BHP Diamonds Inc.

BOSTON GOLD PROJECT,
AIMAOKTAK LAKE, N. T.

EXPLORATION AND BULK SAMPLING PROGRAM WASTE ROCK DISPOSAL PLAN

Prepared for:

Nunavut Water Board
Gjoa Haven, N. T.

October 1998

Prepared by:

BHP Diamonds Inc.
Vancouver, B.C.

BHP

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1. Introduction

1. INTRODUCTION

BHP Diamonds Inc. (BHP) is a subsidiary of the Broken Hill Propriety Company Ltd., a global resource company headquartered in Melbourne, Australia. BHP, headquartered in Vancouver B.C., is involved in mining and exploration activities across Canada including Nunavut.

The Boston Gold Project has been organized to explore and evaluate areas of gold mineralization on the Southeast shore of Aimaoktak Lake, approximately 450 km west southwest of Gjoa Haven (Figure 1-1).

1.1 Plan Purpose

In accordance with Nunavut Water Board Licence #NWB1BOS9801, Part III, 5.k, BHP has prepared the following revised Waste Rock Disposal Plan for the Boston Gold Property. The plan outlines BHP's general commitments to effectively manage waste rock generated at the Boston Gold project site and to monitor water quality and acid generating potential of all excavated material and activities affecting water quality.

1.2 BHP Environmental Policy

BHP's environmental policy strives to achieve a high standard of environmental care in conducting business as a resource and industrial company contributing to the needs of society. The approach of the company to environmental management is to seek continuous improvement in performance by taking account of evolving scientific knowledge and community expectations. BHP's Environmental Policy is presented in Appendix A.

1.3 Project Description

The Boston Gold Project is located on a small peninsula projecting into Aimaoktak (Spyder) Lake (Figure 1-2). The surficial geology in the area is characterized by washed glacial till and unconsolidated marine clays with some weathered bedrock outcroppings in the vicinity (Rescan, 1998). The dominant vegetation cover in the project area is representative of the Typic Betula-Ledum-

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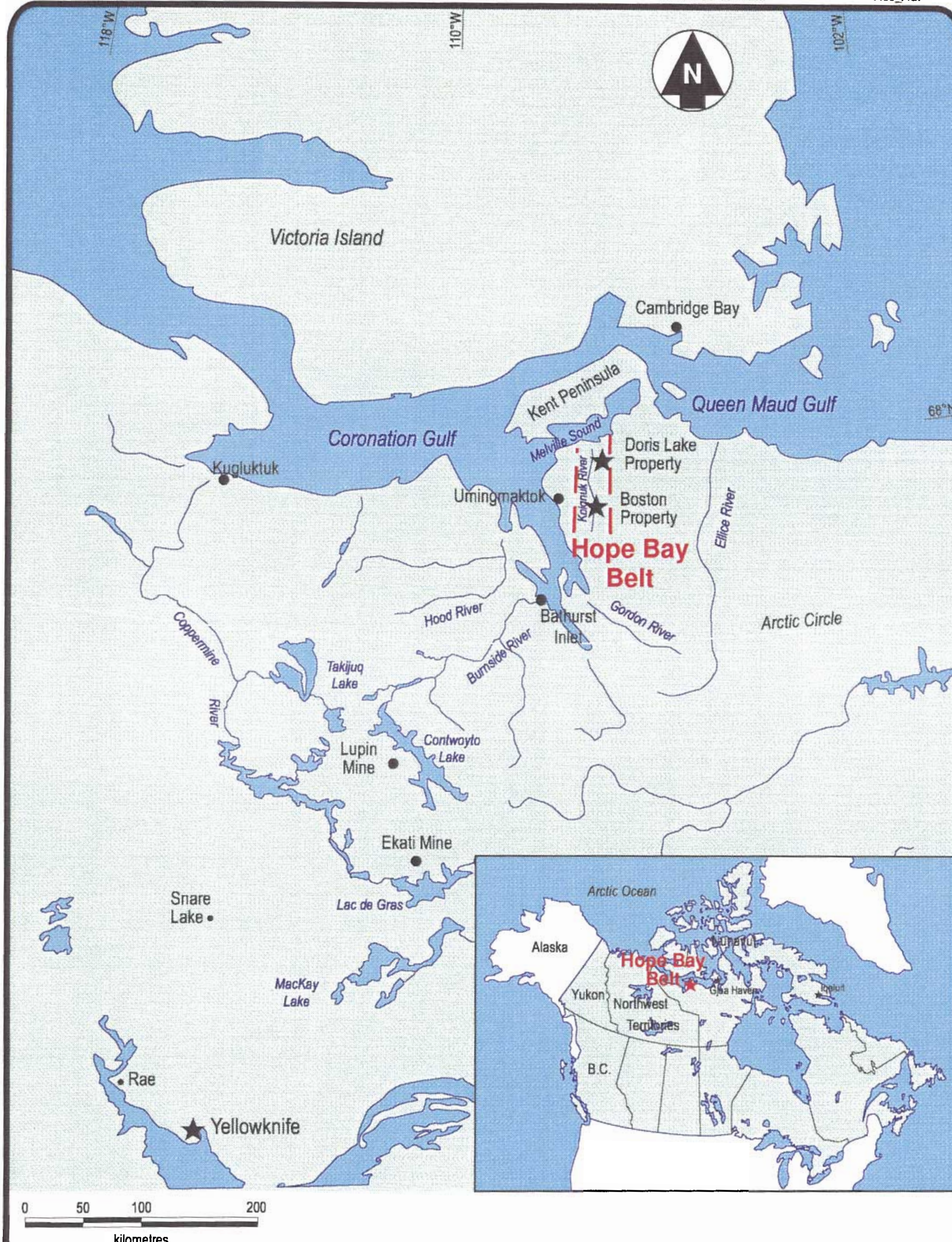

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Project Location Map

FIGURE 1-1

Lichen Unit comprised of Arctic shrubs, herbs, mosses and lichens. Detailed terrestrial ecosystem mapping of the area has been completed and is presented in Rescan, 1998. The present footprint of the Boston Gold Project covers approximated 5.32 hectares (Table 1-1). Figure 1-2, Plate 1-1 and Plate 1-2 illustrate current land use at the Boston Gold Project Site.

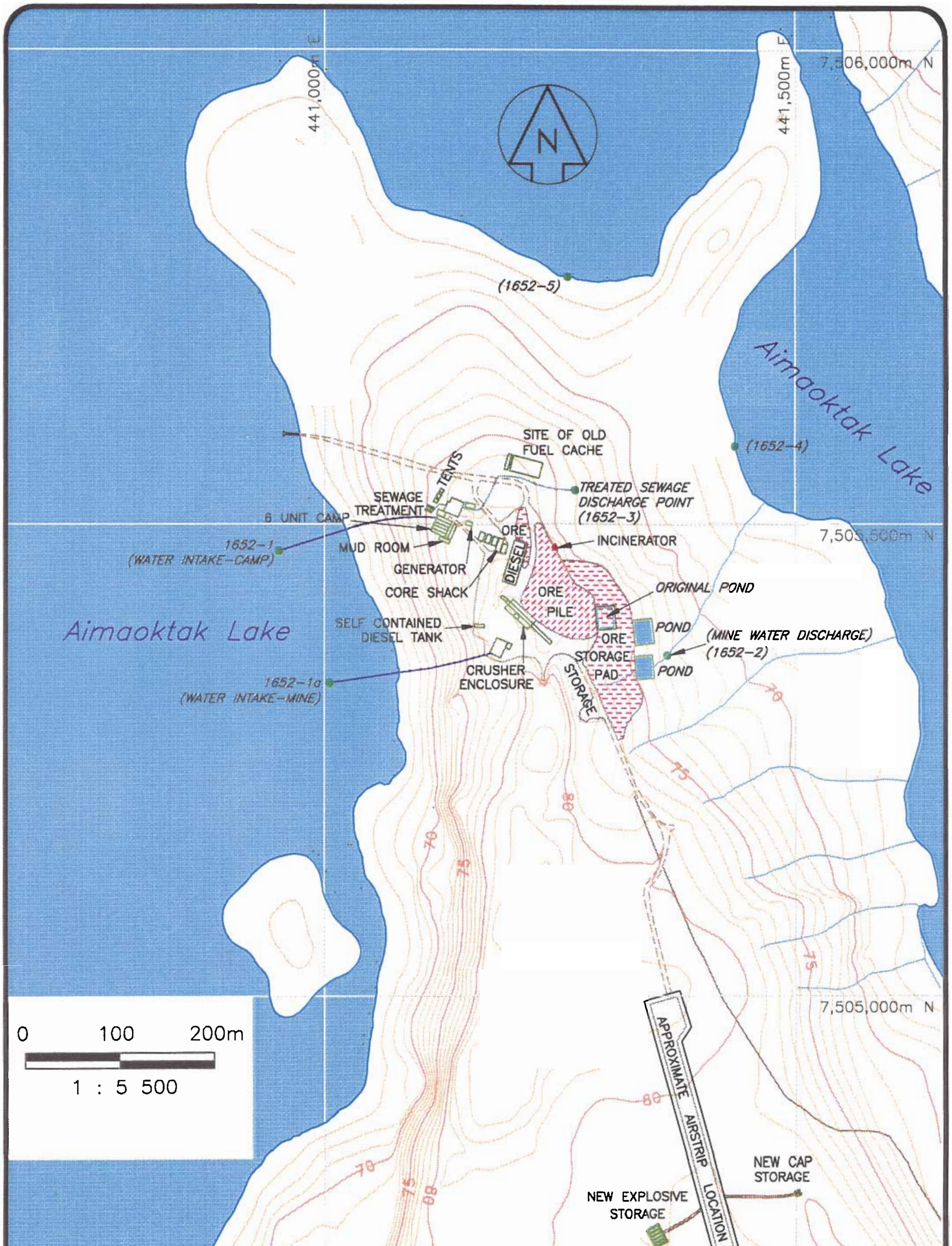
The 1996 and 1997 bulk sampling programs generated approximately 13,000 and 9,000 tonnes of ore material, respectively, and 39,000 and 75,000 tonnes of development rock, respectively. During 1996, 1,000 metres of underground development was completed followed by another 1,400 metres of underground development in 1997. All development rock generated from the operation was used on roadways and the airstrip after appropriate testing to ensure that the rock is non-acid generating.

Table 1-1
1998 Boston Gold Project Footprint

Component	Area (m^2)
Camp	6,000
Industrial Area	11,600
Ore Storage	14,500
Airstrip	15,600
Roads	4,700
Total	**53,200 m^2 (5.32 hectares)**

The treatment of the mineralized samples from the bulk sampling program was, and in the future will continue to be performed off-site. Composite samples will continue to be transported off-site by air. Bermed stockpile pads for ore and potentially acid generating rock have been situated north and east of the portal entrance, as shown in Figure 1-2. Development rock with high NNP was used to construct the stockpile pads, to store and neutralize potential acidic runnoff. Development rock that is not acid generating was used as road/pad building to minimize additional terrain disruption.

