DIMENSION STONE

WORKSHOP 2002

Lower Quarry, Topsails, the Reid NFLD Company quarried granite (1898-1901) for trestle abutments, cobblestone and building stone.

OFFERED BY: THE DEPARTMENT OF INDUSTRY, TRADE AND RURAL DEVELOPMENT AND THE EXPLOITS VALLEY ECONOMIC DEVELOPMENT CORPORATION

OCTOBER 8 TO 11, 2002

DIMENSION STONE PROSPECTOR WORKSHOP
INTRODUCTION

For the Newfoundland and Labrador dimension stone industry to expand and become a significant exporter of high quality/high-end stone products new sources of extractable and marketable stone have to be identified. Prospectors are key to finding new stone varieties whether its through dedicated dimension stone prospecting or accidental discoveries made while looking for various mineral commodities. This need was reinforced by feedback generated from the Newfoundland and Labrador Stone Symposium 2002.

The identification of a perspective dimension stone requires a knowledge or familiarity of international dimension stone trends (i.e. what stone types to focus efforts on) and basic geological factors which dictate whether a stone can be quarried. It is the objective of this workshop to provide prospectors interested in dimension stone with basic hands-on experience. This will be achieved through a combination of classroom lectures and site visits, over a four day period, to active quarry sites and prospects.

The Exploits Valley Economic Development Corporation and the Dept. of Industry, Trade and Rural Development have partnered to deliver this four day workshop. Ms. Sherry Dunsworth M.Sc.P.Geo. will facilitate the training session. She has carried out dimension stone exploration and drilling programs throughout the province and has supervised the opening of new quarry sites. Ms. Dunsworth has traveled extensively, visiting quarries in Italy, Norway, Brazil and the USA, as a block buyer for Epoch Rock Inc.

This manual complements a similar manual prepared for Stone Symposium 2002. Remember, ***Stone Assessment and Marketing Assessment*** must proceed together and compliment each other. Money should not be wasted on an unmarketable stone and likewise market assessment should not be completed on a stone which cannot be quarried. This session will introduce prospectors to the world of dimension stone, the process of stone selection, geological factors influencing quarrying and marketing. Keep this resource manual handy while looking for new stone and remember to be careful and have fun in the process.

Cheers

Mike Regular EVEDC

Dave Evans Dept. I.T.R.D.

Note: As we will be visiting both active and inactive quarry sites care must be taken. Watch for loose rock and be careful in breaking rock, safety glasses must be worn.

DIMENSION STONE PROSPECTOR WORKSHOP

Tuesday, October 8th to Friday, October 11th, 2002
Grand Falls-Windsor and Deer Lake

AGENDA

Tuesday, October 8th Grand Falls-Windsor

- **8:00 Registration**
- **8:30 Introduction to Quarries, Quarry Assessment and Unique Stone**
- **12:30 Depart for Hodges Hill Quarry**
- **5:00 Return to Robin Hood Inn**
- **7:00 Evening Session - Granites Under the Microscope**

Wednesday, October 9th Grand Falls-Windsor

- **8:00 Depart for Jumpers Brook Area Quarries and Prospects**
- **5:00 Return to Robin Hood Inn**
- **7:00 Evening Session - Plotting Geological Data**

Thursday, October 10th Deer Lake

- **8:00 Depart Grand Falls-Windsor for Topsails***
- **6:00 Arrive Driftwood Inn, Deer Lake**
- **8:00 Evening Session - Granite Quarries Around the World**

Friday, October 11th Deer Lake

- **8:00 Depart for Pye's Ridge Marble Prospects**
- **4:00 Depart for Grand Falls-Windsor**

***Note: The agenda for Day 3 is subject to change depending upon access.**

DIMENSION STONE FIELDTRIP GUIDE
OCTOBER 8-11, 2002

DAY 1:

INTRODUCTORY NOTES TO DIMENSION STONE EXPLORATION

Sherry Dunsworth, M.Sc., P.Geo.

DAY 1 – INTRODUCTORY NOTES TO DIMENSION STONE EXPLORATION

Definition

The term **dimension stone** is defined as, "a natural building stone that has been selected, cut and trimmed to specified shapes or sizes with or without one or more mechanically dressed surfaces". The definition applies to rough blocks, slabs and polished material used in building and construction (80%) and monument (20%) industries.

