MAR 20100022: CROWSNEST NORTH

Received date: Dec 02, 2010

Public release date: Dec 06, 2011

DEC 0 2 2010
20100022

A REPORT FOR ASSESSMENT METALLIC AND INDUSTRIAL MINERALS PERMIT 9304091032

SUITABILITY OF SELECTED ROCKS FROM THE CROWNEST VOLCANICS FOR DECORATIVE PURPOSES

November 12, 2010

Submitted by:
Tom Bryant

TABLE OF CONTENTS

Project Summary

This report details an exploration work program carried out on Metallic and Industrial Minerals Permit 9304091032.

Testing was carried out by the author or by others under his direction on samples gathered from a talus slope in Metallic and Industrial Minerals Permit 9304091032 at approximately 49 48' 10.87" N and 114 33' 30.63" W. This phase of the project began early June 2007 and observations were completed at the end of August 2010.

As part of the ongoing exploration on this permit samples were collected and evaluated for their potential economic value. Part of that evaluation is to determine if a viable product can be produced. In this, the work carried out is analogous to exploration assays determining ore values and characteristics or tests of industrial minerals deposits for potential products that can be made. All valuable steps towards moving from exploration to development.

Samples were collected and evaluated in a long term study of the weathering and aesthetic endurance of selected rock from the Crowsnest Volcanics to determine its potential use as a decorative slab/crushed rock product. Testing was carried out to determine the weathering characteristics, freeze/thaw resistance, and other important characteristics that would determine the suitability of the rock for the intended use.

Samples were subjected to extended real world conditions over a three year period as well as an accelerated freeze/thaw examination with and without salt on the surface to mimic ice melting chemicals used in outdoors applications.

The testing proved that the materials under examination had very good resistance to freeze/thaw and to general weathering through multi season observations.

Further work has been recommended. With the successful freeze/thaw and extended weathering studies of smaller slabs, larger slab examinations and market study is justified. Larger slabs will be prepared as market grade product and provided for real world installation with the chance to observe over an extended period.

Further work on resin surface coatings and impregnation needs to be carried out. Studies will include eliminating bubbles, studies of resin as surface coating under various conditions and coating and polishing back to rock surface leaving resin as stabilizer and filler.

A field examination of all available material on the permit area as loose rock for type, grade, size, tonnage and accessibility is advised.

SUITABILITY OF SELECTED CROWSNEST VOLCANIC ROCKS FOR OUTDOOR DECORATIVE PURPOSES INCLUDING FACING ROCK AND FLAGSTONE/PAVERS

A report for Assessment in reference to Metallic and Industrial Minerals Permit 9304091032
November 2010

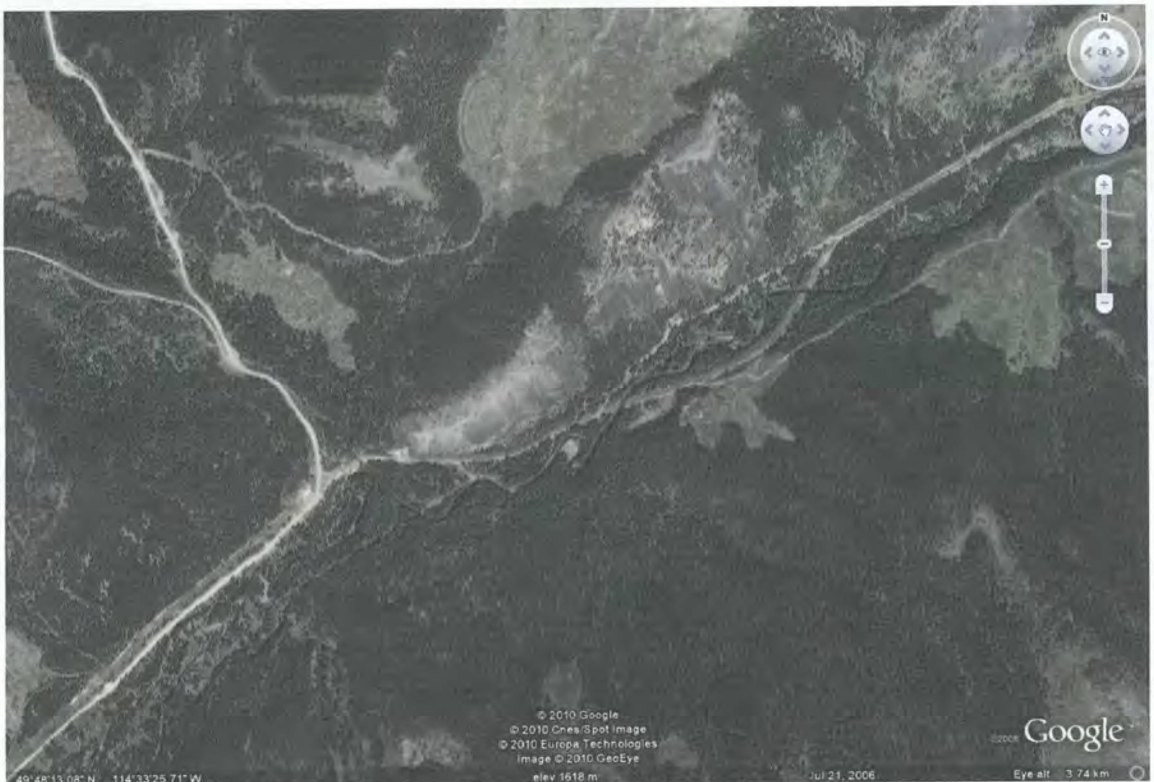
Introduction

Further to an earlier study submitted for assessment on this same permit in 2006 of the potential for Crowsnest Volcanic rock to be used for decorative crushed rock and for decorative rock slabs for interior and exterior use a longer term study of the weathering and aesthetic endurance of various rock types selected from the Crowsnest Volcanics was undertaken.

This program was carried out over a three year period and observations were made on a periodic basis.

Location

This assessment report covers Alberta Metallic and Industrial Minerals Permit 0939304091032.
The samples were taken from the base of a talus slope made up of various types of volcanic rock at approximately 49 48' 10.87" N and 114 33' 30.63" W.
The Forestry Trunk road goes north from Hwy 3 to a pipeline that comes through the Racehorse Pass. A road branches east from where the pipeline intersects the Trunk Road and can be used to access the base of the talus slope referred to above. The location is show in the Google Earth image below and can be referenced in the attached map as well.



Google Earth view of sample site – the site is located along the base of the talus slope immediately to the east of the main road and north of the pipeline road

Geology

The rocks chosen for this study are from a volcanic unit defined by Robin Adair in his 1989 Master's thesis for the University of Alberta as the "Upper Member".

Adair describes that rock unit as "a thick sequence of massive pyroclastic breccias and minor agglomerates." The upper member is a prominent ridge former in the area and can be tracked for many kilometres in a north south trend from north of the study area to south of Hwy 3.

Samples of two rock types were chosen for observations over a three year period. One sample group is from a green coloured layer of volcanic rock and another from a pinkish coloured layer.

The green rock unit corresponds with Adair's definition of the "Upper Member" while the pink rock has characteristics similar to units he ascribes to the "Lower Member".

For the purposes of this study no further attempts were made to refine the categorization as examination in the field was meant to only locate and secure representative rock types that could offer samples of a potentially marketable facing and paving stone. Examinations were also carried out with the aim of identifying the potential to produce large slabs suitable for countertops etc.

Samples were gathered from a talus slope in the permit area. (See location map and Google Earth Image)

Sample acquisition and preparation

A small picker truck was used to secure approximately 12000 lbs of boulders of up to three feet across from several areas along the base of the talus slope. The truck was not able to transport more than one or two boulders at a time but due to the condition of the road and the need to be manoeuvrable when on site the smaller truck was considered the best choice. Boulders were transported to a site near Coleman and then transferred to a larger truck to be transported to a site near Edmonton. At that site they were first broken into pieces of 10 inches or less by a S205 Bobcat skid steer loader fitted with a hydraulic hammer with a rock/concrete breaking point.

SKID STEER LOADER WITH HYDRAULIC HAMMER AND BREAKER POINT - LARGER BOULDERS IN BACKGROUND

The green material was much was much harder to break. The operator often found that the only way to optimize the breaking action was to stack two rocks on top of each other so the lower rock acted as an anvil and the hammer was not losing efficiency due to the softer ground absorbing the blows.

THE GREEN ROCK WAS VERY HARD TO BREAK

From the broken rock pile several pieces were chosen and samples of crushed rock and slabs were prepared. An emphasis was placed on examination and testing of the slabbed samples as there is market interest in the slabs for decorative facing and potentially larger slabs for use in countertops and fireplaces. Both raw rock and slabbed samples were subjected to real world weathering tests. Slabbed samples were also set aside for accelerated freeze thaw and freeze thaw with salt to duplicate de-icing efforts on flagstone type installations.

A sub sample was tested in a 4 by 6 inch jaw crusher reducing fist sized chunks to ½ inch minus.

Despite the difficulty in breaking with the hydraulic hammer all of the material demonstrated excellent crushability in the jaw crusher. Material broke cleanly and quickly with very little overcrush.

TESTING SAMPLES IN A 4 X 6 INCH JAW CRUSHER

A large sample of broken rock was spread directly on the ground as a test for weathering in landscape situations.
Observations began August 18th 2007 and ended August 10th 2010.

A small sample of cut rock was tested for polishing using diamond grit sandpaper on a vibratory sanding machine. Previous samples from the area had been tested using a large flat lap machine and these tests were successful. The selected samples in these tests were done to test the possibility of a low tech field expedient method to evaluate slabbed samples.

SAMPLE OF LARGER PIECES LAID OUT FOR WEATHERING TEST

Ground level extended weathering tests for slabs

Examples of both green and pink slabbed samples were placed on a wooden platform at ground level and left exposed through all four seasons over the three year period beginning on June 20th 2007.

Periodic observations were made over that time.

The observation period ended August 28th 2010.

As the pictures illustrate the slabs were essentially unaffected through that time.

Very minor rust staining was linked to sulphide breakdown in the green rock but that was somewhat expected from previous observations.

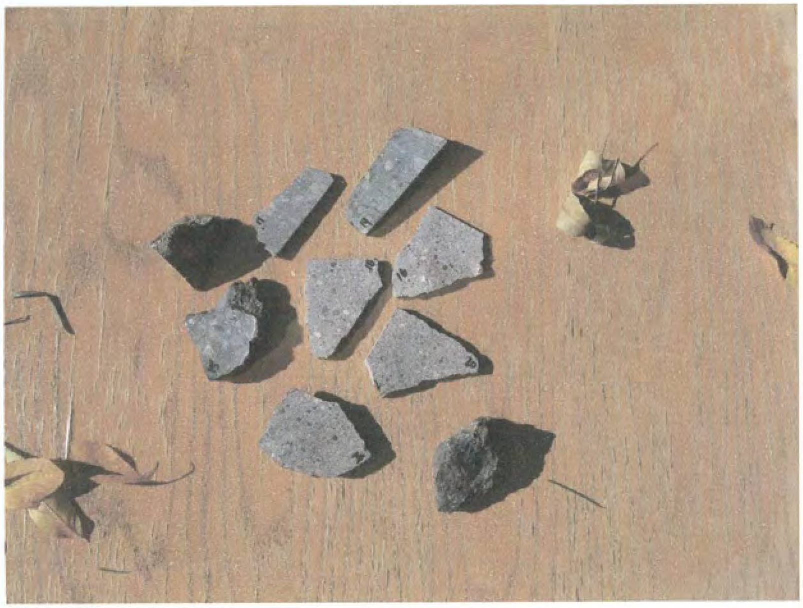
The pink rock slabs showed no significant changes at all.

There was no breakdown from freeze thaw nor did the surfaces show any weathering signs like chalky deposits or surface roughness associated with the breakdown of the mineral grains or matrix.