During 1997 two water lines from Aimaoktak (Spyder) Lake were installed to service the underground workings and camp. Underground water reporting to the mine intake line (south of camp) is recycled to the sumps for use at drilling locations. Water is not generally discharged above surface into the watershed



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Boston Gold Project Site Land Use Plan

Figure 1-2

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Plate 1-1 Boston Gold Project Site – June 1996.

Plate 1-2 Boston Gold Project Site – August 1998.

unless flooding occurs. Sumps are located underground to settle solids (primary water sumps) from recycled water prior to being reused. Two settling ponds are located at the portal entrance on the east side of the roadway by the ore storage pads. The ponds have been designed to accommodate excess water generated in the underground workings. The ponds also act as settling basins to control the level of suspended solids prior to discharge. The pond berms have been built with suitable development rock. The primary settling pond has a bentonite/geotextile membrane liner and a sump capacity of 112 m^3. The second pond, with a sump capacity of 80 m^3, is presently unlined but will be fitted with a similar membrane liner if more capacity is required to meet operational needs.

2. Acid Generation Monitoring Plan

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2. ACID GENERATION MONITORING PLAN

2.1 Nunavut Water Board Requirements

The NWB requires that a detailed plan for monitoring acid generating potential of ore and waste rock be developed for mining operations.

The implementation of the proposed monitoring plan was initiated prior to site development at the Boston Gold Project. The monitoring program will continue throughout the predevelopment period of the underground bulk sampling project.

2.2 Regional Geology

The Boston Property is centred on a carbonatized, mineralized shear zone. Three main rock types are encountered: mafic volcanics, gabbro and sediments (Clarke, 1996). The mafic volcanics are tholeiitic basalts found in pillowed and massive flows. Gabbroic sills are encountered exclusively in the mafic volcanic domain. Sediments in the shear zone are intensely folded, fine-grained phyllites that may or may not contain graphite. The B2 mineralized zone lies along the volcanic-sediment contact on the western limb of the Boston anticline. The B3 mineralized zone occupies an axial planar position, characterized by a series of zones which trend coplanar to lithological contacts within the mafic core.

The most strongly carbonatized portions of the shear are comprised of fine-grained masses of dolomite/ankerite and sericite. These portions are typically enveloped within a less-altered domain comprised of strongly foliated, calcite-bearing, chlorite/sericite schists. Quartz veins are localized within the shear, generally trending sub-parallel to the structure. The veins are comprised of coarsely crystalline, translucent quartz with varying amounts of carbonate present. Sulphide accumulations of up to 3% have been observed.

2.3 Historical Results and Discussion

The activities associated with the generation of development rock and bulk ore samples can affect receiving water quality. A preliminary indicator of a particular rock sample's potential to generate acid may be found through the application of acid-base accounting (ABA). ABA testing is used to determine the net neutralization potential (NNP) of rock as a function of the relative content of acid-generating components (primarily pyrite, FeS_2) and acid-consuming components (carbonates and other rock types capable of neutralizing acids). ABA tests are often referred to as "static" tests since they do not provide information on temporal trends in acid generation or neutralization.

Humidity cells or "kinetic" tests directly measure the rate of acid generation, neutralization and metal leaching over time. Generally, kinetic tests are performed only if mineralogy and static tests point to a potentially significant acid generation problem.

The acid generating capacity is estimated using the total sulfur content, which provides a conservative estimate of acid generating potential, by assuming that all the sulfur present is available to generate acid. Acidic conditions are produced by the oxidation of sulphide minerals. The reported total sulfur is a possible overestimation of the acid generating capacity since sulfate - sulfur (an oxidized form of sulfur not contributing to acid product production) is included in the total sulfur value.

Drill core samples from 1994 were obtained from the targeted mineralization zone which included footwall, hangingwall and ore zone material. These samples were subjected to ABA and petrographic analysis in order to assess the potential for acid generation in this material. Table 2-1 presents the results of the analysis. These ABA tests indicated a strong carbonate net neutralization potential (NNP = 136 to 320) throughout the rock sequence. Paste pH values ranged from 8.7 to 9.4. These results were encouraging and indicated that ore from the Boston deposit had a relatively low potential to generate acid.

Follow-up sampling conducted during the 1996 bulk sampling program by BHP Minerals Canada Ltd. involved the procurement of samples from every second round blasted during the advancement of the underground tunnel. The samples were subject to ABA analysis. The general rock types encountered in the 157 samples included: basalt, basalt-sediment, transition and basalt ore horizon.

Table 2-1
1994 Acid Generation Testwork

Sample	Paste pH	% Sulfide	% Sulphate	Total % Sulphur	MPA	NP	NNP	NP/MPA
1 HW	8.8	2.52	0.03	2.79	87	407	320	4.7
2 FW	9.3	1.72	0.03	1.87	58	296	238	5.1
3 MZ	9.1	1.77	0.02	1.78	56	276	220	4.9
4 HW	9.3	0.52	0.02	0.471	15	303	288	20.2
5 FW	9.4	0.96	0.02	0.942	29	277	248	9.6
6 MZ	8.9	0.26	0.02	0.233	7	307	300	43.9
7 HW	9.4	0.18	0.02	0.174	5	252	247	50.4
8 FW	8.7	4.40	0.05	4.66	146	282	136	1.9
9 MZ	9.4	0.14	0.02	0.108	3	259	256	86.3

#1-3: 93NOD59 **#4-6: 93NOD61** **#7-9: 93NOD35**
FW - footwall **HW - hangingwall** **MZ - mineralized zone.**

The results are presented in Table 2-2. The samples are organized according to rock unit.

Table 2-2
1996 Acid Generation Testwork

Sample	Paste pH	Total % Sulphur	MPA	NP	NNP	NP/MPA
Sediment Transition, Ore Horizon	8.5	2.47	77	254	177	5.0
Basalt Ore Horizon	8.8	1.79	·56	311	256	7.4
Basalt	8.8	0.42	13	330	317	90.5
Basalt - Sediment Transition	8.9	0.89	28	255	227	31.7

Reference: Hope Bay Belt Project, Environmental Baseline Studies, Rescan Environmental Services Ltd. 1997.

The results of the 1996 ABA analyses completed at the Boston Property indicated that the majority of rock sampled had a very low potential to generate acid. The sulfur content varied over a wide range. The NNP is the difference between the neutralization potential (NP) and maximum potential acidity (MPA). A sample with an NNP less than zero is considered acid-generating. The NP/MPA is also used to determine the overall acid-generating capacity of a sample. Neutralizing potential ratios (NPR) greater than three can be considered acid consuming.

The low acid-generating potential of the rock removed as part of the acid-generation monitoring workplan may be attributed to the high amount of neutralization potential typical of carbonate minerals such as dolomite and calcite or slower dissolving aluminosilicate minerals.

The results obtained from the 1996 ABA analyses were consistent with the findings from the 1994 program. The majority of rock sampled exhibited a very low potential to generate acid.

2.4 1997 - 1998 Acid Generation Test Work

The different rock types from which samples were obtained are described in Table 2-3. The basalt, the major ore host, has been divided into four sub-categories based on the degree of alteration.

Table 2-3
Boston Property Rock Units

Rock Type	Label	Comments
Basalt - unaltered	B-ua	
Basalt - weakly altered	B-wa	Weakly sericitic, 1-30% dolomite
Basalt - moderately altered	B-ma	Moderately sericitic, 31-60% dolomite
Basalt - strongly altered	B-sa	Strongly sericitic, >60% dolomite
Zone B2 - Alteration halo	B2-AH	
Zone B2 - Mineralized zone	B2-MZ	
Zone B3 - Alteration halo	B3-AH	
Zone B3 - Mineralized zone	B3-MZ	
Gabbro - unaltered	G-ua	
Quartz/carbonate dyke	Q/C dyke	
Metasediments - unaltered	S-ua	
Metasediments - strongly altered	S-sa	Strongly sericitic, >60% dolomite

Boston Property samples were obtained from two sources; excavation samples and drill core. Samples were taken from every second round of excavation sampling and sent to Chemex for static prediction testing. Excavation samples were obtained to represent a volume of rock, not a specific rock type. The excavation samples analyzed by Chemex were altered basalt along with minor gabbros and quartz/cabonate dyke. This is a general classification and it is possible that a sample could include minor components of other rock types. In total, 126 excavation samples were sent for chemical analysis.

Samples were also obtained from Boston Property drill core. The drill core samples were chosen to represent the rock types described in Table 2-3. In total, 43 drill core samples were submitted for analysis. Three additional samples collected from drill core were submitted for kinetic prediction testing. The rock types sampled and sent for kinetic prediction testing were B2 mineralized zone, B3 alteration halo and moderately altered basalt.

Details of the analytical methods employed and complete results obtained are presented in Appendix B which is reproduced from BHP's 1997 Environmental Data Report (Rescan, 1998). The 1997 ARD characterization program re-confirmed that the majority of rock sampled exhibited very low acid-generating potential. These favorable characteristics will greatly facilitate the future abandonment and reclamation of the Boston Property Site (BHP, 1998a).

3. Mine and Treated Water Control Plan

3. MINE AND TREATED WATER CONTROL PLAN

3.1 Nunavut Water Board Requirements

Effluent quality criteria for mine water and treated sewage water are provided in the Water Licence authorized by the NWB. The sampling program specified in Licence #NWB1B0559801 will be strictly observed in accordance with BHP's QA/QC Plan (BHP, 1998b). Mine water discharge at Surveillance Network Program (SNP) Station 1652-2, will be monitored (when present) to meet the effluent quality guidelines presented in Table 3-1. A complete ICP metal scan will also be performed on a monthly basis when present.

Table 3-1
SNP Monitoring Parameters (Station 1652-2)

Parameter	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Arsenic	0.5 mg/L	1.0 mg/L
Copper	0.3 mg/L	0.6 mg/L
Lead	0.2 mg/L	0.4 mg/L
Nickel	0.5 mg/L	1.0 mg/L
Nitrogen Ammonia	2.2 mg/L*	
Zinc	0.5 mg/L	1.0 mg/L

*: At pH = 6.5 and temperature = 10°C .

Station 1652-3, where treated sewage effluent is discharged, will be sampled for the parameters listed in Table 3-2, and also for fecal coliform and Biological Oxygen Demand (BOD_5). Compliance with the SNP criteria outlined in Table 3-2 will be monitored at Stations 1652-4 and 5.

