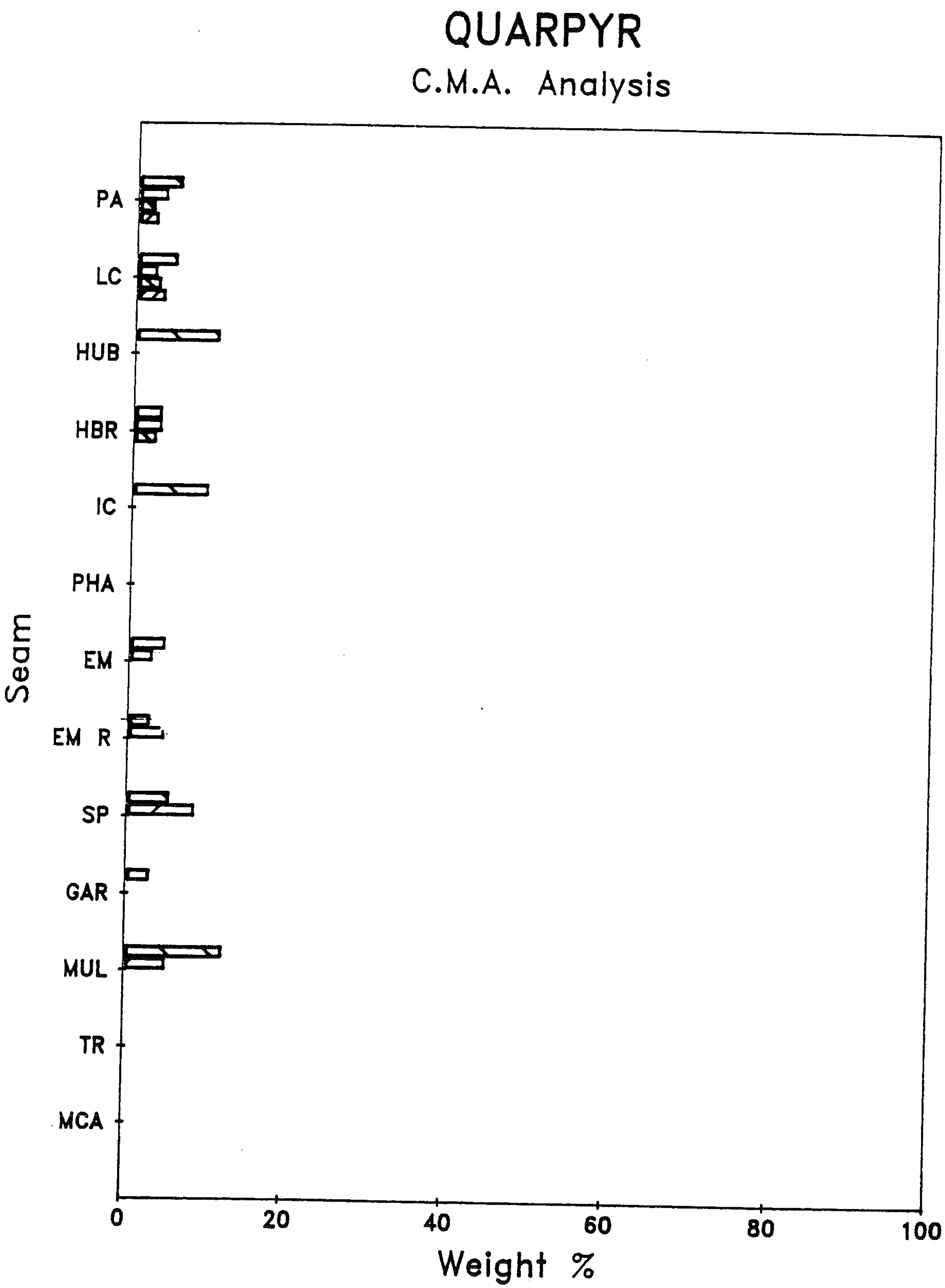


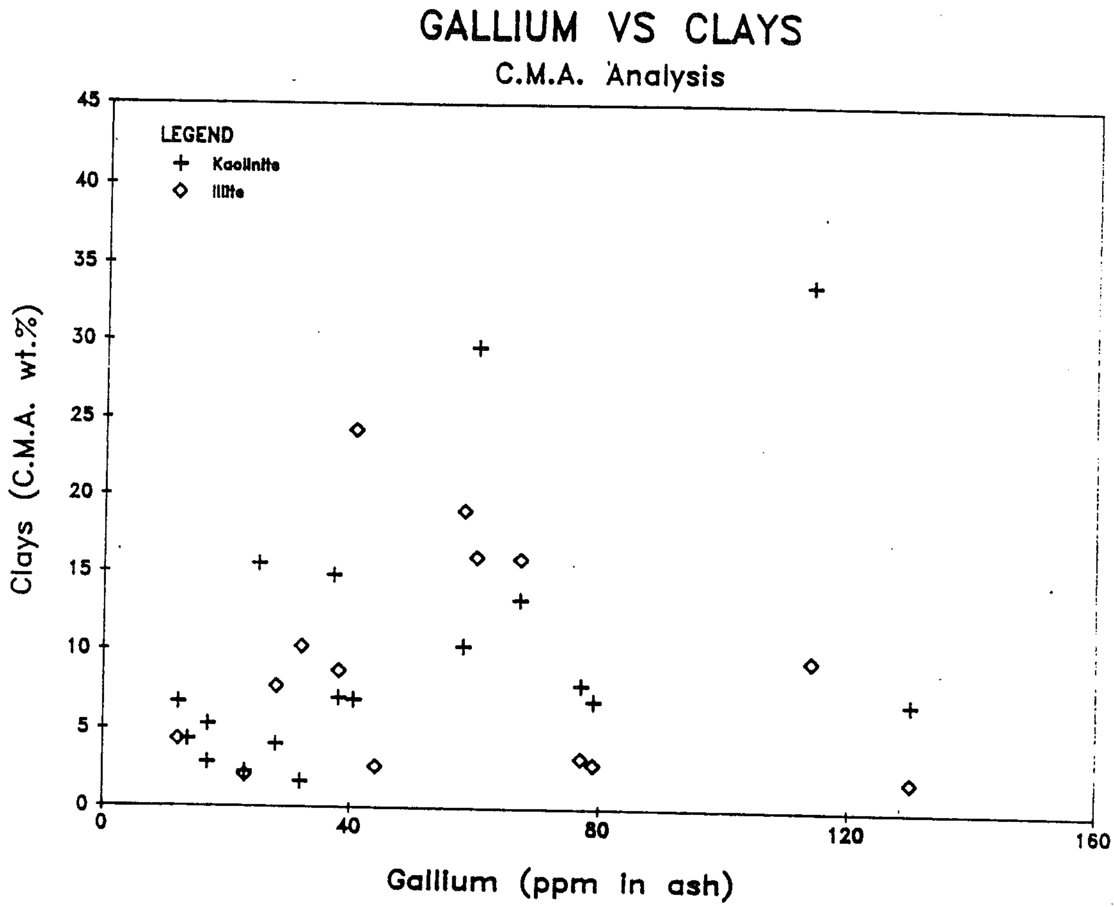
PYRJAR

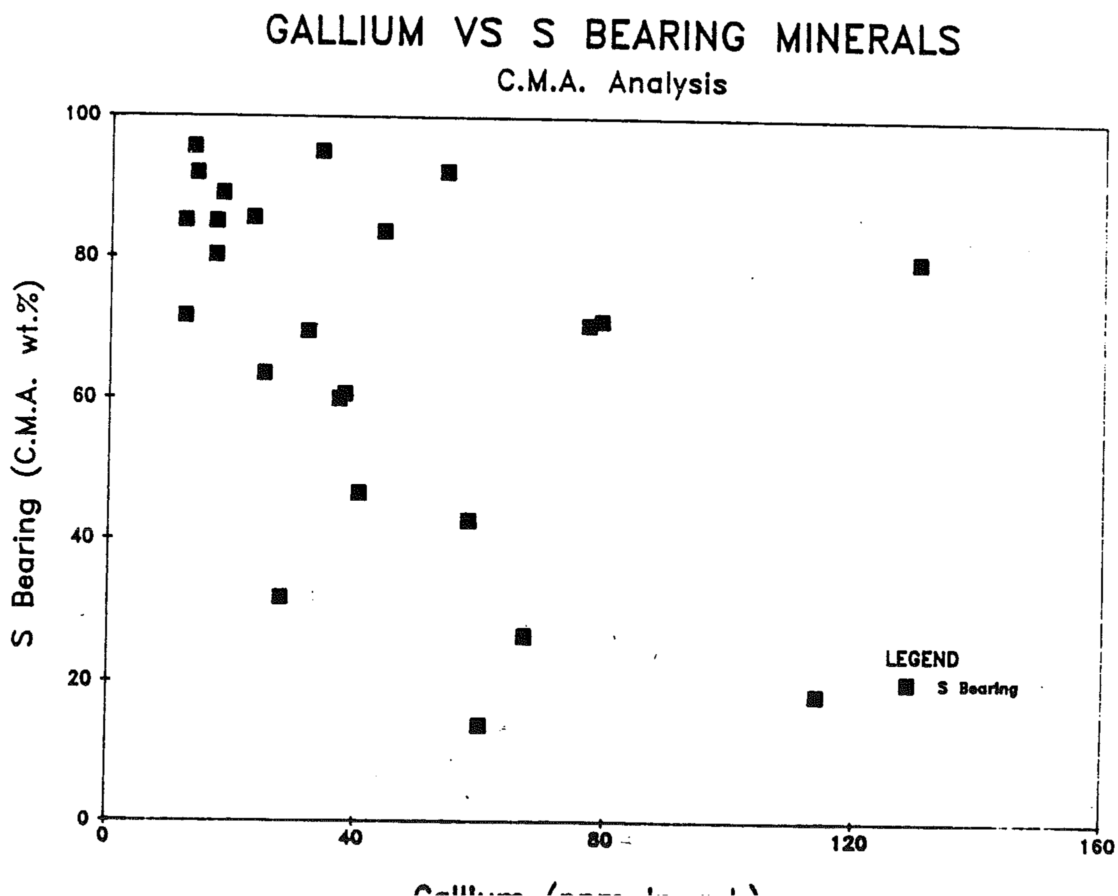
C.M.A. Analysis




FE-SUL
C.M.A. Analysis
PA
LC
HUB
HBR
IC
PHA
EM
EM R
SP
GAR
MUL
TR
MCA
Seam
0
20
40
60
80
100
Weight %


QUARPYR
C.M.A. Analysis
PA
LC
HUB
HBR
IC
PHA
EM
EM R
SP
GAR
MUL
TR
MCA
Seam
0
20
40
60
80
100
Weight %


GALLIUM VS CLAYS
C.M.A. Analysis
LEGEND
Kaolinite
Illite
Clays (C.M.A. wt.%)
Gallium (ppm in ash)
0
5
10
15
20
25
30
35
40
45
0
40
80
120
160


GALLIUM VS S BEARING MINERALS
C.M.A. Analysis
LEGEND
S Bearing
S Bearing (C.M.A. wt.%)
0
20
40
60
80
100
0
40
80
120
160