The lack of weathering over a three year period was considered an encouraging result pending the result from accelerated weathering in the freeze/thaw testing


June 20, 2007


September 18, 2008


November 22, 2008


May 27, 2009

October 12, 2009

July 8, 2010


August 28, 2010

Moisture absorption

Before beginning the freeze thaw experiments some baseline data was collected to determine how much moisture the different rock types would absorb, The premise being that those rock types most likely to absorb water would be most likely to suffer the effects of freeze/thaw.

The pink varieties gained between 0.31% to 0.43% in water weight.
Green varieties gained between 0.74% and 0.81 % in water weight.

Water soluble minerals wicking onto rock surface from the ground

In the fall of 2009 some samples of the loose broken rock stored directly on the ground began to show a very thin chalky coating. Generally the coating was not so obvious that it would be an aesthetic issue but it did dull the colour. Microscopic examination of the chalky deposits as well as simple acid testing revealed that it was a calcium deposit similar to hard water scale. After examining the storage site it was concluded that the calcium was coming from the wet ground under the rock. It needs to still be determined if the calcium is from ground moisture that is wicking along the surface of the rock or if the rock is sufficiently permeable that ground moisture is soaking into the rock and then working its way to the exposed upper surface to them evaporate leaving the calcium behind. Slabbed samples did not show much in the way of an acid reaction to calcium on the interior of the rock so for the slabbed samples at least it appears to be a surface effect and not due to the rock soaking up moisture throughout.
Given that the green rock showed a higher water absorbency there was some thought that the wicking effect should have been more pronounced. If it was it was a marginal increase as both pink and green

rock showed the effect to a similar degree. The darker green rock however suffered more aesthetically as the light coloured minerals wicked to the surface were more obvious.

Diamond grit sandpaper polishing tests

Testing was carried out on a group if mixed slabs. Diamond grit sanding paper was fastened to a standard orbital sander and manipulated by hand.

Beginning with 120 grit the process was taken in stages to 800 grit. During the processing the slabs were washed off regularly and at times the sandpaper was wet down. The 120 grit was able to remove the chatter marks and other imperfections caused by sawing and as long as the operator did not get impatient and move to the next finer grit prematurely the polishing went quickly.

As the operator began to consider the course grit stage done a checkerboard of pencil lines was put on the slab and it was placed on the sanding machine for a brief time. If the slab had reached proper flatness the pencil marks would be gone. If there were still marks left then the course polishing would continue.

The overall impression was that slabs polished easily and quickly and that this method could be used in the field to determine how various samples will respond to polishing.

Freeze thaw with and without salt

Slabbed samples were subjected to an extended freeze thaw examination.

Freeze thaw experiments were carried out with and without salt added to duplicate de-icing of sidewalks.

Unpolished slabs were subjected to freeze thaw conditions over several months with examination of their surfaces for signs of breakdown. Not only does freeze thaw carry the potential to degrade the slabs but salt has a certain level of reactivity that could lead to chemical attacks on certain surfaces.

Samples of both the green variety and the pink variety of Crowsnest Volcanic were tested.

Initially slabs were placed in a low sided shallow tray wetted on their surface and the water allowed to soak for several minutes before placing the sample into a freezer. There was some overflow into the tray that soaked the lower surface of the rock and formed a thin layer in the tray.

The plastic trays had a lip that acted to retain any mineral grains that may have shed from the slabs.

Samples were left for a minimum of 24 hours and then removed from the freezer and placed into a refrigerator for 24 hours. A visual inspection of the slabs was carried out before carefully pouring off excess water and re-wetting with refrigerated distilled water. Every 10 cycles defrosted samples were examined with magnification.

The salted freeze/thaw samples followed the same basic protocol with the first salt application done at the end of the first freeze cycle. There were salt losses due to salt going into solution and being poured off with excess water build-up in the pan but the salt endured quite well if wetting was carried out carefully. Samples were then carried through the freeze/thaw cycles until the 10th cycle. The defrosted samples were rinsed off with refrigerated distilled water to remove salt so that the surface could be examined. After examination the samples were rewetted and the put through the first freeze cycle and then a new layer of salt was applied to the frozen surface before placing the samples in the refrigerator for the thaw cycle.

All of the samples for slab testing were of limited size.

Two attempts to get larger slabs were not successful due to mechanical issues with the equipment.

A large diamond bladed saw with the rated capacity to cut slabs to 30 cm was first tried. Problems with the feed mechanism and the balance of the blade became issues that could not be overcome before the tests had to be underway.
A second attempt to cut larger slabs was tried with a home built gang type saw. A simple arrangement using a wooden frame to support a piece of 1/16 th aircraft cable or, alternatively, a piece of mild steel strapping, 1/16 inch thick and of suitable length set on edge like a toothless saw blade. The blade frame was set in a guide frame and caused to move back and forth by a reciprocating mechanism driven by a small electric motor. An abrasive slurry was pumped from a tank under the rock being cut in a way to recycle water and abrasive. As a system it offers benefits in economy and simplicity but it is a lot slower than a circular saw using diamond impregnated blades.
It does offer a key benefit in that it can cut very large rock and the depth of the cut can be accommodated more easily than with a rotary saw. A rotary saw cut is limited to a little under one half the diameter of the saw blade where the shaft is bolted to the blade. A gang saw type has only the limits of the saw blade support frame and can be built to have a very large open area without the high cost and mechanical limitations of the rotary blade.
As a single slab cutting saw a gang saw type is very slow compared to rotary diamond blades but the gang saw design can gain back some advantage in that frames can be constructed with multiple blades in the same frame. They are spaced in the frame to cut the proper slab thickness and can cut multiple slabs at the same time.
The system, as built, showed merit but several mechanical issues and difficulty in keeping the slurry moving consistently to the cutting face caused the effort to be suspended. Further work on an improved saw using this system will be part of future study.

Observations

All of the slabbed samples exhibit fine cracks in their surface. There does not appear to be a grain to the rock but rather small cracks that do not "carry through" the rock or exhibit any particular pattern.
Most appear to be quite fine and the competency of the rock is still good though for outdoor use they may offer an opportunity for water to penetrate and accelerate weathering due to freeze thaw conditions. Deeper cracks that compromise competency are usually evident right at the slabbing stage; the vibration from the saw causing the slab to fracture along that point of weakness. This is not unusual for natural rock and is not considered to be an issue other than requiring careful quality control protocols to ensure that finished slabs do not show cracks offering the potential for failure under normal usage.
As with other natural rock the cutting and sorting of slabs will create a range of sizes outside of a standard and those off standard pieces will need to be set aside and sold as a specialty item. The standard size flagstone can be cut on site by installers but unless the design calls for a straight sided stone the natural look of the installation will be lost. Having some stone available that is of other sizes that can be used to complete an installation and using the natural contour of a fracture break to preserve the look may be of benefit.

The absorption and wicking of moisture causing a wicking effect and creating hard water stains on the surface should be considered when using this rock for outdoor decorative purposes. Good drainage and the use of non permeable underlay would be two significant improvements. While no tests have been carried out it is very likely that a combination of period hosing down and good drainage should eliminate or reduce the issue. Observers noted that the effect was not that pronounced and it was mainly because they had seen the rocks when they were first broken up and at their cleanest that made the dulling effect more noticeable. It may not be an issue to a casual observer at all.

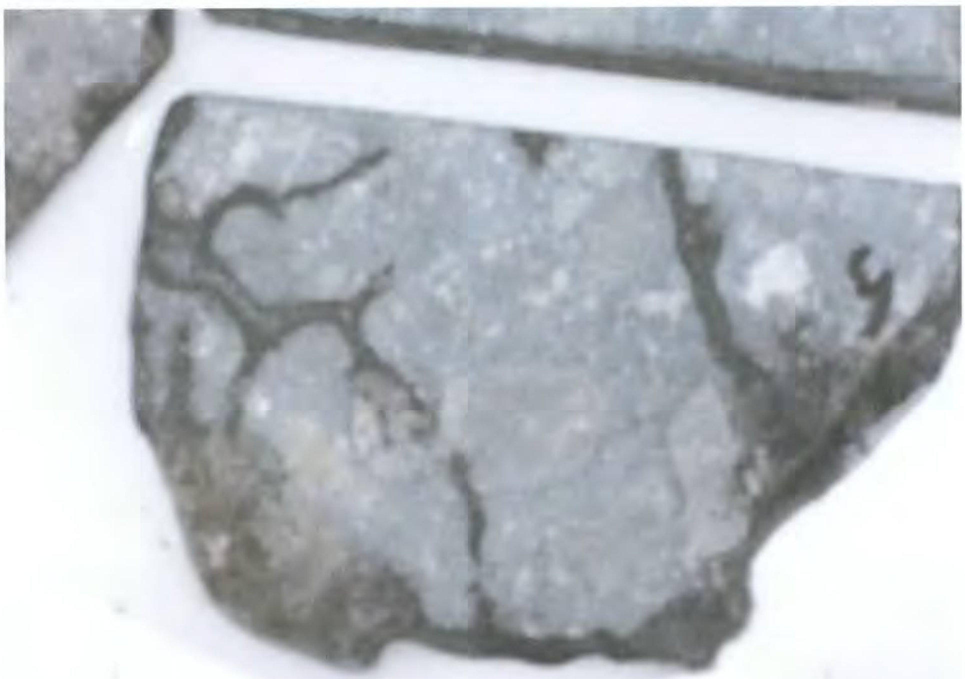
Particularly with the green volcanic surface rust staining is common on weathered samples. Blebs of sulphide cause localized stains and in some applications this could be an issue.

All of the observed fractions – raw rock and slabs have staining issues.

Observers felt that if slabbed flagstones were used in a foot traffic area the staining would be largely worn off and kept off through normal use. Even sweeping the surface with a stiff broom would diminish the stain significantly as long as the discolouration was fresh. Some stains that were left for long periods were more persistent leaving a rusty blush to the area of rock after the stain was removed. The rust will penetrate between some of the mineral grains and resist mechanical removal.

No attempts were made to use commercial cleaning solutions to remove the stains but testing should be carried out to see if this can be done without compromising the rock.

Frozen slabs without salt showed a highlighting effect along the surface cracks as they defrosted and dried. Moisture collecting along the crack caused it to stand out from the lighter colour of the slab.