Table 3-2
SNP Monitoring Parameters (Station 1652-3)

Parameter	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Suspended Solids	25 mg/L	50.0 mg/L
Oil and Grease		5 mg/L
pH	6.0 to 9.5	

3.2 Proposed Workplan

Prior to the discharge of any liquid effluents, BHP will provide notice to the Nunavut District Inspector, DIAND (Mr. Paul Smith, Iqaluit, Tel. 867-979-4407, Fax 819-979-6445).

When approved discharges occur, surface erosion will be minimized at the point of discharge by dispersing the flow of water. This will be accomplished by diffusing the flows to reduce velocity over the tundra. An area has been selected with a gentle slope that will reduce velocity and minimize erosion.

A water line from Spyder Lake will service the underground mine workings. Once water is within the underground system, the water will be recycled. Water will be discharged only if the underground sumps flood. All excess minewater will be diverted to the settling pond located on the ground surface. If tests indicate non-compliance, the water will be retained in the settling pond until compliance is achieved.

References

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Rescan. 1998. *Hope Bay Belt Project 1997 Environmental Data Report.* Report prepared for BHP Diamonds Inc.

Appendix A
BHP Environmental Policy

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ENVIRONMENTAL POLICY

It is BHP's policy to achieve a high standard of environmental care in conducting its business as a resources and industrial company contributing to society's material needs. BHP's approach to environmental management seeks continuous improvement in performance by taking account of evolving scientific knowledge and community expectations.

Specifically, it is BHP's policy to:

- comply with all applicable laws, regulations and standards; uphold the spirit of the law; and where laws do not adequately protect the environment, apply standards that minimize any adverse environmental impacts resulting from its operations, products or services;
- communicate openly with government and the community on environmental issues, and contribute to the development of policies, legislation and regulations that may affect BHP;
- ensure that its employees and suppliers of goods and services are informed about this policy and aware of their environmental responsibilities in relation to BHP business;
- ensure that it has management systems to identify, control and monitor environmental risks arising from it operations;
- conduct research and establish programs to conserve resources, minimize wastes, improve processes and protect the environment.

J. B. Prescott
Managing Director and Chief Executive Officer
July 1991

Appendix B
1997 – 1998 Acid Generation Testwork and Results (from Rescan, 1998)

6. ACID ROCK DRAINAGE CHARACTERIZATION

The exposure of sulphide-bearing material to the atmosphere can result in the generation of acid. This acid can cause metals to leach out of surrounding rock, producing acid rock drainage (ARD). If a sufficient quantity of ARD is generated, the quality of receiving waters can be affected. This section describes the ARD characterization program that was conducted on rock obtained from the Boston Property in 1997.

6.1 Regional Geology

The Boston Property is centred on a carbonatized, mineralized shear zone. Three main rock types are encountered: mafic volcanics, gabbro and sediments (Clarke, 1996). The mafic volcanics are tholeiitic basalts found in pillowed and massive flows. Gabbroic sills are also encountered exclusively in the mafic volcanic domain. Sediments in the shear zone are intensely folded, fine-grained phyllites that may or may not contain graphite. The B2 mineralized zone lies along the volcanic-sediment contact on the western limb of the Boston anticline. The B3 mineralized zone occupies an axial planar position, characterized by a series of zones which trend coplanar to lithological contacts within the mafic core.

The most strongly carbonatized portions of the shear are comprised of fine-grained masses of dolomite/ankerite and sericite. These portions are typically enveloped within a less-altered domain comprised of strongly foliated, calcite-bearing, chlorite/sericite schists. Quartz veins are localized within the shear, generally trending sub-parallel to the structure. The veins are comprised of coarsely crystalline, translucent quartz with varying amounts of carbonate present. Sulphide accumulation of up to 3% is observed.

The different rock types from which samples were obtained are described in Table 6.1-1. The basalt, gabbro and sediments have been divided into four sub-categories based on the degree of alteration.

Table 6.1-1
Rock Units

Rock Type	Label	Comments
Basalt - unaltered	B-ua	
Basalt - weakly altered	B-wa	Weakly sericitic, 1-30% dolomite
Basalt - moderately altered	B-ma	Moderately sericitic, 31-60% dolomite
Basalt - strongly altered	B-sa	Strongly sericitic, >60% dolomite
Zone B2 - Alteration halo	B2-AH	
Zone B2 - Mineralized zone	B2-MZ	
Zone B3 - Alteration halo	B3-AH	
Zone B3 - Mineralized zone	B3-MZ	
Gabbro - unaltered	G-ua	
Quartz/carbonate dyke	Q/C dyke	
Metasediments - unaltered	S-ua	
Metasediments - strongly altered	S-sa	Strongly sericitic, >60% dolomite

6.2 Methods

6.2.1 Sampling Methods

The sampling program was conducted during the 1997 exploration season by BHP geologists and the analytical work was performed by Chemex Laboratories (Chemex) in Vancouver, British Columbia. Boston Property samples were obtained from two sources; excavation samples and drill core. Samples were taken from every second round of excavation sampling and sent to Chemex for static prediction testing. Excavation samples were obtained to represent a volume of rock, not a specific rock type. In all cases, the excavation samples analyzed by Chemex were weakly to moderately altered basalt. This is a general classification and it is possible that a sample could include minor components of other rock types. In total, 126 excavation samples were sent for chemical analysis.

Samples were also obtained from Boston Property drill core. The drill core samples were chosen to represent the rock types described in Table 6.1-1. In total, 43 drill core samples were submitted for analysis. Three additional samples collected from drill core were submitted for kinetic prediction testing. The rock types sampled and sent for kinetic prediction testing were B2 mineralized zone, B3 alteration halo and moderately altered basalt.

6.2.2 Analytical Methods

Chemex was also used to conduct the chemical analysis of the samples obtained from the Boston Property and was used throughout the ARD characterization program. The samples were analyzed through static and kinetic prediction testing to determine their acid-generating characteristics. Kinetic test samples were characterized through whole rock analysis, total metals analysis and petrographic examination. The methods that were used are described in greater detail below.

6.2.2.1 Static Prediction Testing

Static prediction testing is used to determine the balance between the acid-consuming potential and acid-generating potential of a sample. The accepted method of static prediction testing is acid-base accounting (ABA). The ABA methods outlined below are based on the standard methods developed by the U.S. EPA (Sobek *et al.*, 1978) and are described in greater detail in the Department of Indian Affairs and Northern Development (DIAND) guidelines (DIAND, 1993) and the more recent draft guidelines for ARD prediction in British Columbia (Price and Errington, 1997). The parameters measured as part of the static prediction test program were: fizz test, paste pH, total sulphur, sulphide sulphur, sulphate sulphur, inorganic carbon and neutralization potential. The analytical procedure for each of these parameters is described below.

A fizz test is completed prior to performing the analysis for neutralization potential to determine the volume and normality of hydrochloric acid that is to be used in the analysis. The test is conducted by adding one or two drops of 25% HCl to approximately 0.5 grams of crushed sample and assessing the amount of effervescence that is produced.

Paste pH is a measure of the amount of readily available neutralizing mineral associated with a sample and whether or not the sample has previously generated acidity. Paste pH is determined by adding approximately 5 mL of deionized water to 10 grams of crushed sample and allowing the sample to become saturated. More water can be added if necessary to produce the desired consistency. The pH of the paste is then measured using a Hanna Instruments S1900 pH meter/electrode combination.

Total sulphur is analyzed using a Leco sulphur analyzer. The sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Sulphur dioxide released by the sample is measured using an infrared detection system and the total sulphur result is provided. To measure sulphide sulphur, a prepared sample is digested with nitric acid and bromine, followed by hydrochloric acid and then taken to dryness. The salts are dissolved in dilute hydrochloric acid. Silica and other acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulphate in the resulting filtrate is then precipitated with barium chloride. The barium sulphate precipitate is filtered, ignited, weighed and calculated as %S in the original sample. The percent sulphide sulphur is the difference between the %S of this test and the %S found as HCl-soluble sulphate. Sulphate sulphur is measured by heating a prepared sample in dilute hydrochloric acid for 30 minutes. Silica and other acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulphate in the resulting filtrate is then precipitated with barium chloride. The barium sulphate precipitate is filtered, ignited, weighed and calculated as %S (of the HCl-soluble sulphate) in the original sample.

Inorganic carbon is determined by leaching a prepared sample with dilute hydrochloric acid. Carbon dioxide is released and carried into a measuring buret by a stream of oxygen. The volume of the two gases is measured and the two gasses are then passed through a potassium hydroxide solution that dissolves the carbon dioxide. The oxygen is returned to the buret and the volume is again measured. The difference in volume, corrected for temperature and pressure, is proportional to the percentage of inorganic carbon in the sample.

Neutralization potential is measured by treating a 2.0 gram sample with the volume and normality of HCl determined from the fizz test described above. The sample is heated gently until the reaction is complete and then carbon dioxide-free deionized water is added. The solution is allowed to boil for one minute and then covered tightly to cool. Once the solution has cooled to room temperature, it is titrated with the appropriate volume and normality of sodium hydroxide until the pH reading remains at 7.0 for at least 30 seconds. The neutralization potential is calculated from this information using the following formula:

$$\text{Neutralization Potential (NP)} = \frac{50a\,[x-(b/a)y]}{c}$$

where a = normality of HCl
b = normality of NaOH
c = sample weight in grams
x = volume of HCl added (mL)
y = volume of NaOH added (mL) to pH 7.0

The NP is expressed as kilograms of calcium carbonate equivalent per tonne of material (kg $CaCO_3$/t).

From these values, a number of other parameters can be calculated, including: maximum potential acidity (MPA), carbonate neutralization potential (CaNP), net neutralization potential (NNP) and the neutralization potential to maximum potential acidity ratio or neutralization potential ratio (NPR). Maximum potential acidity is calculated by multiplying the total sulphur result by 31.25. This is a molar conversion based on the assumption that the sulphur is present as pyrite and it generates a value expressed in the same terms as NP (kg $CaCO_3$/t). The carbonate NP is calculated by multiplying the inorganic carbon result by 22.743. This converts the percent CO_2 into kilograms of $CaCO_3$ equivalent per tonne of material. The NNP is calculated by subtracting the MPA from the NP and the NPR is calculated by dividing the NP by the MPA.

6.2.2.2 Kinetic Test Sample Characterization

Prior to the start of kinetic prediction testing, selected samples were characterized using whole rock analysis, total metals analysis and petrographic examination. Whole rock and metals analyses were conducted at Chemex and petrographic examination was performed by Harris Exploration Services (Vancouver, British Columbia).

Six drill core samples selected for kinetic testing were sent to Chemex for analysis. Whole rock analysis was accomplished using standard methods for X-ray Fluorescence (XRF) spectrometry and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) following aqua regia digestion. Total metals analysis was performed using standard ICP-MS and atomic absorption spectrometry (AAS). The same samples were then forwarded to Harris Exploration Services for petrographic examination. Small portions of each sample were briquetted with epoxy and prepared as polished thin sections. Thin section examination used both cross-polarized transmitted light and reflected light. Dominant constituents were identified and the abundance of each was estimated.