Main varieties of dimension stone are:

(1) Marble – including metamorphosed / recrystallized marble as well as travertine, serpentine, onyx, limestone and dolostone
(2) Granite – including granite (20%-40% quartz), gabbro, anorthosite, gneiss, syenite
(3) Slate and Sandstone

Major rock forming minerals comprising 98% of the earth crust:

MINERAL GROUP	MINERAL	COMPOSITION	OCCURRENCE
Feldspars :	Plagioclase	$(Na,Ca)(AlSi_3O_8)$	granite, gabbro, anorthosite
	Alkali Feldspars	$(K,Na)(AlSi_3O_8)$	granite, syenite, gneiss, detrital in sediments
Quartz		SiO_2	granite, gneiss, detrital in sediments
Amphiboles :	Horneblende	$Ca_2(Mg,Fe,Al)_5(OH)_2[(Si,Al)_4O_{11}]_2$	granite, gabbro, gneiss
	Actinolite	$Ca_2(Mg,Fe)_5(OH)_2(Si_4O_{11})_2$	gneiss, marble, altered gabbro
Pyroxenes :	Enstitite	$MgSiO_3$	gabbro, peridotite
	Hypersthene	$Mg,Fe)SiO_3$	gabbro, peridotite
	Diopside	$Ca(Mg,Fe)(SiO_3)_2$	gabbro, peridotite
	Augite	$Ca(Mg,Fe)(SiO_3)_2[(Al,Fe)_2O_3]$	gabbro, peridotite, gneiss
Micas :	Muscovite	$KAl_2(OH)_2(AlSi_3O_{10})$	granites-pegmatites, gneiss, detrital in sediments
	Biotite	$K_2(Mg,Fe)_2(OH)_2(AlSi_3O_{10})$	granite, gabbro, gneiss, detrital in sediments
Olivine		$(Mg,Fe)_2SiO_4$	gabbro, peridotite, serpentinite

Primary application based upon physical and chemical properties and appearance:

(1) Marbles – Marble exhibits a low resistance to environmental attack and is used primarily for interior applications, except in favorable climates and in exterior restoration projects. Marble dominated dimension stone usage until the 1970's when granite gradually increased in usage until today where granite occupies ~50% of the market.

(2) Granites – Granites physical and chemical stability, strength and aesthetic appeal lends to durable exterior cladding applications as well as a growing interior usage for flooring and kitchen countertops.

(3) Slates and Sandstones – Physical and chemical stability and appearance lends to exterior (roofing slate, landscaping, building block) and interior (flooring and wall cladding) applications.

The Dimension Stone Industry: A World Perspective

The dimension stone industry is very much a world-wide industry, involving more than 50 major countries that are currently producing, exporting, and consuming stone products (i.e.: rough block, monument blanks, polished slabs, tiles, and cut-to-size finished products). The industry is a very close-knit community, one which congregates at major stone trade shows and conferences that are held each year throughout the world (i.e.: USA, Brazil, China, Italy, Spain, Portugal, Germany, and India).

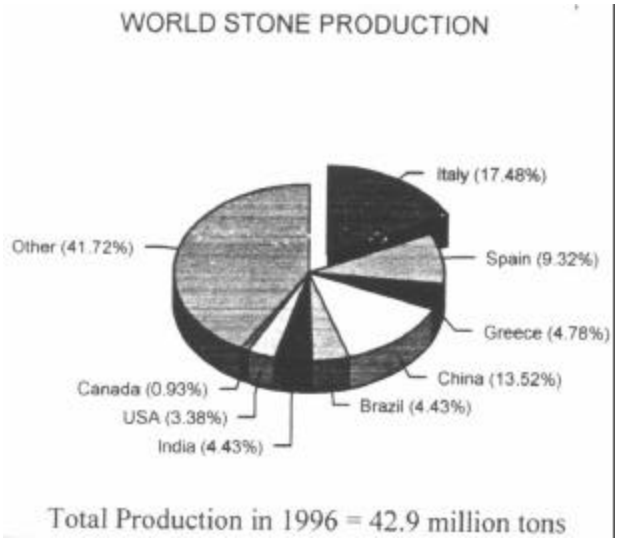
The United States of America is the world's biggest consumer of dimension stone. It is instructive to look at the value ($USD) of dimension stone imported to the USA from the whole world, and examine what percentage of that stone is imported from Canadian stone producers (Table 1).