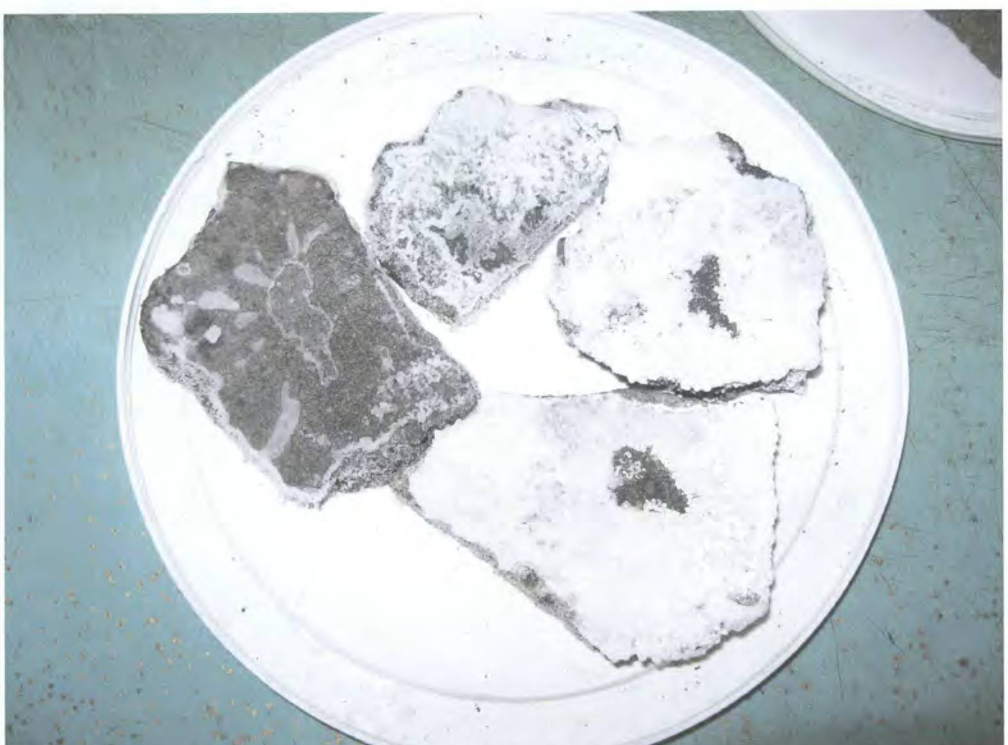
FREEZE/THAW PLAIN WATER SHOWING HOW WATER REMAINS IN THE FRACTURE LINES AS THE SLAB DRIES

SLABS DRYING AFTER A FREEZE/THAW TEST SHOWING FRACTURES HOLDING WATER LINKED TO THE GREEN VOLCANIC ROCK

As the slab continued to dry the highlight effect was gone though there is some concern that hard water might leave trace minerals behind and leave stains behind. Hard water staining is unlikely when the slabs are used indoors but the effect can still be a concern when using cleaners on the surface that might leave a residue. No testing has been carried out to evaluate the possibility. The effect was most pronounced with the green rock. For outdoors installations the potential for hard water staining may be enhanced. In traffic areas with constant wear there would probably be less chance for stains to endure.

The salted slabs kept a layer of water/slush/salt on the surface as they defrosted and the surface did not dry in a way that would emphasize the surface flaws. The salt tended to retain water and keep the surface wet looking for an extended period however if allowed to dry completely the salt would form an obvious crust covering the slab.

SALTED SAMPLES IN FREEZE/THAW SHOW A WET LOOK AS WATER CONTINUES TO COME OUT OF THE SALT AS THE SAMPLE DRIES



WHEN FULLY DRY THE SALTED FREEZE/THAW SAMPLES SHOW DEFINITE SALT CRUST

In the fall of 2009 some samples of the loose broken rock stored directly on the ground began to show a very thin chalky coating. Generally the coating was not so obvious that it would be an aesthetic issue but it did dull the colour. Microscopic examination of the chalky deposits as well as simple acid testing revealed that it was a calcium deposit similar to hard water scale. After examining the storage site it was concluded that the calcium was coming from the wet ground under the rock. It needs to still be determined if the calcium is from ground moisture that is wicking along the surface of the rock or if the rock is sufficiently permeable that ground moisture is soaking into the rock and then working its way to the exposed upper surface to them evaporate leaving the calcium behind. Slabbed samples did not show much in the way of an acid reaction to calcium on the interior of the rock so for the slabbed samples at least it appears to be a surface effect and not due to the rock soaking up moisture throughout.

Freeze/thaw testing was carried out over 100 cycles.
Only one slab in the regular water group fractured and that was along the margin of the rough rock and the sawn portion of the slab. From microscopic examination it would appear that the fracture was pre-existing and that water expansion wedged the fracture open. The regular water freezes harder at the temperature used and may have had a greater expansion factor. An examination along the fracture indicates an area of weakness may have been created around the margins of a larger than average garnet crystal. There may have been an area of weakness around the crystal that allowed greater water penetration and an enhanced ice expansion effect,

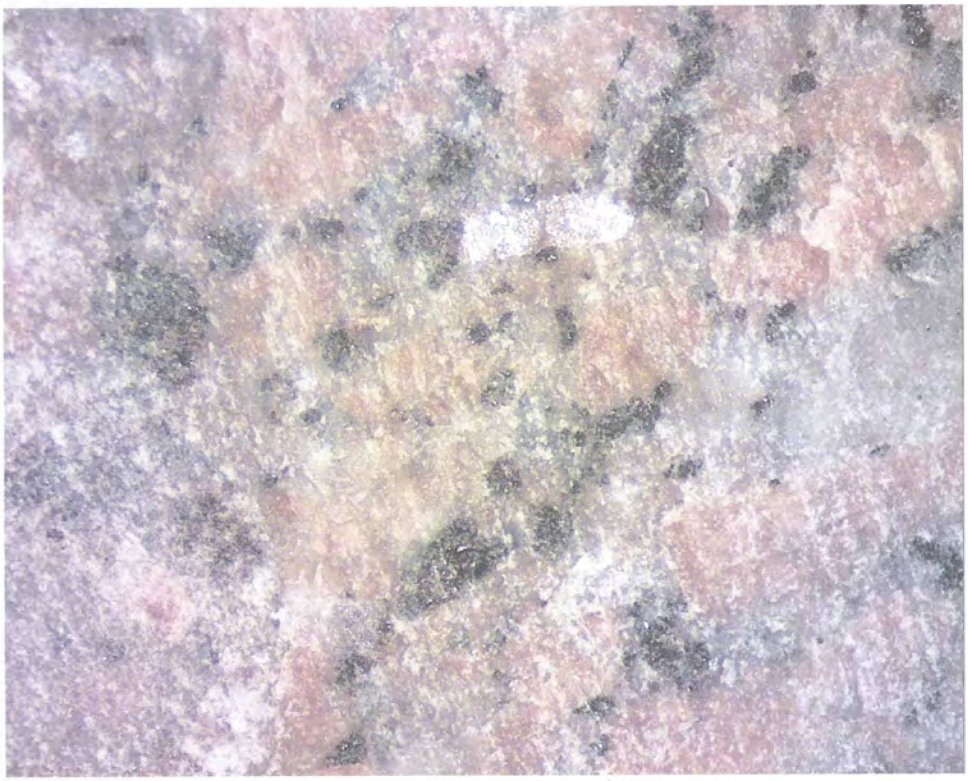
Over the test period a small amount of fine grained material sloughed off the slabs. The salted slabs showing the greater evidence of breakdown. Examination of the slabs showed very little surface breakdown and the materials observed appear to be from the rough stone edges of the slabs more than the smooth cut surface.

FINE GRAINED MATERIAL SLOUGHED OFF THE SLABS DURING SALTED FREEZE/THAW

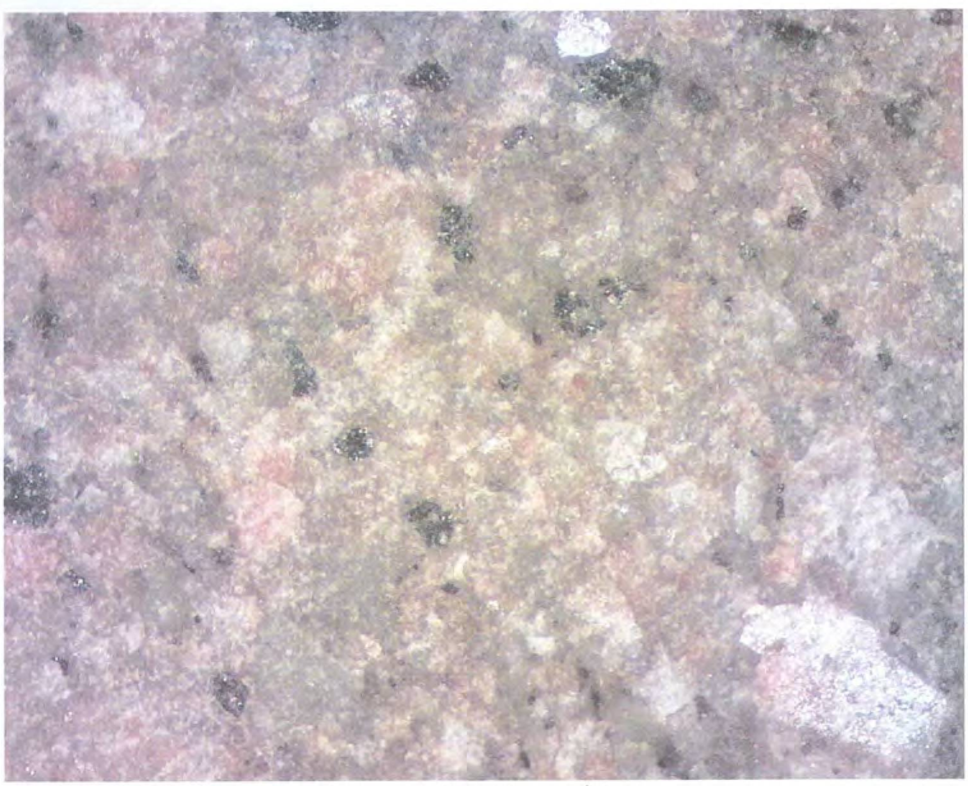
ONLY A SMALL AMOUNT OF VERY FINE MATERIAL SLOUGHED FROM THE
REGULAR WATER FREEZE/THAW

Some selected surface comparisons from the freeze/thaw testing

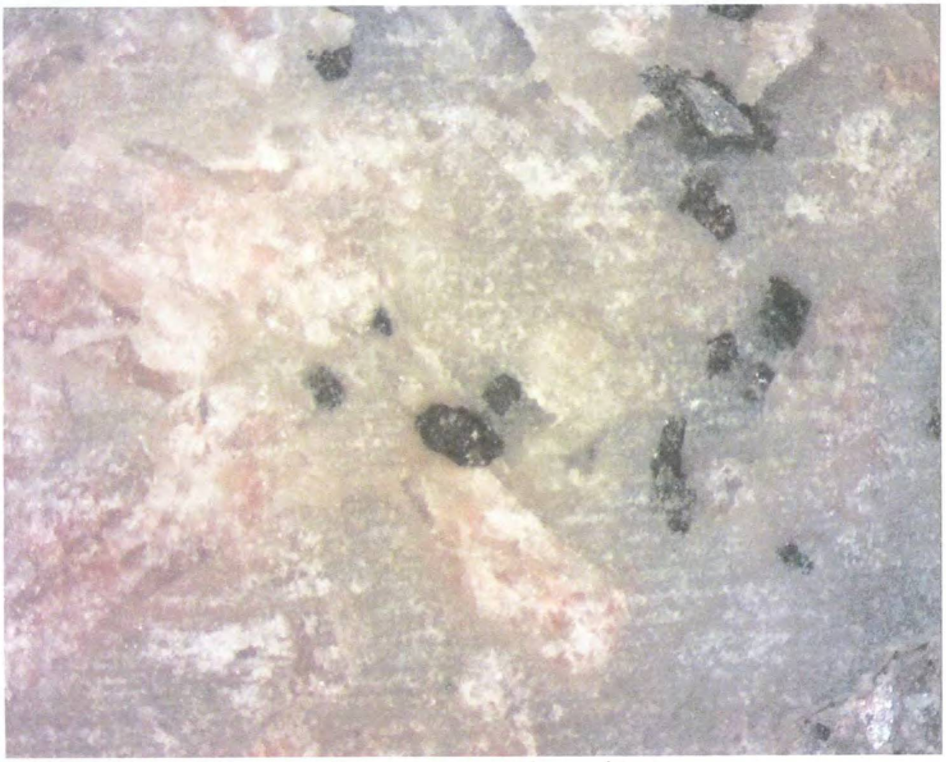
Before and after photos were taken using a USB microscope attachment. Because of the variables associated with positioning and focus of the camera in the microscope tube and the photo capture software an exact magnification had to be estimated. Comparisons between the USB view and observers eye views puts the degree of magnification at approximately 15x.
Samples of both the green and the pink rock were examined and a concerted effort was made to locate and photograph the same areas in both the before and after.
Other significant features were also photographed.
Making allowances for variation in lighting it can be seen that the surfaces were not affected by freeze/thaw to any significant degree.