6.2.2.3 Kinetic Prediction Testing

Kinetic prediction testing is a procedure that artificially accelerates weathering processes in order to provide information on the rates of sulphide oxidation, metal leaching and neutralization potential consumption. For the Boston Property samples, humidity cells were used. Humidity cells are Plexiglas tubes that hold approximately 1 kg of sample on a perforated plate. Dry air is passed through the sample for 3.5 days followed by humid air for 3.5 days. At the end of the seventh day, 500 mL of deionized water are added to the sample. The sample is then stirred and allowed to sit for two hours. After two hours, the sample is allowed to drain for two hours and the collected leachate is filtered and analyzed for physical parameters and dissolved metals using standard procedures. The weekly data obtained from this analysis are then used to calculate, among other things, rates of sulphide oxidation, metal leaching and neutralization potential consumption. Kinetic tests are typically run for at least 40 weeks.

6.3 Results and Discussion

The results of the 1997 ARD characterization program completed for the Boston Property indicate that the majority of rock samples have a very low acid-generating potential. The raw data are included in Appendices 6.3-1 to 6.3-4 and discussed below.

6.3.1 Static Prediction Testing

The parameters described above for static prediction testing are used to provide insights into the acid-generating characteristics of the material in question. The interpretation of ABA results in general is described below, followed by a discussion of the sample-specific results.

Paste pH is a measure of the amount of readily available neutralizing mineral associated with a sample and indicates whether or not the sample has previously generated acidity. A paste pH of 5 or higher indicates that the sample contains sufficient neutralizing mineral to provide some degree of buffering capacity. A pH of less than 5, on the other hand, indicates that the sample has generated acidity.

The NNP provides the mathematical difference between the neutralization potential and the acid-generating potential. Theoretically, a sample with an NNP of less than zero is considered acid-generating. In practice, however, it has been observed that samples with an NNP of +20 may still generate net acidity. Therefore, it is generally accepted that a sample must have an NNP of +20 or higher to be considered net acid consuming (DIAND, 1993). The problem in using NNP can best be demonstrated with an example. A sample with an NP of 30 and an MPA of 10 and a sample with an NP of 220 and an MPA of 200 both have an NNP of +20 kg $CaCO_3$/t, but the relative amount of each is much different between the two samples. The one sample has three times as much NP as MPA while the other sample has approximately the same amount of NP as it does MPA. This difference in relative amounts of NP and MPA can have significant repercussions in terms of acid generation if only NNP is used to plan a waste management strategy because the sample with the smaller proportion of NP is more likely to be acid-generating.

A more useful predictor of a sample's acid-generating characteristics is the neutralization potential ratio (NPR). This value is the ratio of neutralization potential to acid-generating potential in a sample. Depending on where the project is located, the interpretation of NPR differs slightly. In the Northwest Territories, an NPR of greater than 3 indicates the sample has a low potential for generating acid; an NPR between 1 and 3 indicates an uncertain potential for generating acid; and an NPR of less than 1 indicates that the sample has a high potential for generating acid (DIAND, 1993). In most cases, those samples with an NPR between 1 and 3 require further characterization, frequently in the form of kinetic prediction testing.

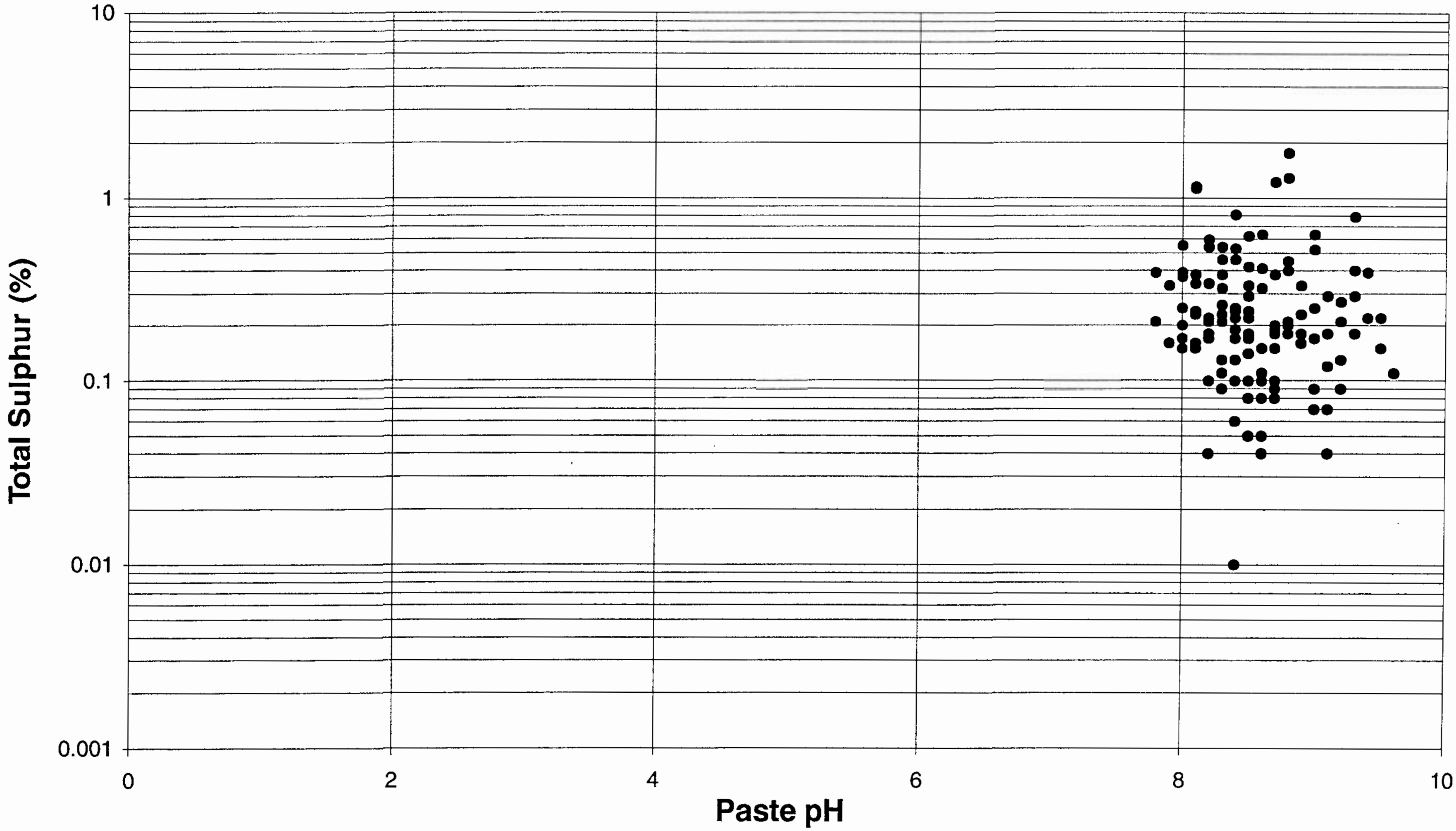
6.3.1.1 Excavation Sampling

The raw data from the ABA analyses of the excavation samples appear in Appendix 6.3-1. Based on the results of earlier analyses, which indicated a very low sulphate content in Boston Property rocks, total sulphur was the only sulphur parameter measured in the excavation samples.

All of the excavation samples have total sulphur contents of less than 2% (Figure 6.3-1), NP values greater than 190 kg $CaCO_3$/t (Figure 6.3-2) and paste pH values that range from 7.8 to 9.6. More than 77% of the excavation samples have total sulphur contents of less than 0.5%, NP values greater than 300 kg $CaCO_3$/t and paste pH values greater than 8.0. These results suggest that the excavation samples have a low potential for acid generation. In addition, the tight grouping seen in Figures 6.3-1 and 6.3-2 indicates that, at least in terms of chemical characteristics, the classification of the excavation samples as being of the same rock type is a reasonable conclusion.

Figure 6.3-3 plots NP against MPA, and therefore presents the NPR of the excavation samples. From this figure, it is clear that all of the excavation samples have NPR values well above that indicated by both DIAND and British Columbia in order to classify a sample as having a low acid-generating potential. In fact, the lowest NPR of the excavation samples is 7.1 and the majority of samples have NPR values that are greater than 40. Again, these results indicate a low potential of acid generation from the excavation samples.

The graph presented in Figure 6.3-4 is a Klingmann diagram plotting NPR against total sulphur. The diagram is divided into four quadrants. In terms of acid-generating potential, Quadrant I has the lowest potential, Quadrants II and III have uncertain potential and Quadrant IV has the highest potential. In Quadrant II, the higher the NPR the lower the acid-generating potential while in Quadrant III, the lower the sulphur content the lower the acid-generating potential. From this figure it can be seen that all of the excavation samples fall in Quadrants I and II. The majority of samples are found within Quadrant I and the lowest NPR of the samples in Quadrant II is 7.1. As with the other ABA data, these results provide additional evidence that the excavation samples, representative of the weakly to moderately altered basalt rock type, have a very low potential for generating acid.