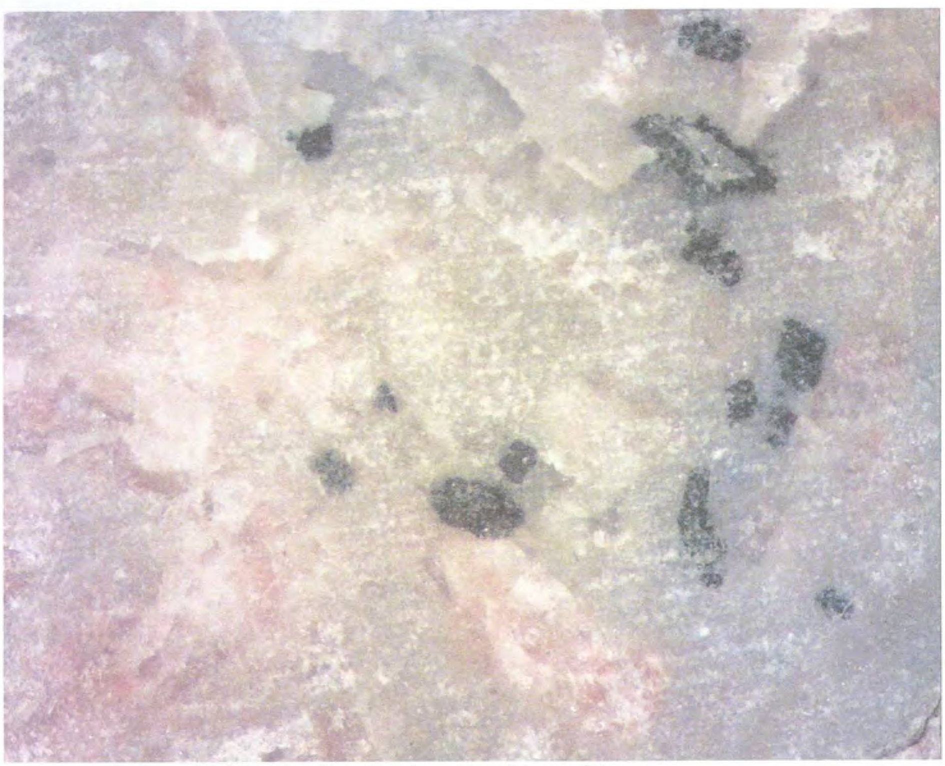


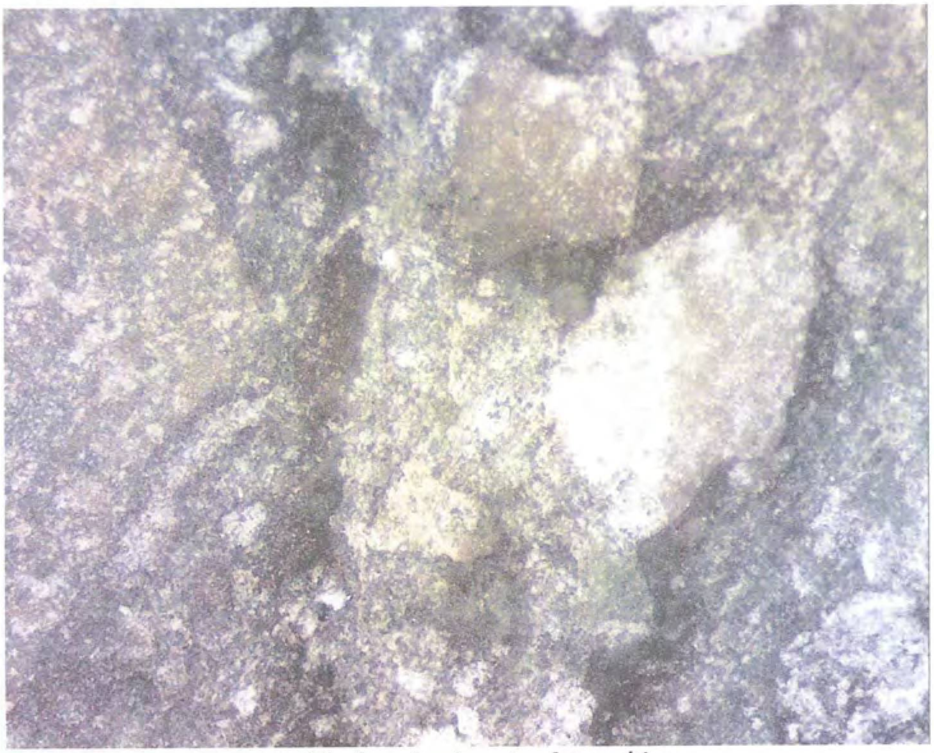
Pink rock before fresh water freeze/thaw



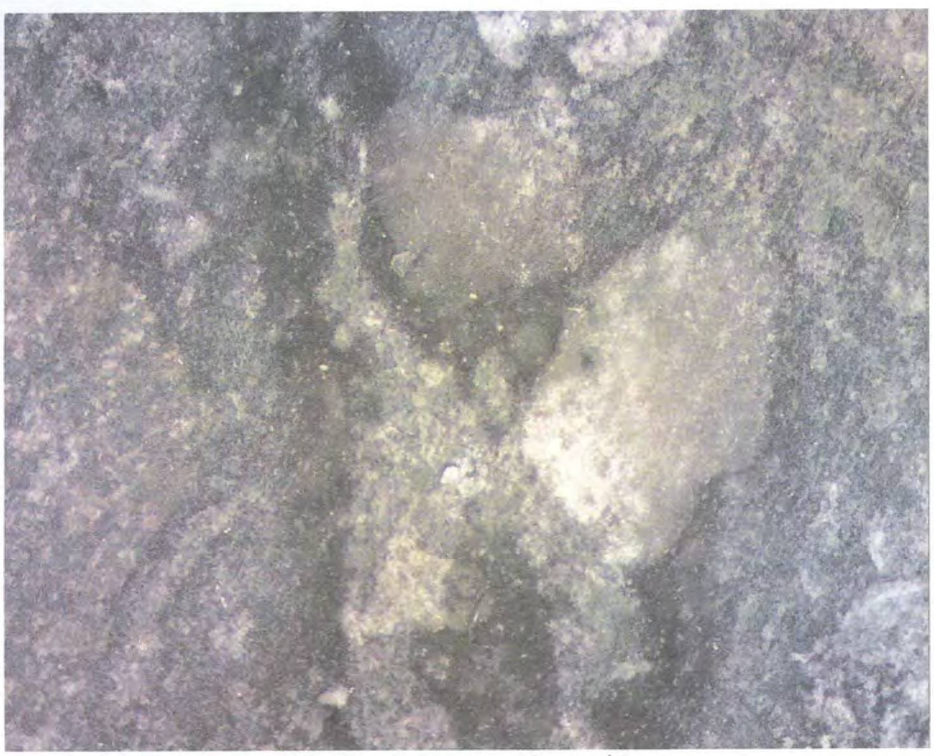
Pink rock after fresh water freeze/thaw


Pink rock before fresh water freeze/thaw


Pink rock after fresh water freeze/thaw

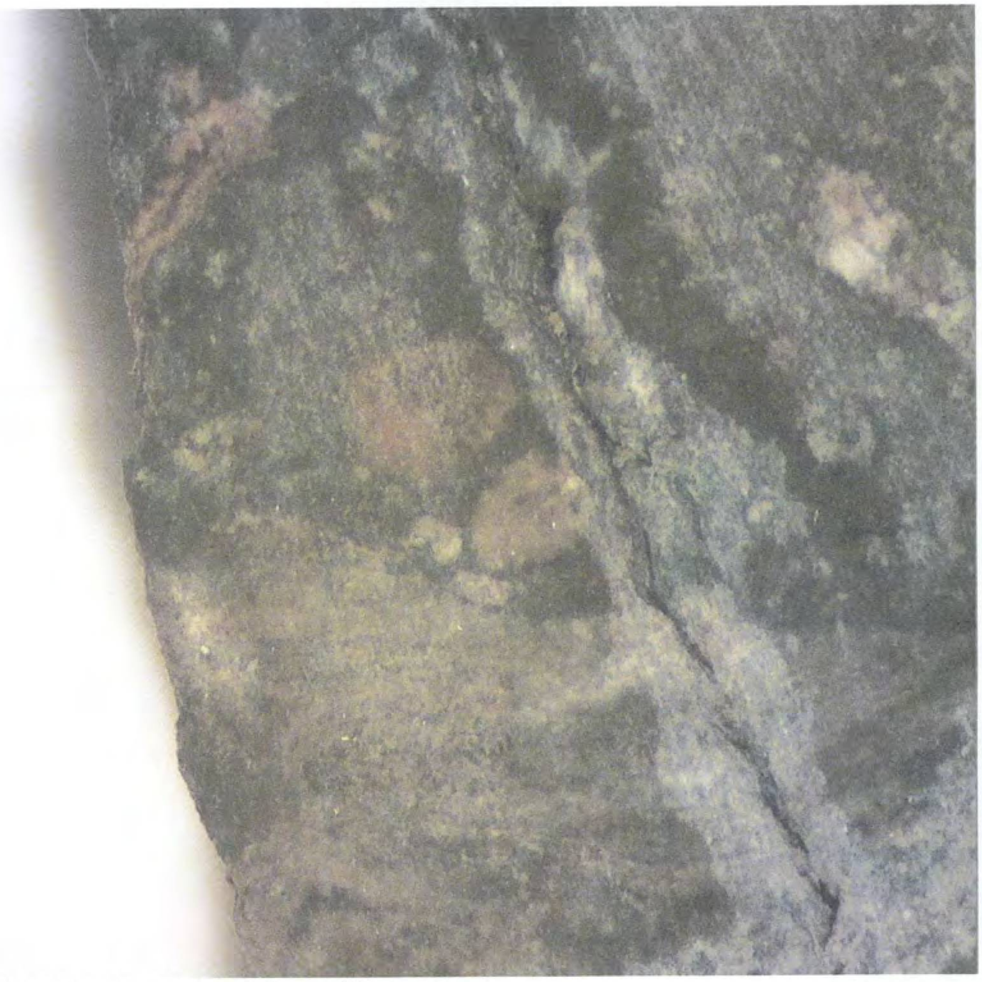


Green rock before fresh water freeze/thaw

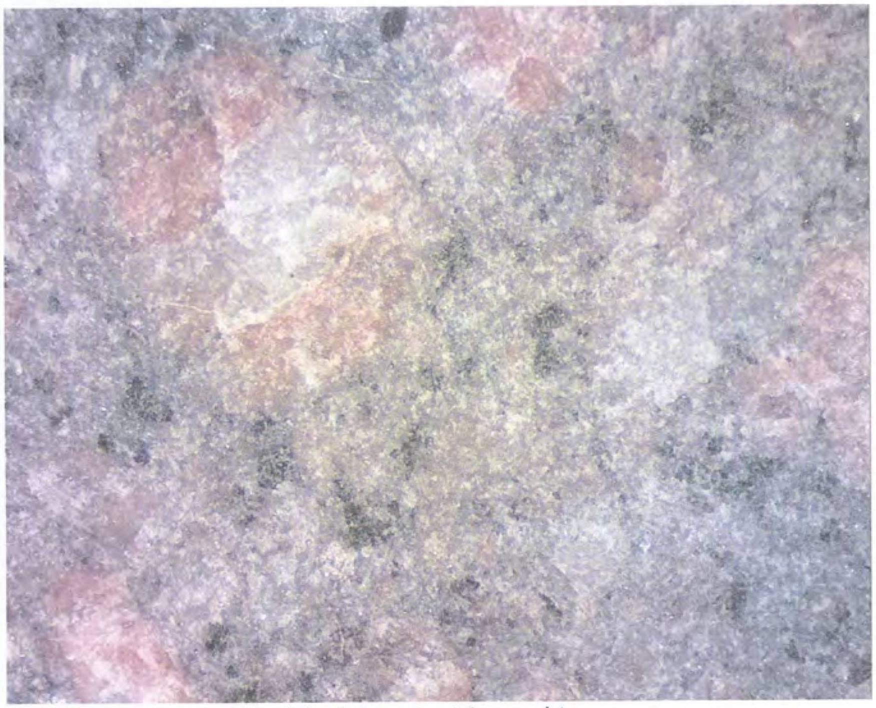


Green rock after fresh water freeze/thaw

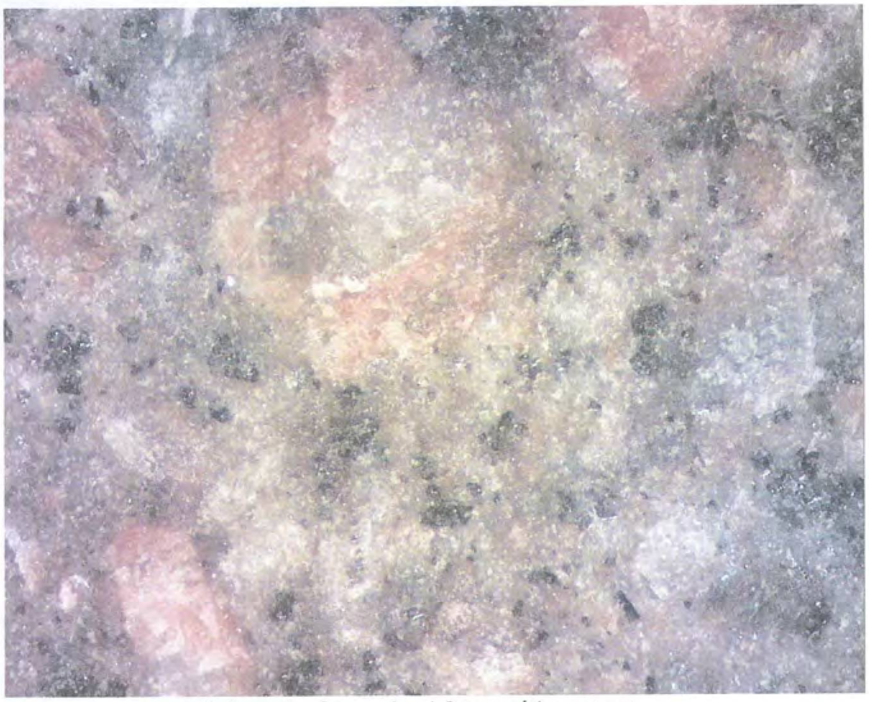
Very rare pop-outs in green rock from fresh water freeze thaw



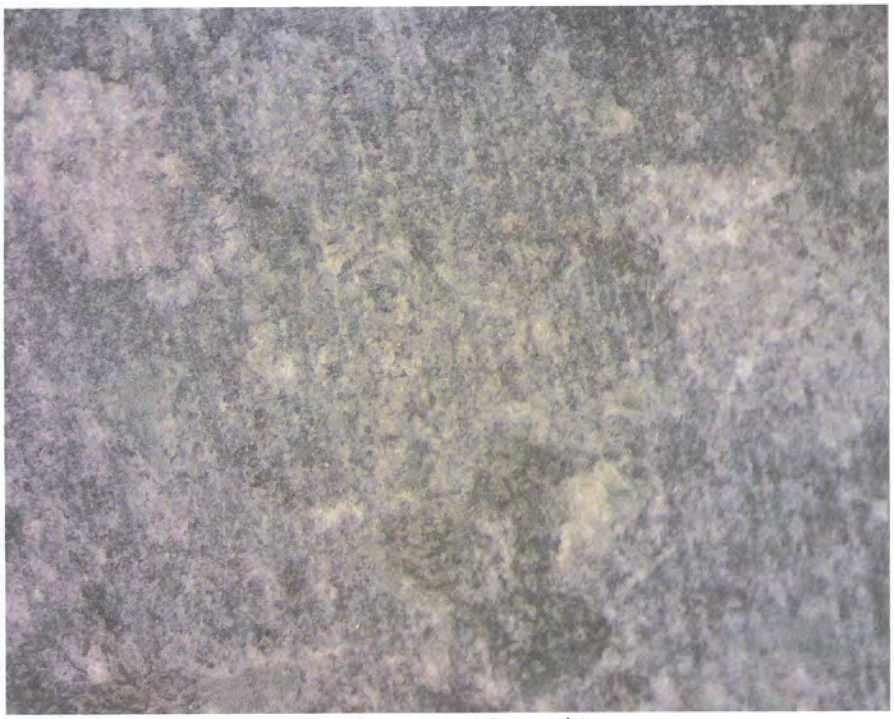
Fracture forming at the edge of the slab in freeze/thaw test



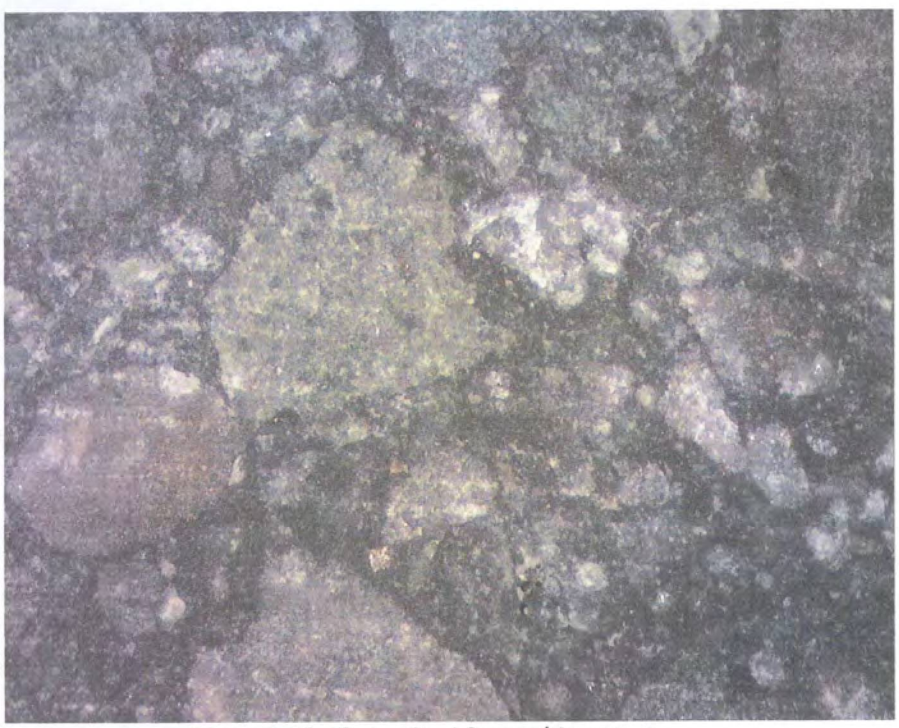
Pink rock before salted freeze/thaw test



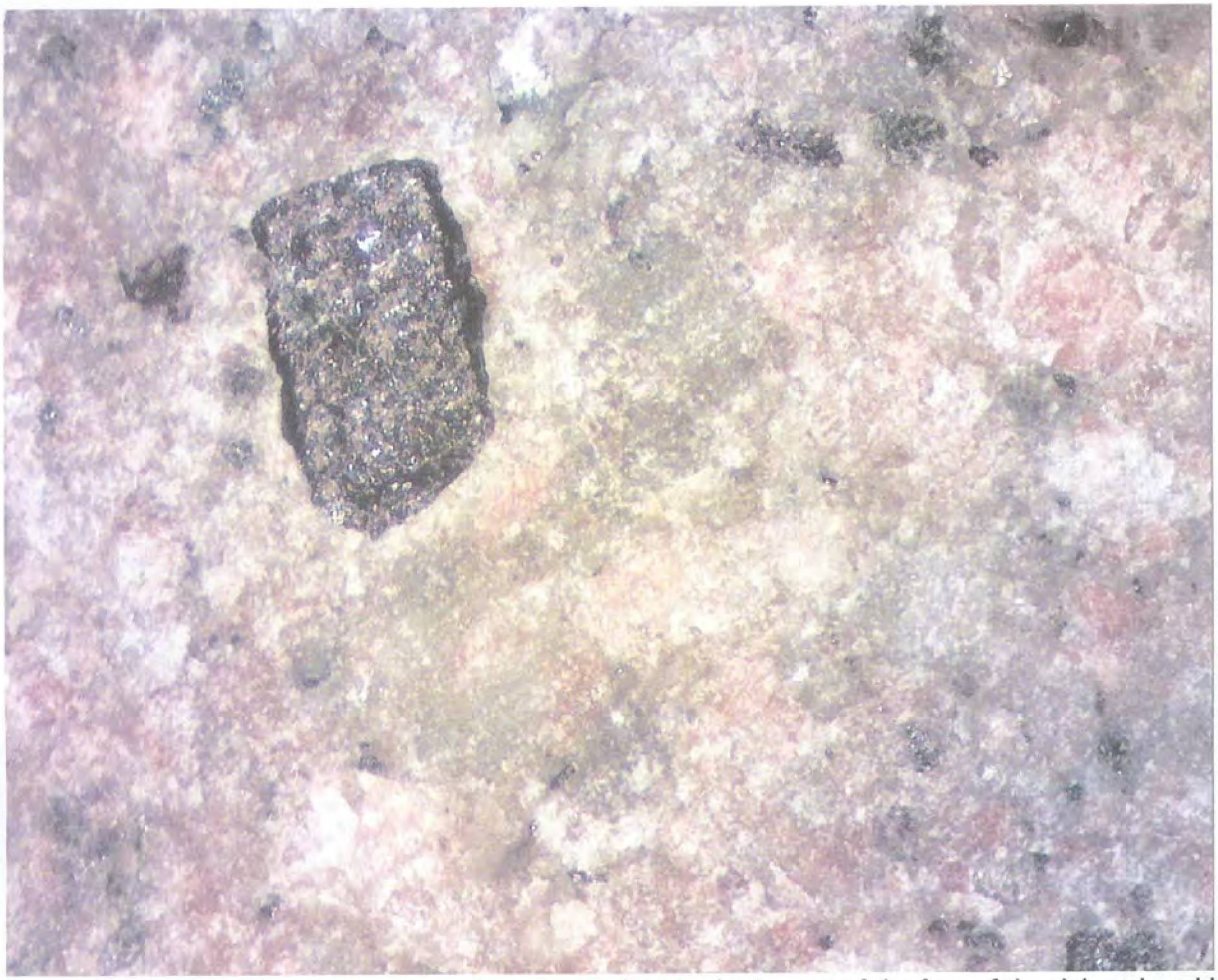
Pink rock after salted freeze/thaw test



Green rock before salted freeze/thaw test



Green rock after salted freeze/thaw test

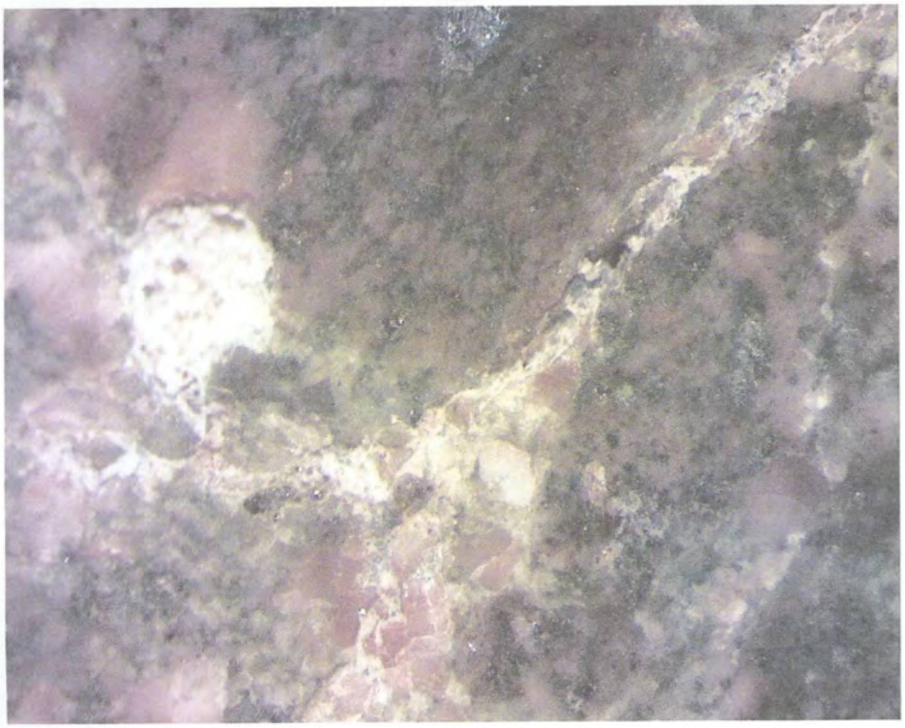

Garnet in the pink rock was seen in rare instances to be weathering out of the face of the slab and could potentially come loose leaving a void space blemish on the surface