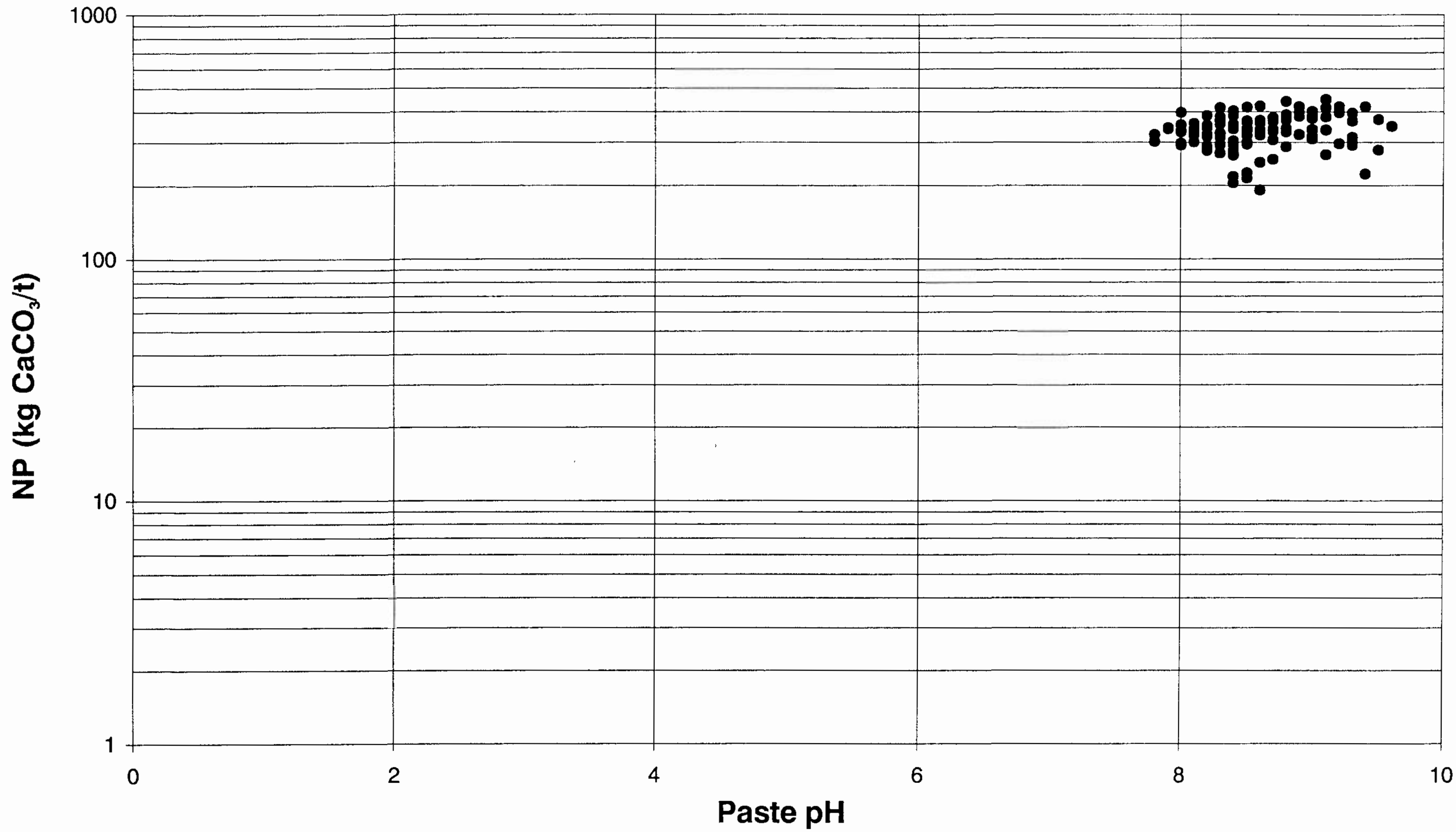


BHP

Total Sulphur vs Paste pH
Excavation Sample Data (1997)

FIGURE 6.3-1

Rescan

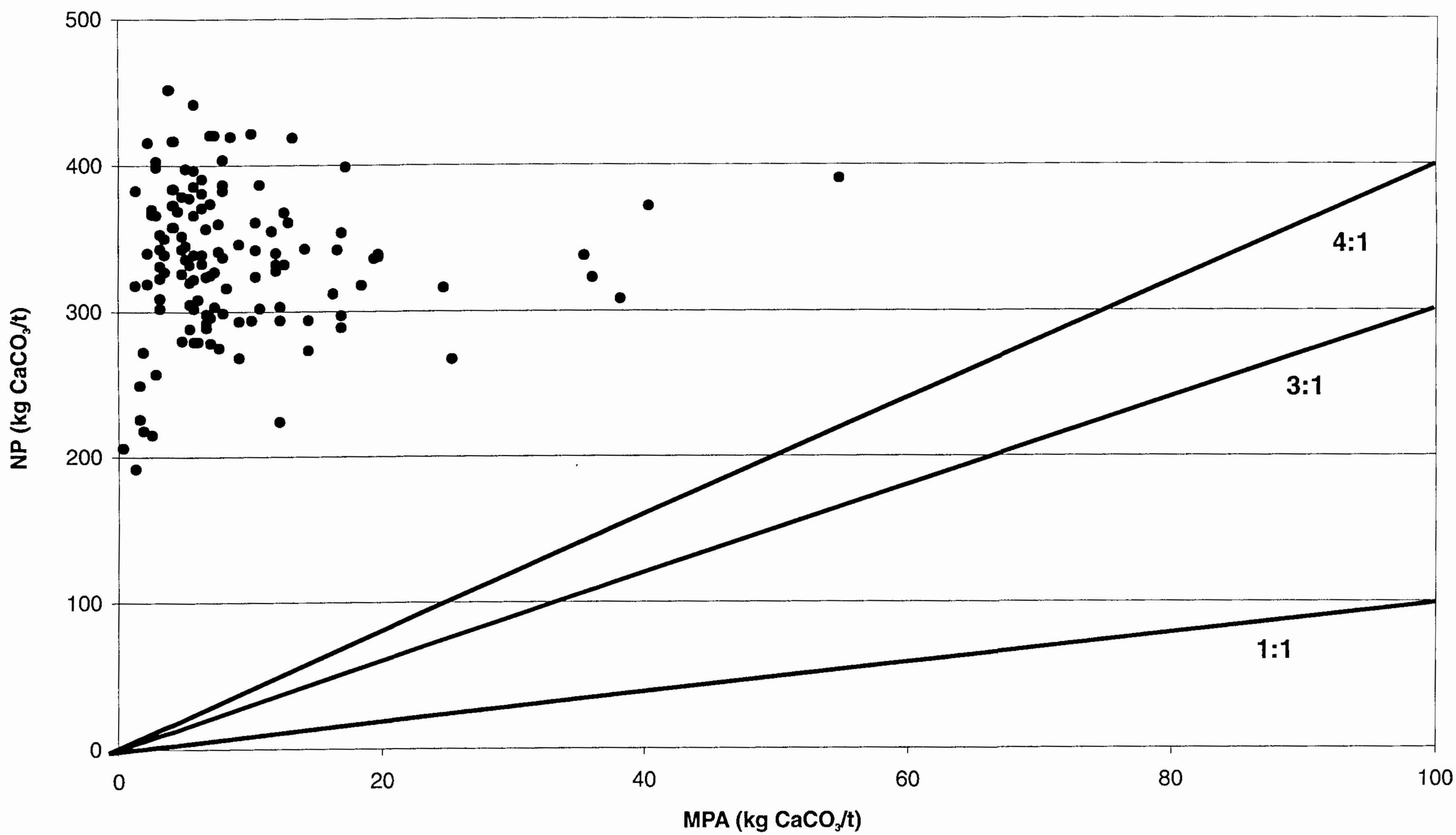


BHP

**Neutralization Potential (NP) vs Paste pH
Excavation Sample Data (1997)**

FIGURE 6.3-2

Rescan



BHP

Neutralization Potential (NP) vs Maximum Potential Acidity (MPA) - Excavation Sample Data (1997)

FIGURE 6.3-3

Rescan

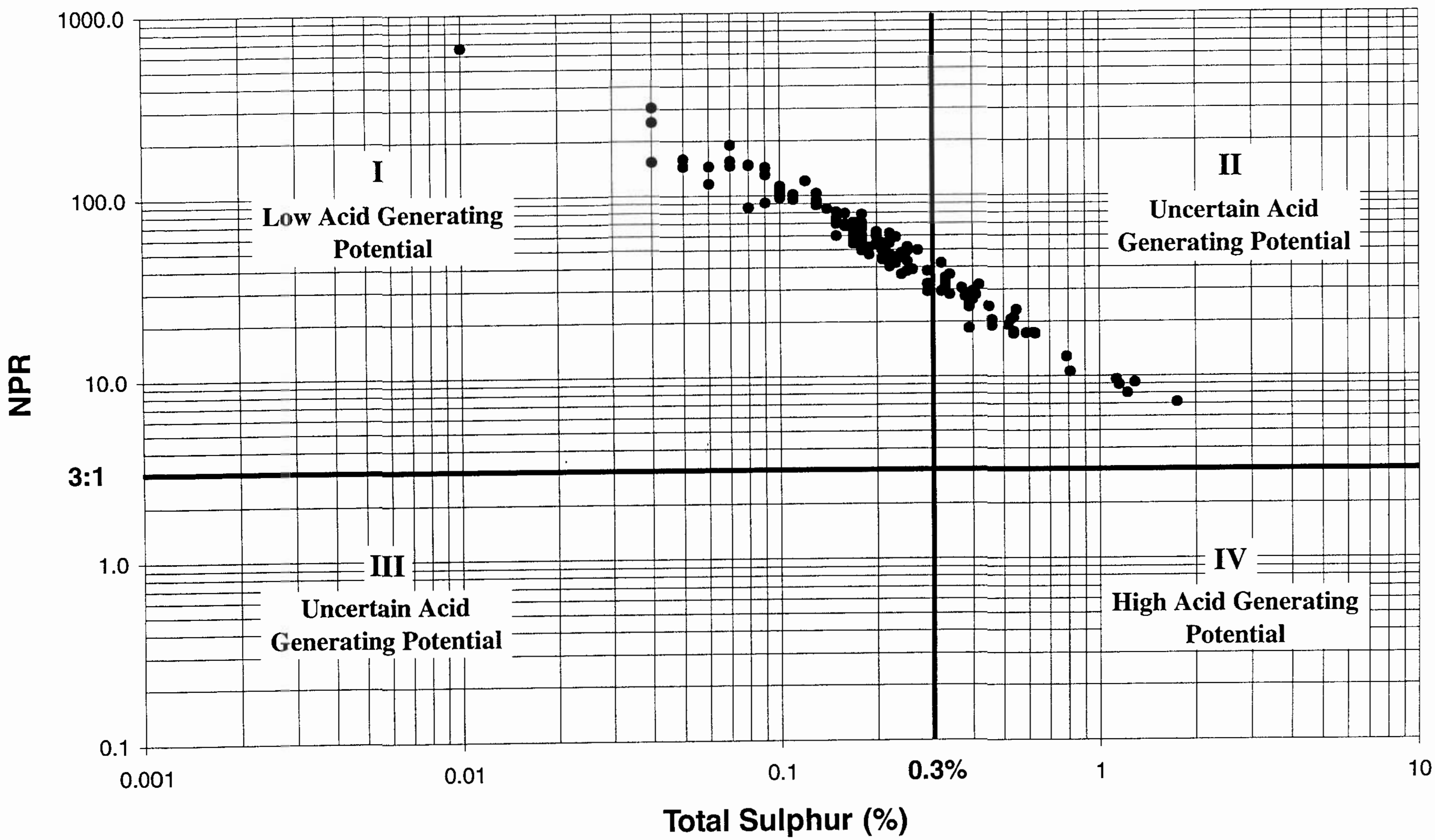


FIGURE 6.3-4

BHP

Neutralization Potential Ratio (NPR) vs Total Sulphur (%S) - Excavation Sample Data (1997)

Rescan

6.3.1.2 Drill Core

The raw data from the ABA analyses of the drill core samples are provided in Appendix 6.3-2. The sulphate sulphur content was less than the detection limit for all of the samples so it was not possible to accurately determine the sulphide sulphur content of the samples. As mentioned above under sampling methods, the samples obtained from drill core were chosen to represent the various rock types that will be encountered during development of the Boston deposit. Therefore, the results of the ABA analyses have been separated by rock type.

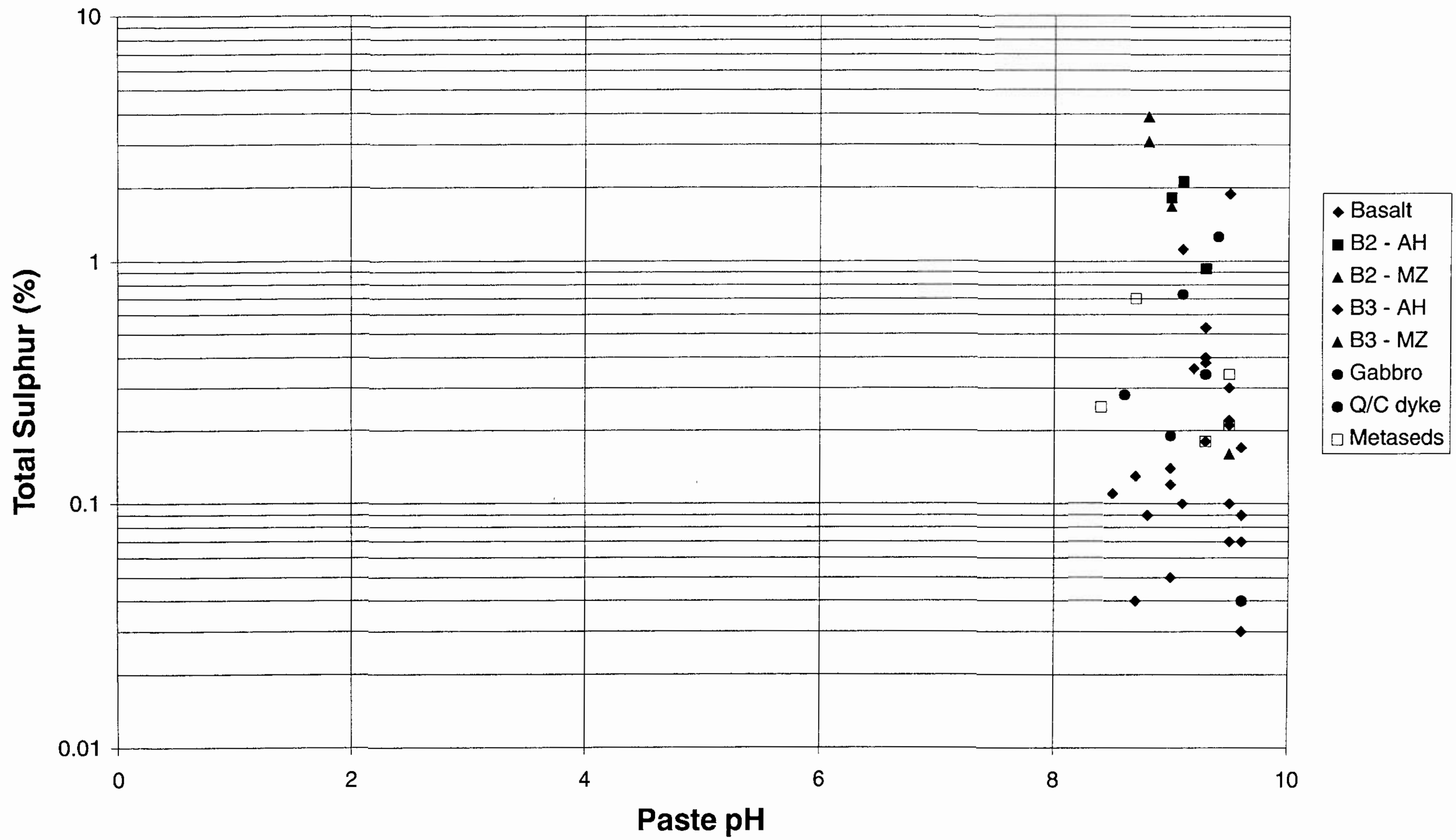
The drill core samples range in total sulphur content from 0.03 to 3.85% (Figure 6.3-5) and in NP from 9 to 457 kg $CaCO_3$/t (Figure 6.3-6). The paste pH of these samples ranges from 8.4 to 9.6. More than 80% of the samples have total sulphur contents of less than 1.0%, NP values greater than 200 kg $CaCO_3$/t and paste pH values greater than 9.0. These results indicate a low potential for acid generation from the majority of the drill core samples. As is expected from the degree of mineralization in these zones, samples from the B2 and B3 zones have among the highest total sulphur contents of the drill core samples. Samples taken from the basalt rock type, on the other hand, have among the lowest total sulphur contents, with the majority of basalt samples having less than 0.1% total sulphur. The other rock types varied between 0.1 and 1.0% total sulphur. With respect to NP, with the exception of one sediment sample and one dyke sample, the drill core samples have NP values greater than 100 kg $CaCO_3$/t and most are greater than 200 kg $CaCO_3$/t. No obvious trend exists between rock types.

To determine what type of minerals are contributing to the neutralization potential of a sample, NP is plotted against carbonate NP (Figure 6.3-7). Sample values that fall along a 1:1 line indicate the NP of the sample is being produced by carbonate. Sample values that plot above the 1:1 line indicate that there is additional NP being supplied by non-carbonate minerals (*e.g.* fast-weathering silicates). If the sample plots below the 1:1 line, this indicates that some of the inorganic carbon is not generating alkalinity or is unreactive. This would suggest the presence of iron- or manganese-rich carbonates or the presence of organic matter, respectively. The majority of the drill core samples plot below the 1:1 line, probably due to the presence of ankerite and/or siderite, both of which are iron-rich carbonates.

Of the samples that plot above the 1:1 line, all five are of the basalt rock type supporting the interpretation that there are non-carbonate minerals, such as feldspars, contributing to the NP in these samples. When carbonate NP (CaNP) is plotted against paste pH (Figure 6.3-8), the distribution is similar to that seen when NP was plotted against paste pH (Figure 6.3-6). In most cases, however, the CaNP is higher than the NP indicating that there are mineral species present in the samples that do not contribute net alkalinity or are unreactive. Therefore, in order to be conservative, NP was used in subsequent calculations.

Neutralization potential and MPA of the drill core samples were plotted against each other in Figure 6.3-9. This figure indicates that the majority of the drill core samples are well above the 3:1 criterion of DIAND. Only 3 of the 43 samples fall below the NWT criterion. Of the 3 samples that fall below the DIAND criterion, one is from the quartz/carbonate dyke, one is from the B2 alteration halo and the third is from the B3 mineralized zone. The samples from the B2 and B3 zones, due to their significant mineralization, have relatively high MPA values and fall in the category of uncertain acid-generating potential. The low NPR for the dyke sample is somewhat unexpected due to the high carbonate content of this structure. The other two samples analyzed from the dyke are both well above the DIAND criterion and the anomalously low ratio for the one sample is likely an artifact due to sampling procedures (either contamination or non-representivity). It is possible, however, that the dyke is not homogeneous and that the one sample encountered a "pocket" of low carbonate mineralization. This possibility should be kept in mind for future sampling programs, especially if this material will be exposed in waste rock dumps.

As can be seen from Figure 6.3-10, the majority of drill core samples fall within Quadrant I of the Klingmann diagram. This indicates that these samples have a low potential for generating acid. The same can be said for most of those samples that fall within Quadrant II. Of the samples in Quadrant II, the ones with the higher potential for generating acid are those with greater than 0.7% total sulphur and an NPR of less than 10. Most of these samples are from the B2 and B3 zones, although there are samples from other rock types as well, namely the moderately altered basalt, the unaltered gabbro, the quartz/carbonate dyke and the strongly altered

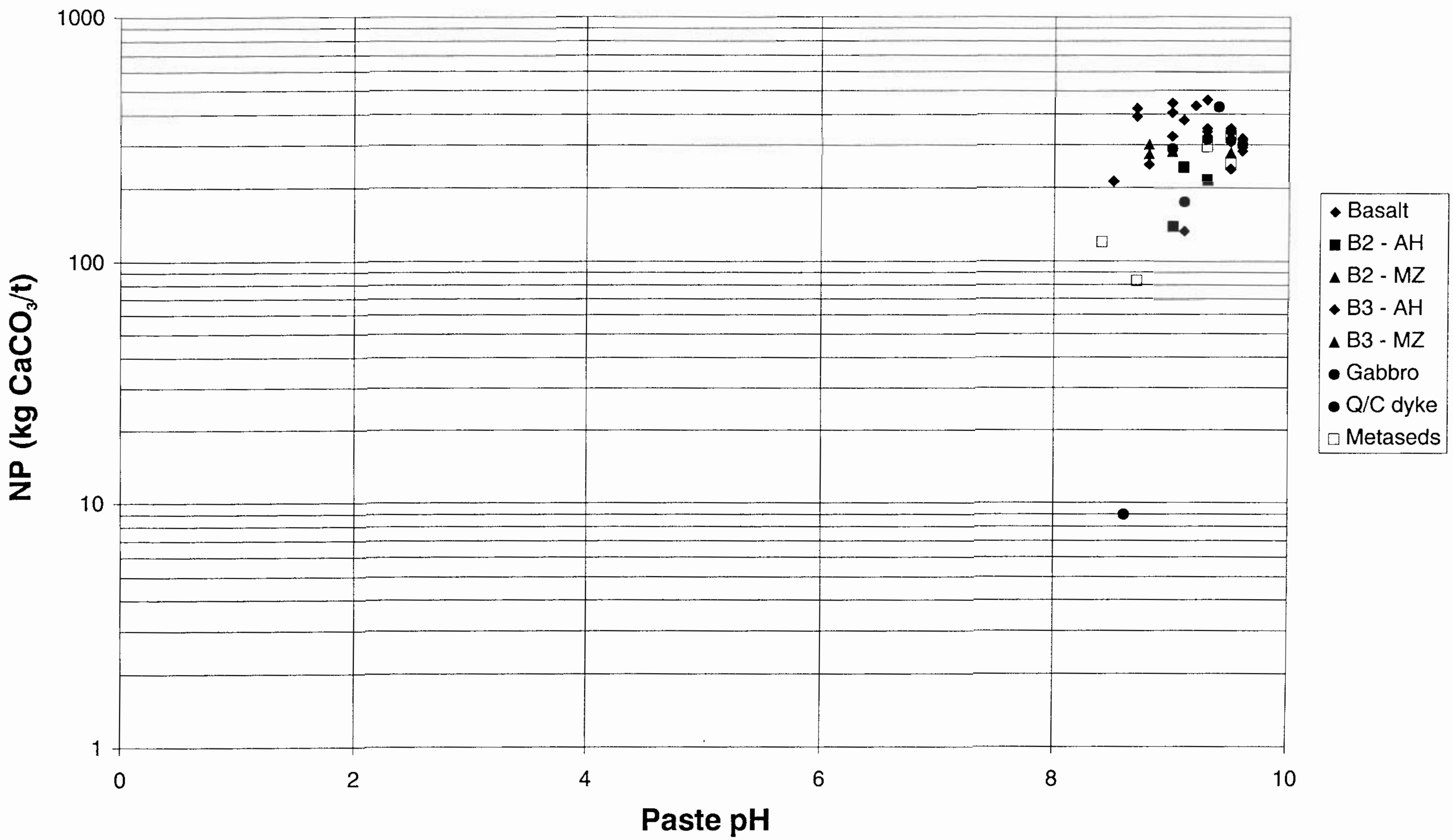


BHP

Total Sulphur (%) vs Paste pH
Drill Core Data (1997)