<u>Microscopic exam of selected samples</u>

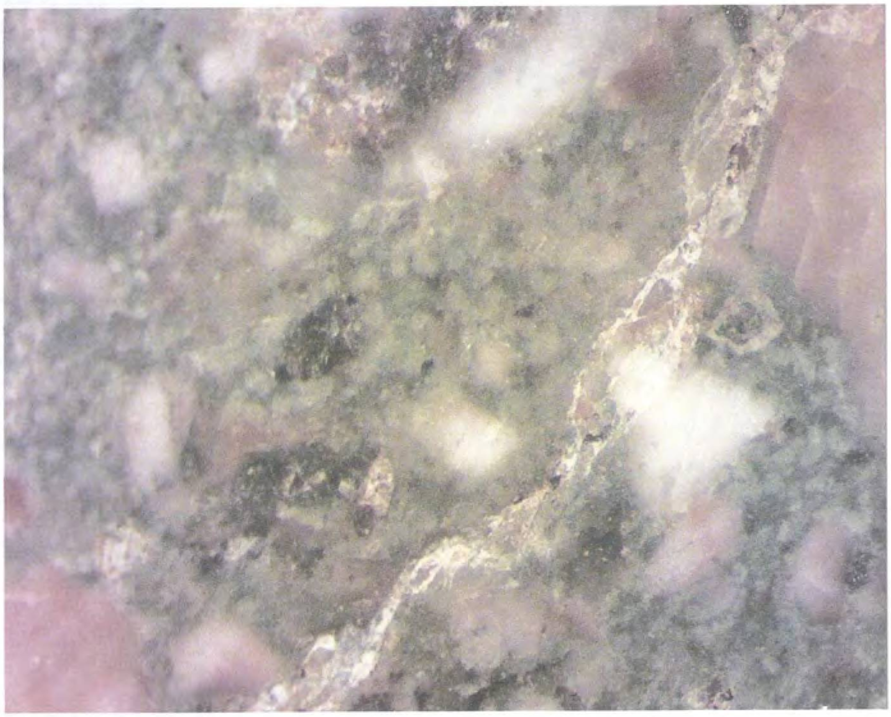
Samples were examined at (estimated) 6, 10, and 15 power using a stereo Zeiss Opton Microscope with a USB Celestron Digital Microscope Imager mounted on one optical tube. Because of variances in the positioning of the microscope camera in the microscope tube and the software used to capture the image, magnification is estimated from comparison with the observers eye view through the unused stereo microscope tube.

Before work began slabs were examined to get a general character and base line information for the study.
Though they were rough sawn slabs the surface was relatively smooth and textural information as well as any significant surface finish details were noted. Of particular interest was the fracturing and infill minerals seen in many of the green rock slabs.

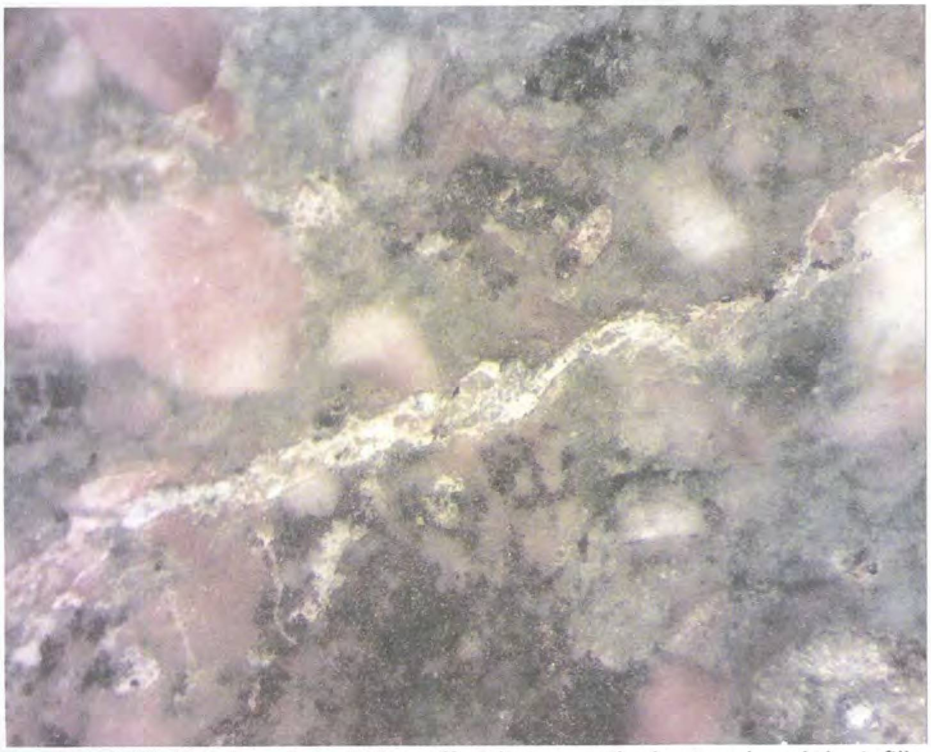
It was thought that these obvious fractures could be weak points for freeze/that attack. The following photos were all at 15x.



EXAMPLE OF GREEN ROCK WITH SHALLOW FRACTURE WITH SOME WHITE INFILL MINERAL



SAMPLE OF GREEN ROCK SHOWING BLEBS OF SULPHIDE MINERAL AND
FRACTURE INFILLING WITH WHITE MINERAL


Fracture infill showing a brecciation effect between the host rock and the infill mineral

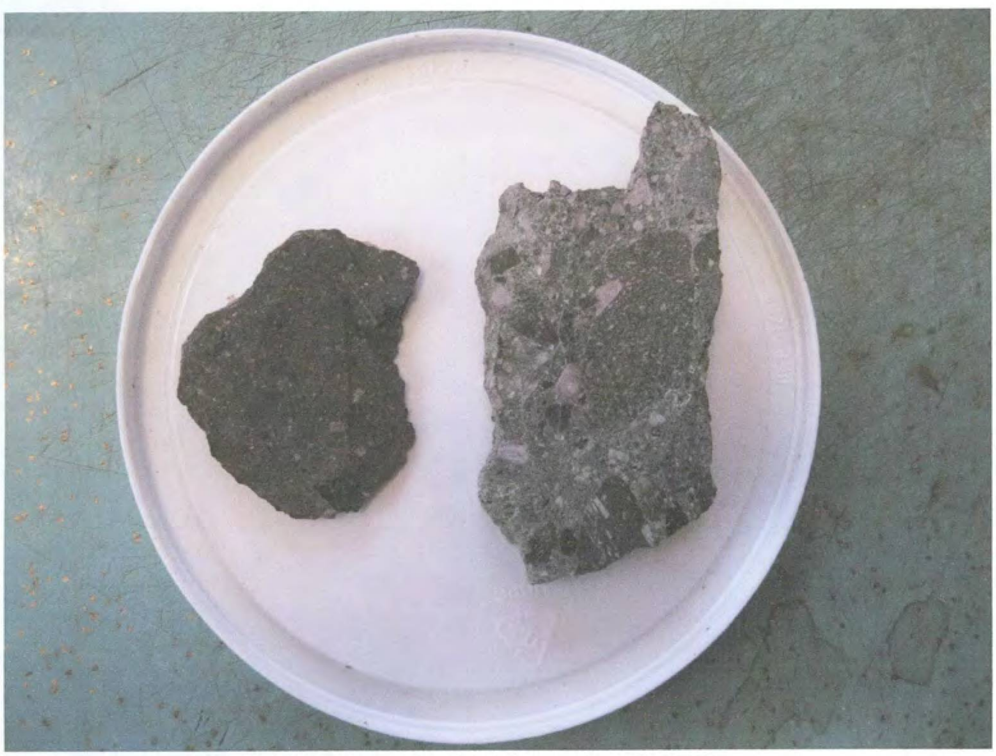
Resin coatings

A simple two part resin was used to coat the surface of several slabs. The test was very basic but did show that a very pleasing "wet look" finish could be achieved for use in certain applications. The resin was resistant to chemical attack but was vulnerable to heat. A hot cooking pot set on a resin covered counter top for instance.

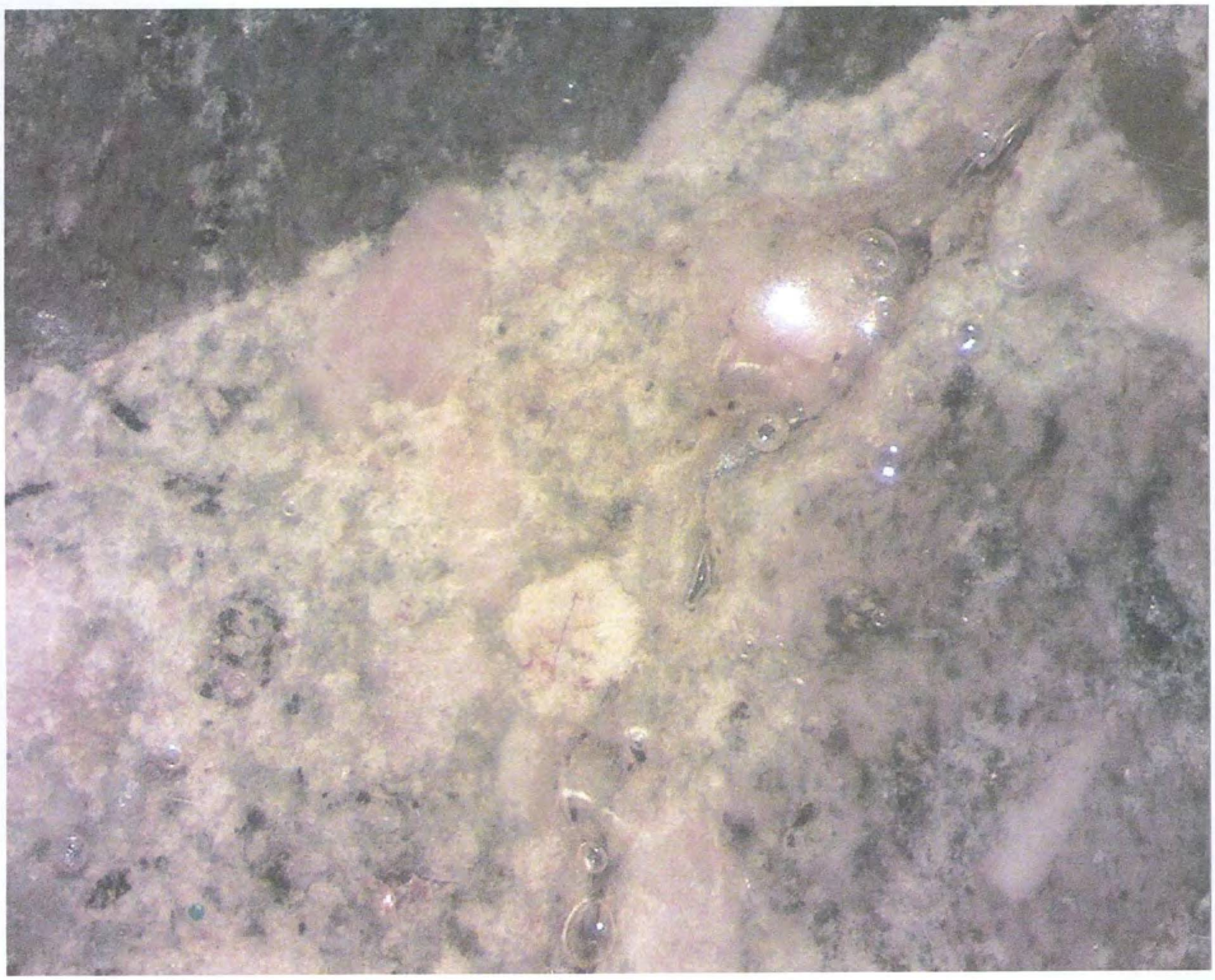
The examination was done for a basic cover finish. Further wok will examine "polishable" resins that can be applied and then polished away from the surface leaving it in the cracks and crevices in the rock surface o even the finish and stabilize the slab.

On closer examination it can be seen that the resin application method of coating using a brush does create very small bubbles in the resin. These bubbles are not generally visible to the naked eye but could, if concentrated in an area, cause the resin to looked hazed or foggy.

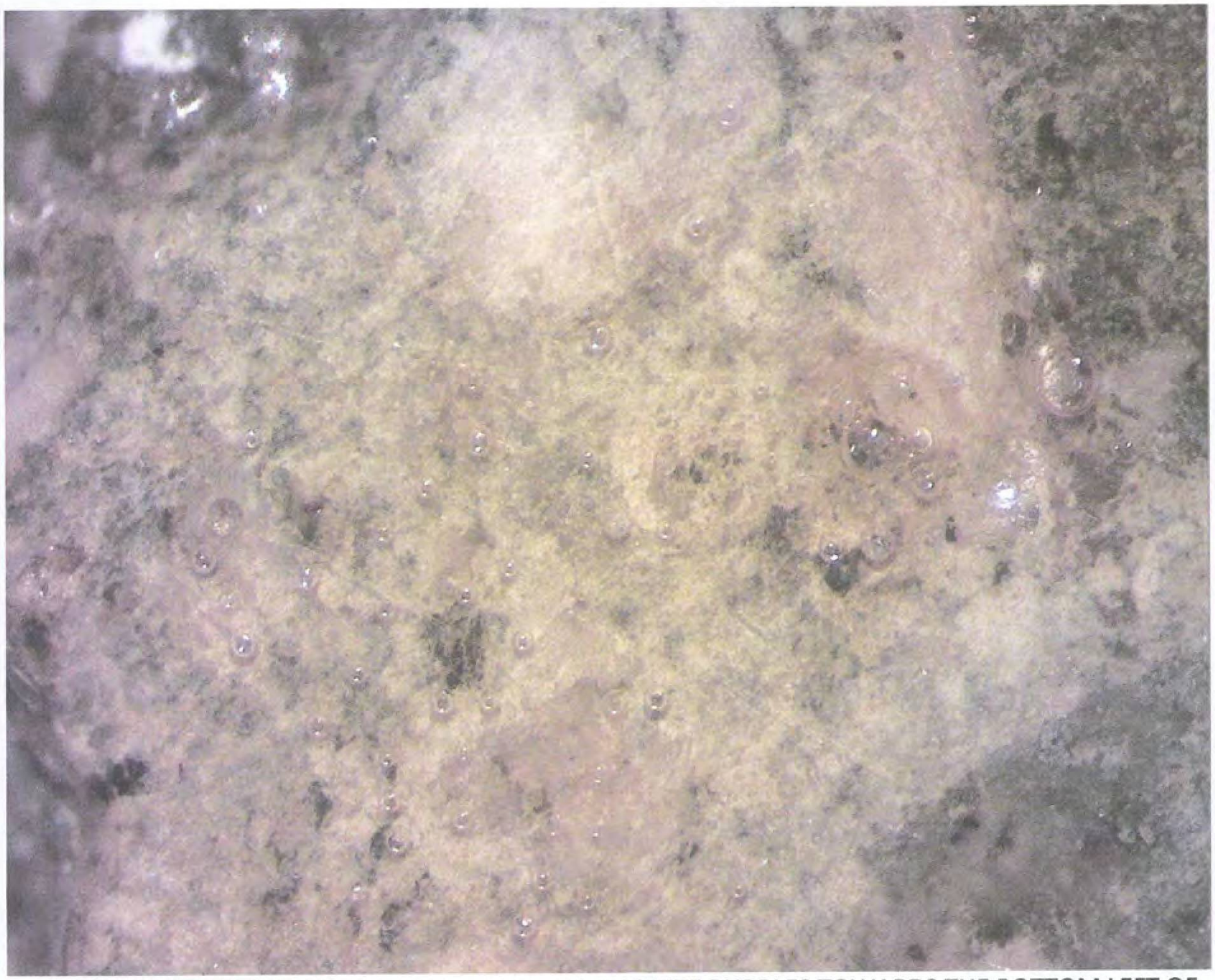
RESIN COATED SAMPLES SHOWING COATED FACE



SAME SAMPLES SHOWING NON COATED FACE



BUBBLES IN THE RESIN



UNDER A MICROSCOPE YOU CAN SEE A MASS OF DISCRETE BUBBLES TOWARDS THE BOTTOM LEFT OF THE PHOTO –NOT SEEN BY THE NAKED EYE THEY HAVE A TENDENCY TO APPEAR AS A FOGGY OR MATTE FINISH

Conclusions

The raw crushed rock showed little change except for a hard water surface scale forming on several of the rocks in close contact with bare ground. The surface scale was determined to be from water wicking onto the surface from the ground and evaporating. Other than the slightly chalky appearance caused by the water scale the rocks showed little change. No significant colour change, little evidence of surface breakdown. Some samples of the green group show evidence of surface rust stain from the breakdown of sulphides. The stain was not considered to be a significant aesthetic consideration having a tendency to blend with the general character of the rock. Some people might find it objectionable so sales of the green rock should point out the possibility of rust staining to potential customers.

Sawn slabs do show surface imperfections in the form of thin cracks but those cracks are generally stable. It was a concern in the freeze thaw testing that these surface cracks might be prone to infiltration of water and therefore more ice damage in the freeze cycle but after 100 cycles there was minimal effect.

Imperfections that might compromise the slab will often show up at the sawing stage when using a rotary diamond blade. The vibration as the blade cuts causing breakage along critical flaws.

Surface imperfections like cracks will show as wetted surfaces dry but are not considered to be important aesthetically.

Freeze/ thaw testing indicates that sawn slabs have good resistance to weathering and breakdown. Surface cracks did not show any indication of higher damage caused by freeze/thaw.

There is evidence under microscopic exam of fracture infilling minerals but they do not show any particular reactivity to water or salt brine formed during freeze/thaw cycles.

A surface resin coating can be used to replace the polish stages. It is quick and resistant to many chemicals though heat and UV resistance can be an issue. In applications like counter tops the resin finish can be compromised by the heat from a hot cooking pot. In areas subject to bright sunlight man resins can suffer dulling, yellowing and eventual breakdown, becoming brittle and breaking away form the rock's surface.

Resins examined created a very pleasing "wet" look and a strong, chemical resistant finish. When used in the proper installations it would offer a very attractive and functional surface.

The issue with bubbles being retained in the resin could be addressed with application under vacuum or depending on end use a surface application and polish back to stone leaving the resin as a stabilizer and filler in the pores of the rock.

Some resins may be less prone to bubble formation and continued study is considered worthwhile.

There is a wide range of hardness between mineral grains in the rock and not all minerals will take on a high sheen though the appearance is not diminished by the occasional matte finish mineral grain.

Polished slabs take on a matte finish readily and can be brought to a high sheen with careful attention to grit size and hardness.

Future work

With the successful freeze/thaw and extended weathering studies of smaller slabs larger slab examinations and market study is justified. Larger slabs will be prepared as market grade product and provided for real world installation with the chance to observe over an extended period.

Further work on resins needs to be carried out. Studies will include eliminating bubbles, studies of resin as surface coating under various conditions and coating and polishing back to rock surface leaving resin as stabilizer and filler.

A field examination of all available material on the permit area as loose rock for type, grade, size, tonnage and accessibility is advised.

REFERENCES

A Report for Assessment in Reference to Metallic and Industrial Minerals Permit 9304091032
Sept. 12, 2006
By Tom Bryant

The Pyroclastic Rocks of the Crowsnest Formation, Alberta
MSc Thesis submission
University of Alberta Geology Department
1986
By Robin Adair

Web References

http://stone-network.com/sealing_stone_2007.html
A report from the Marble Institute of America on the science of sealing natural stone using various methods

http://www.youtube.com/watch?v=xzs1E06Sjpg&feature=related
A video report from the Marble Institute of America on the basics of stone countertop manufacture and marketing of stone slab products

http://www.youtube.com/watch?v=ZukwLo5iZjM&feature=related
A video showing stone slab polishing using hand tools

http://www.stonesedgegranite.com/fabrication.php
A website by a commercial stone slab producer showing various products and a discussion of fabrication processes.

http://www.defusco.com/Glues-Epoxy-Polyester-etc
A commercial website offering various sealing agents for stone and information on their proper use.

http://www.p2pays.org/ref/02/01524/urb523ms.htm
An Illinois NRCS – Natural Resources Conservation Services – reference on material specifications for rip rap freeze/thaw