FIGURE 6.3-5

Rescan

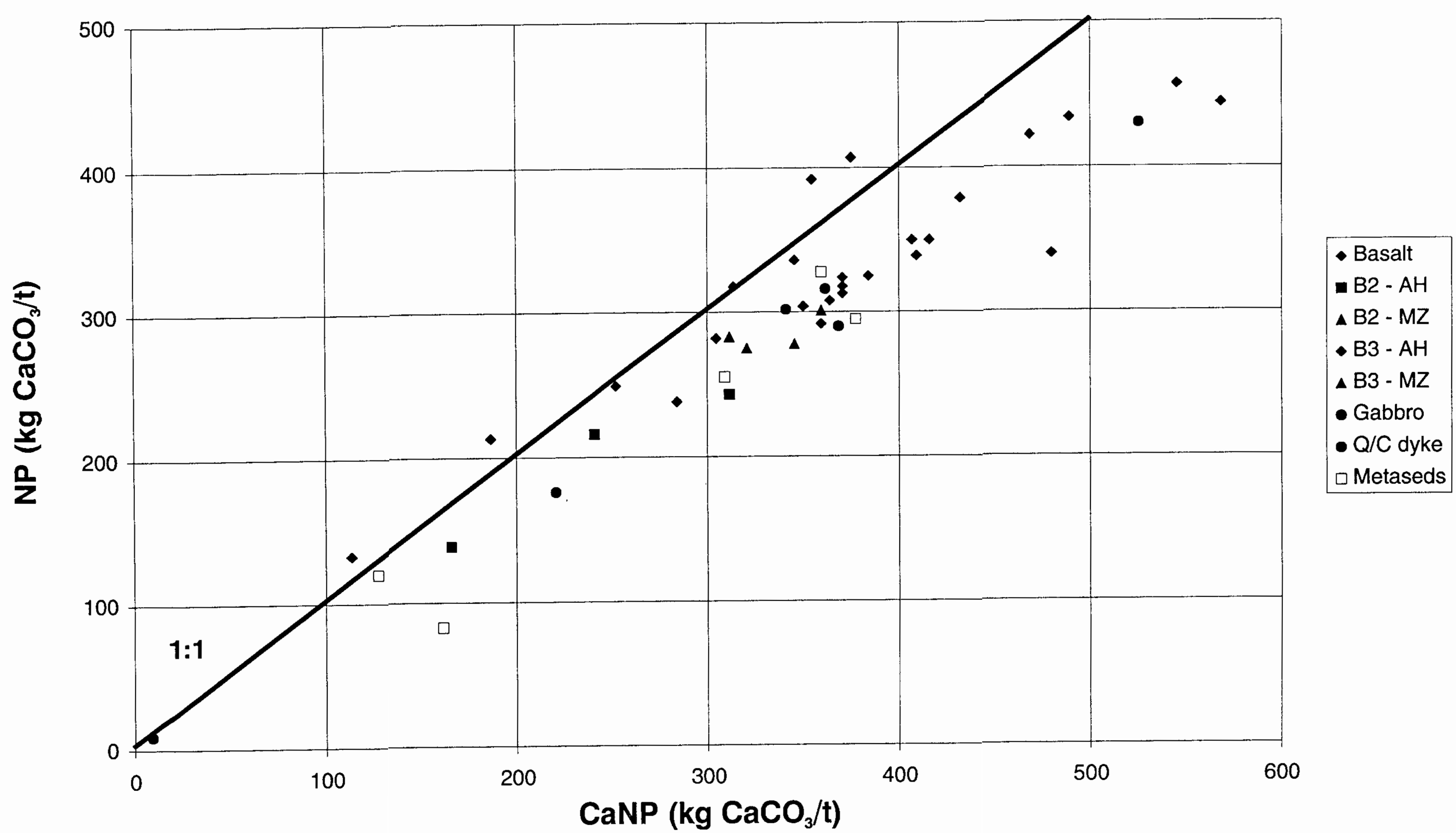


BHP

Neutralization Potential (NP) vs Paste pH Drill Core Data (1997)

FIGURE 6.3-6

Rescan

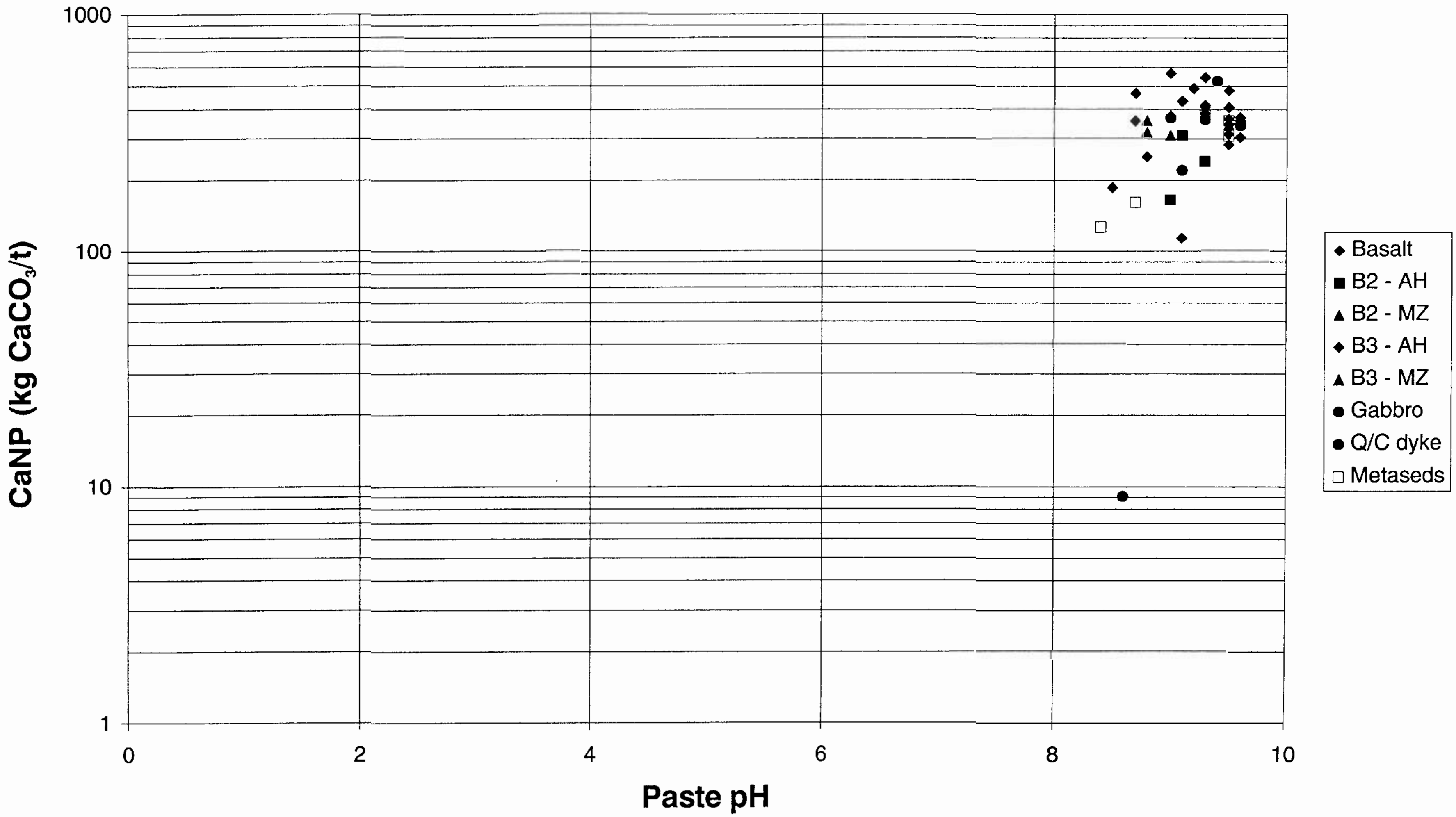


Neutralization Potential (NP) vs Carbonate Neutralization Potential (CaNP) - Drill Core Data (1997)

FIGURE 6.3-7

BHP

Rescan



BHP

Carbonate Neutralization Potential (CaNP) vs Paste pH
Drill Core Data (1997)

FIGURE 6.3-8

Rescan

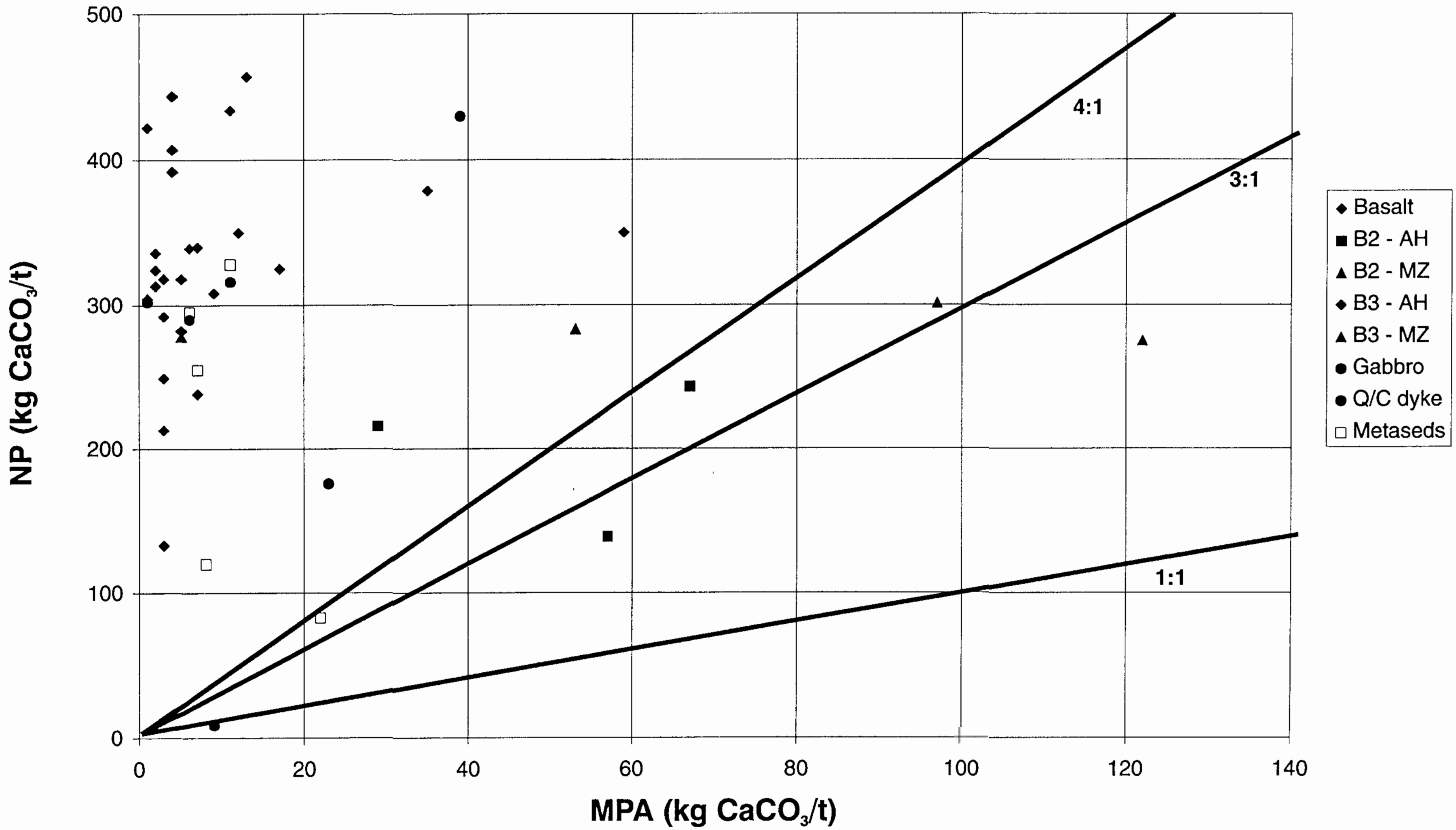


FIGURE 6.3-9

BHP **Neutralization Potential (NP) vs Maximum Potential Acidity (MPA) - Drill Core Data (1997)** Rescan

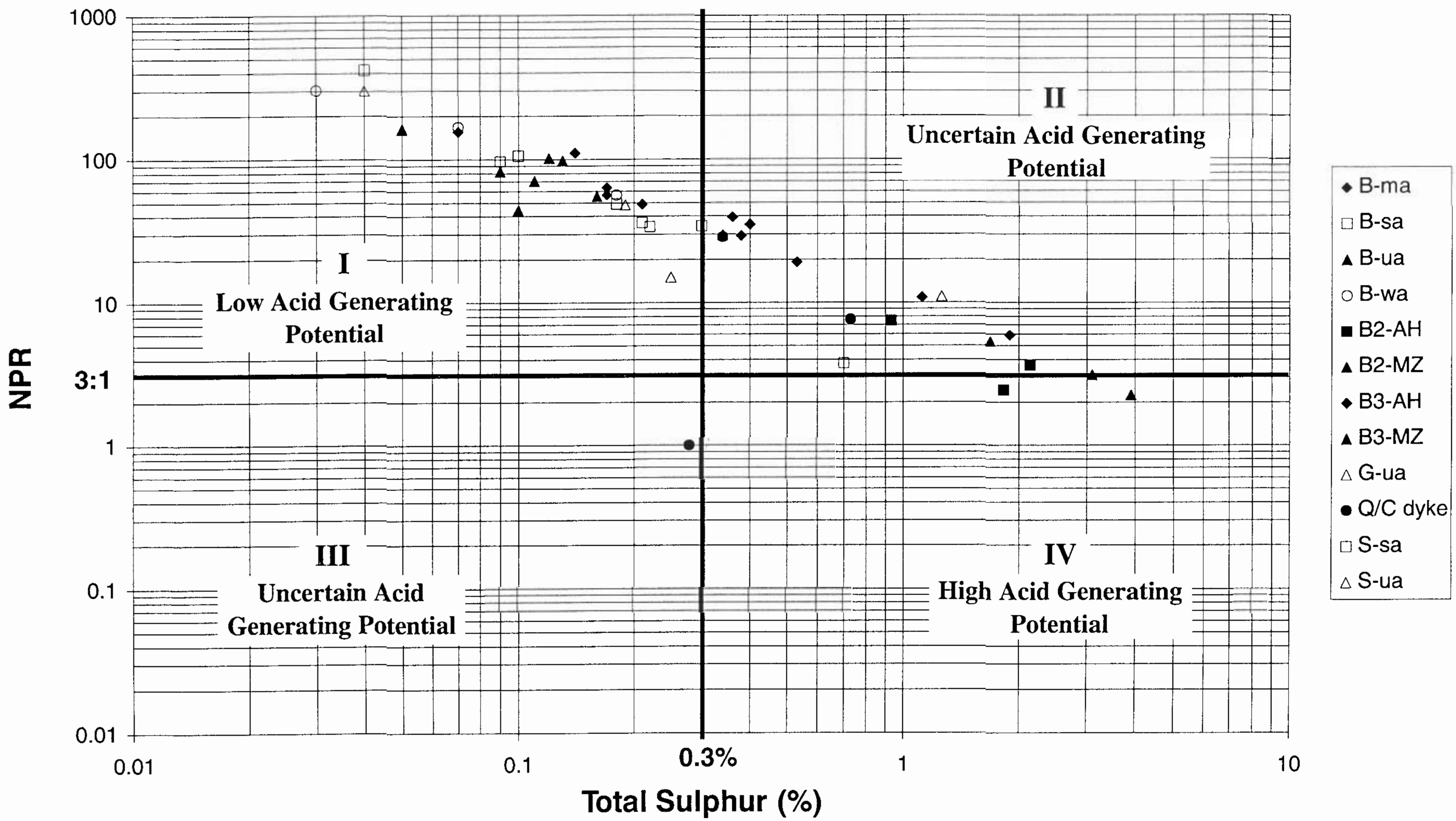


FIGURE 6.3-10

BHP

Neutralization Potential Ratio (NPR) vs Total Sulphur Drill Core Data (1997)

Rescan

sediment. Not surprisingly, the samples with the greatest potential for generating acid (Quadrants III and IV) contain the anomalous dyke sample and samples from the B2 and B3 zones. With the high degree of mineralization in these zones, it is expected that these samples would display the highest potential for acid generation of all the drill core samples.

6.3.2 Kinetic Prediction Testing

The preliminary data from the kinetic prediction tests are provided in Appendices 6.3-3a and 6.3-3b. The data for sample characterization are presented in Appendices 6.3-4a, 4b and 4c. It must be stressed that these are preliminary data only and by following the DIAND guidelines, kinetic testing on the drill core samples will have to continue until the criteria are met (*e.g.* there is no longer constant or increasing sulphate production). The kinetic testing commenced on October 9, 1997 and a total of 17 weeks of data have been obtained to date.

The data collected to date indicates that the samples are not going acidic. Table 6.3-1a and 6.3-1b provide the average values from the last five weeks of data for selected parameters. The pH of the weekly leachate is neutral, with most measurements being above 8.0. The B3 alteration halo sample has the lowest pH of the three, but it is still generating a neutral pH. The production of neutral leachate is expected based on the results of the petrographic examination that indicated the samples contain significant quantities of carbonates. The conductivity of the leachate is relatively low (less than 200 μmohs/cm), which is not surprising considering the low sulphate concentrations measured in the leachate. With the exception of the first five weeks of testing for the B2 mineralized zone sample, the sulphate concentration of the leachate from all three cells has been close to or less than 20 mg/L. This low sulphate concentration is expected based on the petrographic examination, which indicated that the samples contain very little sulphide, and the ABA analysis, which indicated that the samples contain very little sulphate. The alkalinity of the samples is relatively high but, as expected, it is lowest in the B3 alteration halo sample. Examining the whole rock, total metals and petrographic analyses it is expected that these samples would generate significant alkalinity. All three of these analyses indicate that the samples contain large amounts of carbonate. It must be mentioned, however, that the total metals analysis and petrographic examination indicate that ankerite and/or siderite could account for a significant proportion of the carbonates. These carbonate minerals contribute to the NP measured for a sample, but do not provide net alkalinity upon dissolution due to the concurrent generation of acid. Therefore, the alkalinity being generated is likely coming from dolomite and possibly calcite. There is very little acidity being produced by the samples but, as expected, the B3 sample is generating the most acidity of the three.

Table 6.3-1a
Kinetic Test Data (Physical Parameters)

Sample	pH	Conductivity (μmohs/cm)	Alkalinity (mg $CaCO_3$/L)	Acidity (mg $CaCO_3$/L)	Sulphate (mg SO_4/L)
B3 altha (alteration halo)	7.4	77	17.2	3.5	5.1
B2 minzo (mineralized zone)	8.3	89	36.4	-	6.0
Alt basa (altered basalt)	8.4	73	33.2	-	3.7

Table 6.3-1b
Kinetic Test Data (Selected Dissolved Metals)

Sample	Sb (μg/L)	As (μg/L)	Ca (μg/L)	Cu (μg/L)	Mn (μg/L)	Ni (μg/L)	Sr (μg/L)	Zn (μg/L)
B3 altha (alteration halo)	99.6	9630	4800	5.4	2.2	667	32.6	1.7
B2 minzo (mineralized zone)	2.6	9.8	8230	3.7	18.6	1.2	24.5	1.2
Alt basa (altered basalt)	28.8	603	6340	9.8	5.3	6.8	33.4	0.7

With respect to dissolved metal concentrations, aluminum is relatively high in the B2 mineralized zone and altered basalt samples, but it is close to the detection limit in the B3 alteration halo sample. Antimony and arsenic are very high in the B3 alteration halo sample and somewhat elevated in the altered basalt sample. Nickel, silver and zinc are also elevated in the B3 alteration halo sample as compared to the other samples, although the zinc concentrations vary quite widely. As expected, based on the carbonate and silicate content of the samples, calcium, magnesium, potassium and sodium concentrations are all high. The whole rock and total metals analyses for the samples indicate that they contain a lot of iron, probably in the form of ankerite and/or siderite. The very low concentrations of iron in the weekly leachate from the cells indicate that these carbonates are not reacting.

As mentioned above, these tests are ongoing and the results available to date are preliminary only. Once the testwork has been completed, a full report will be prepared that provides a detailed interpretation of the kinetic test results.