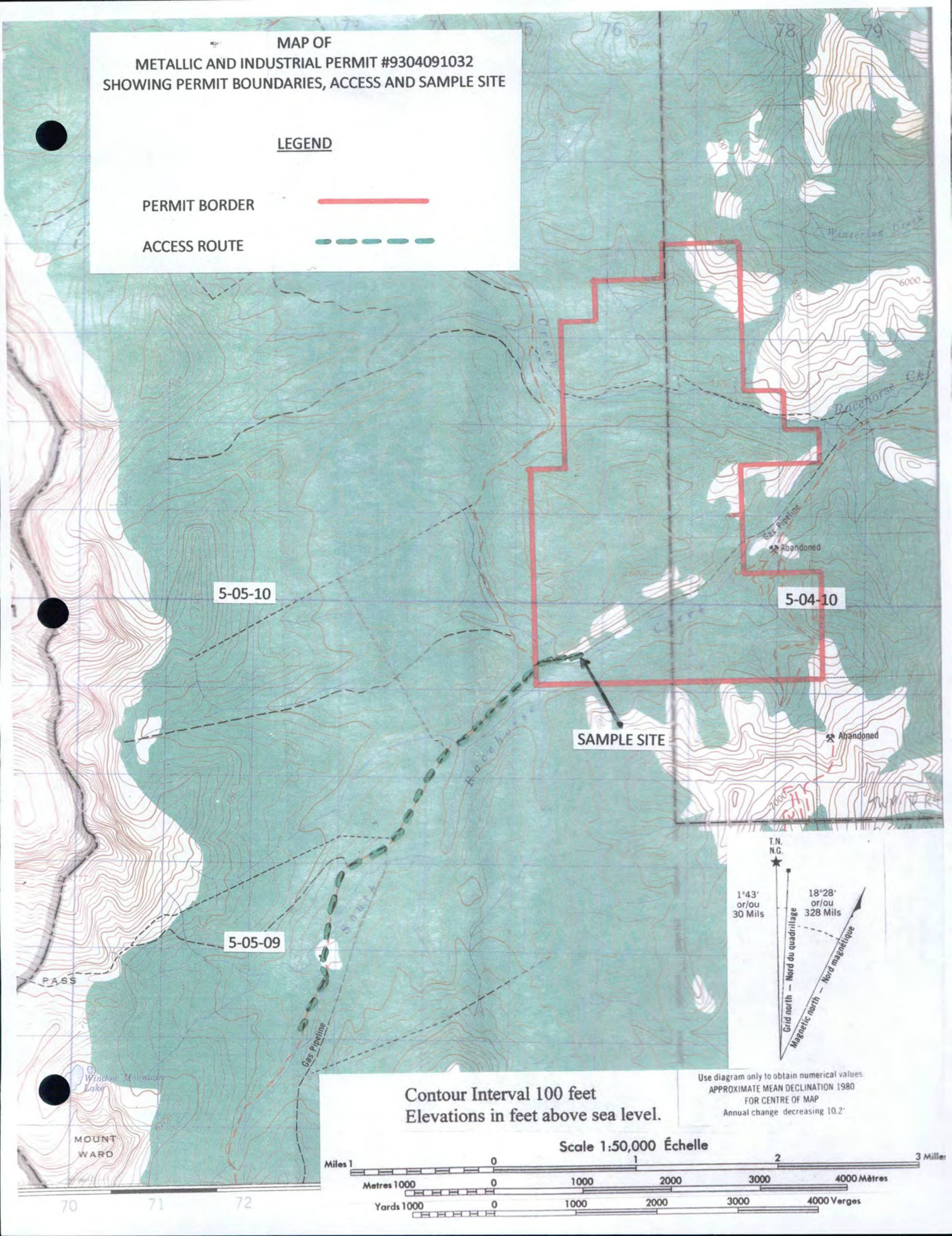
I, Tom Bryant, am the author of this report and either carried out the work detailed herein or caused that work to be done.
I am a mineral exploration and development professional with over 33 years of experience as prospector, project operator and consultant to industry.

[redacted]

Tom Bryant

APPENDIX A

MAP OF PERMIT AREA
LEGAL LAND DESCRIPTION
FREEZE/THAW OBSERVATION LOGS



MAP OF
METALLIC AND INDUSTRIAL PERMIT #9304091032
SHOWING PERMIT BOUNDARIES, ACCESS AND SAMPLE SITE
LEGEND
PERMIT BORDER
ACCESS ROUTE
5-05-10
5-04-10
5-05-09
SAMPLE SITE
Abandoned
Abandoned
Gas Pipeline
Gas Pipeline
Racehorse Ck
Racehorse
South
Creek
Wintering Creek
PASS
MOUNT WARD
Window Mountain Lake
6000
T.N.
N.G.
1°43′ or/ou 30 Mils
18°28′ or/ou 328 Mils
Grid north — Nord du quadrillage
Magnetic north — Nord magnétique
Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION 1980
FOR CENTRE OF MAP
Annual change decreasing 10.2′
Contour Interval 100 feet
Elevations in feet above sea level.
Scale 1:50,000 Échelle
Miles 1 0 1 2 3 Miles
Metres 1000 0 1000 2000 3000 4000 Mètres
Yards 1000 0 1000 2000 3000 4000 Verges
70
71
72
76
77
78
79

Alberta

MINERAL AGREEMENT DETAIL REPORT

Report Date: November 27, 2010 11:09:20 AM

Agreement Number: 093 9304091032

Status: ACTIVE
Agreement Area: 1136

Term Date: 2004-09-16
Continuation Date:

DESIGNATED REPRESENTATIVE

Client Id: 8012480
Client Name: BRYANT, THOMAS EDWARD
Address: SITE 270 BOX 24
RR 2
STONY PLAIN, AB
CANADA T7Z 1X2

LAND / ZONE DESCRIPTION

5-04-010: 07S,NW,L9,L10;18W,L9,L10,L15;19W
5-05-010: 12;13S,NE,L11,L14;24SE,L3,L6,L9,L10

METALLIC AND INDUSTRIAL MINERALS

CYCLE	OBSERVATIONS Freeze/Thaw with salt	DATE
1		Feb 4 2009
2		Feb 6 2009
3		Feb 9 2009
4		Feb 12 2009
5		Feb 16 2009
6		Feb 18 2009
7	salt water slush does not seem to show cracks - dries to a dry salt layer masking surface	Feb 21 2009
8		feb 24 2009
9		Feb 27 2009
10	no change of sawn surface	March 2 2009
11		March 4 2009
12		March 8 2009
13		March 10 2009
14		March 13 2009
15		March 15 2009
16		March 18 2009
17		March 20 2009
18	slight grey tinge to melt water - rock dust in suspension? Confirmed	March 23 2009
19		March 25 2009
20	slabs dried and salt crust left on for a time before washing off -no change in surface	March 28 2009
21		March 30 2009
22		April 2 2009
23		April 4 2009
24		April 7 2009
25		April 9 2009
26		April 11 2009
27		April 14 2009
28		April 16 2009
29		April 20 2009
30	no change of sawn surface	April 22 2009
31		April 25 2009
32		April 27 2009

33	some very fine particles of rock in the support dish -do not look like from sawn face but rather the rough outer edge.	May 3 2009
34		May 5 2009
35		May 8 2009
36		May 11 2009
37		May 13 2009
38		May 15 2009
39		May 19 2009
40	some surface roughness noted but no evidence of rock breakdown in the form of free mineral grains - lighting?	May 21 2009
41	confirmed lighting effect cause rough appreance - actually reflection off saw blemish	May 23 2009
42		May 26 2009
43		May 28 2009
44		May 31 2009
45		June 2 2009
46		June 5 2009
47		June 7 2009
48		June 9 2009
49		June 12 2009
50	no change of sawn surface - washed and allowed to dry -thin salt crust but rough unsawn portions stay wet looking	June 14 2009
51		June 16 2009
52		June 19 2009
53		June 22 2009
54		June 24 2009
55		June 26 2009
56		June 29 2009
57		July 2 2009
58		July 4 2009
59		July 7 2009
60	no change in sawn surface	July 9 2009
61		July 12 2009
62		July 14 2009
63		July 16 2009
64		July 18 2009
65		July 20 2009

66		July 22 2009
67		July 25 2009
68		July 27 2009
69		July 29 2009
70	first time surface cracks show because of wet- thin salt crust with damp along cracks -no change in surface	July 31 2009
71		Aug 2 2009
72		Aug 4 2009
73		Aug 7 2009
74		Aug 9 2009
75		Aug 11 2009
76		Aug 14 2009
77		Aug 17 2009
78		Aug 19 2009
79		Aug 22 2009
80	USB microscope down - but used regular microscope -no surface change 16 X	Aug 24 2009
81		Aug 26 2009
82		Aug 29 2009
83		Sept 2 2009
84		Sept 5 2009
85		Sept 7 2009
86		Sept 11 2009
87		Sept 14 2009
88		Sept 16 2009
89		Sept 19 2009
90	no change in surface	Sept 22 2009
91		Sept 25 2009
92		Sept 28 2009
93		Sept 30 2009
94		Oct 3 2009
95		Oct 6 2009
96		Oct 8 2009
97		Oct 11 2009
98		Oct 14 2009

99		Oct 16 2009
100	final cycle -heavy salt crust allowed to dry -stubborn to wash off -surface looks ok -concern about salt staining	Oct 20 2009

CYCLE	OBSERVATIONS Freeze/Thaw with salt	DATE
1		Feb 4 2009
2		Feb 6 2009
3		Feb 9 2009
4		Feb 12 2009
5		Feb 16 2009
6		Feb 18 2009
7	salt water slush does not seem to show cracks - dries to a dry salt layer masking surface	Feb 21 2009
8		feb 24 2009
9		Feb 27 2009
10	no change of sawn surface	March 2 2009
11		March 4 2009
12		March 8 2009
13		March 10 2009
14		March 13 2009
15		March 15 2009
16		March 18 2009
17		March 20 2009
18	slight grey tinge to melt water - rock dust in suspension? Confirmed	March 23 2009
19		March 25 2009
20	slabs dried and salt crust left on for a time before washing off -no change in surface	March 28 2009
21		March 30 2009
22		April 2 2009
23		April 4 2009
24		April 7 2009
25		April 9 2009
26		April 11 2009
27		April 14 2009
28		April 16 2009
29		April 20 2009
30	no change of sawn surface	April 22 2009
31		April 25 2009
32		April 27 2009

33	some very fine particles of rock in the support dish -do not look like from sawn face but rather the rough outer edge.	May 3 2009
34		May 5 2009
35		May 8 2009
36		May 11 2009
37		May 13 2009
38		May 15 2009
39		May 19 2009
40	some surface roughness noted but no evidence of rock breakdown in the form of free mineral grains - lighting?	May 21 2009
41	confirmed lighting effect cause rough appreance - actually reflection off saw blemish	May 23 2009
42		May 26 2009
43		May 28 2009
44		May 31 2009
45		June 2 2009
46		June 5 2009
47		June 7 2009
48		June 9 2009
49		June 12 2009
50	no change of sawn surface - washed and allowed to dry -thin salt crust but rough unsawn portions stay wet looking	June 14 2009
51		June 16 2009
52		June 19 2009
53		June 22 2009
54		June 24 2009
55		June 26 2009
56		June 29 2009
57		July 2 2009
58		July 4 2009
59		July 7 2009
60	no change in sawn surface	July 9 2009
61		July 12 2009
62		July 14 2009
63		July 16 2009
64		July 18 2009
65		July 20 2009

66		July 22 2009
67		July 25 2009
68		July 27 2009
69		July 29 2009
70	first time surface cracks show because of wet- thin salt crust with damp along cracks -no change in surface	July 31 2009
71		Aug 2 2009
72		Aug 4 2009
73		Aug 7 2009
74		Aug 9 2009
75		Aug 11 2009
76		Aug 14 2009
77		Aug 17 2009
78		Aug 19 2009
79		Aug 22 2009
80	USB microscope down - but used regular microscope -no surface change 16 X	Aug 24 2009
81		Aug 26 2009
82		Aug 29 2009
83		Sept 2 2009
84		Sept 5 2009
85		Sept 7 2009
86		Sept 11 2009
87		Sept 14 2009
88		Sept 16 2009
89		Sept 19 2009
90	no change in surface	Sept 22 2009
91		Sept 25 2009
92		Sept 28 2009
93		Sept 30 2009
94		Oct 3 2009
95		Oct 6 2009
96		Oct 8 2009
97		Oct 11 2009
98		Oct 14 2009

99		Oct 16 2009
100	final cycle -heavy salt crust allowed to dry -stubborn to wash off -surface looks ok -concern about salt staining	Oct 20 2009

MINERAL ASSESSMENT
EXPENDITURE BREAKDOWN BY TYPE OF WORK

☐ **Estimated Expenditure** (submitting with **Statement of Intent to File**)

☒ **Actual Expenditure** (**for Part B of Report**; Must match total filed in Part A)

Project Name: Crowsnest North

	AMOUNT
1. Prospecting	$14,764
2. Geological Mapping & Petrography	$
3. Geophysical Surveys	
a. Airborne	$
b. Ground	$
4. Geochemical Surveys	$
5. Trenching and Stripping	$
6. Drilling	$
7. Assaying & whole rock analysis	$
8. Other Work: Evaluation of economic potential	
– analogous to assay	$5680
SUBTOTAL	**$20444**
9. Administration (up to 10% of subtotal)	$1226
TOTAL	**$21670**

Tom Bryant

SUBMITTED BY (Print Name)

Nov. 12 / 2010

DATE

[redacted]

SIGNATURE