TABLE 1: Granite, marble and slate dimension stone imports (mostly finished product) to the USA from 'The World', compared to Canada imports only, for the year July 2000 – July 2001 (compiled from statistics reported in Stone World magazine).

	GRANITE		**MARBLE**		**SLATE**	
	TOTAL	CANADA	TOTAL	CANADA	TOTAL	CANADA
Total	$402,273,300	$28,745,000	$578,684,900	$6,388,840	75,770,900	3,672.197
Monthly Aver	$33,522,775	$2,395,420	$48,223,740	$532,400	6,314,242	306,016

From a world perspective (Table 2), the total world dimension stone production for 1996 was estimated at 50 million tons (Resource Development Assoc., 1998). Of this total, the USA produced 3.4% while Canada less than 1% of this overall world production.

TABLE 2: Chart showing the total world dimension stone production for 1996 (from Resource Development Assoc., 1998).



The Newfoundland and Labrador Dimension Stone Industry

(1) Historical Perspective: 1700's - 1910

The development of a "white man's" dimension stone industry in the province of Newfoundland and Labrador dates back to the 1700's when red and green sandstone from Signal Hill and Southside Hills were used to construct fortifications in St John's. The Signal Hill sandstone was used during the 1800's to construct Government House and the Basilica in St. John's. Buff sandstone quarried from Kelly's Island in 1839 was used in the Basilica's walls (Martin, 1983). During the 1850-1880's, granite from Rose Blanche was used in construction of the local lighthouse and granite boulders from Holyrood were used in the construction of Presentation Convent in St. John's (Martin, 1983). During the mid to late 1800's, granites from Shoal Harbour in Trinity Bay, at Benton, and near the Gaff Topsails were quarries to supply blocks for bridge abutments during construction of the Newfoundland Railway (Martin, 1983). Between 1898 and 1901, blocks from the Topsails were used in construction of the St. John's railway station and as cobblestone paving of Water Street. Petites granite was quarried between 1898 -1899 to provide cobblestone to Water Street and granite facing for the St. John's Court House. Limestone from Chapels Cove, Conception Bay, was used in the 18th century to construct fortifications in St. John's. During the 1870's, limestone blocks from Cobbs Arm, New World Island in Notre Dame Bay was shipped to St. John's for construction purposes. Quarrying of marble at Sop's Arm during the 1930's produced blocks intended for flooring in the St. John's General Hospital. In the 1950's, the Dormston quarry near Corner Brook produced marble for the building of the Corner Brook Memorial Hospital (Martin, 1983).

TABLE 3: A summary of the history of dimension stone quarrying from the 1700's to the early 1900's in the province of Newfoundland and Labrador (after Martin, 1983).

Rock Type	Dates	Quarry Site	Product	Usage
Sandstone	1700's	Southside Hills	block	Fortifications in St. John's
	1700's	Signal Hill	block	Fortifications in St. John's
	1800's	Signal Hill	block	Government House & The Basilica in St. John's
	1839	Kelly's Island	block	The Basilica in St. John's
Granite	1850-1870	Rose Blanche	block	Lighthouse at Rose Blanche
	1850-1870	Holyrood	block	Presentation Convent in St. John's
	Mid-late 1800's	Shoal Harbour	block	Railway bridge abutments
	Mid-late 1800's	Benton	block	Railway bridge abutments
	Mid-late 1800's	Gaff Topsails	block	Railway bridge abutments
	1898-1901	Gaff Topsails	blocks	Railway station in St. John's
	1898-1901	Gaff Topsails	cobblestone	Paving on Water Street, St. John's
	1898-1899	Petites	block	Facing on the St. John's Couthouse
	1898-1899	Petites	cobblestone	Paving on Water Street, St. John's
Limestone	1800's	Chapel's Cove	blocks	Fortifications in St. John's
	1870's	Cobb's Arm	blocks	Construction in St. John's
Marble	1930's	Sop's Arm	slab	Intended as flooring for St. John's General Hospital
	1950's	Dormston	block	Construction of the Corner Brook Memorial Hospital
Slate	1847-1849	Roberts Arm area	slates	Roofing slate
	1880's-1906	Nut Cove	slates	Roofing slates and floor tiles
	Late 1890's-1910	Random Sound	slates	Roofing slates and floor tiles (3 quarries)
	1903-1909	Summerside	slates	Intended as roofing slates - St. John's railway station
	1907-1908	Curling	slates	Roofing slates

(2) Dimension Stone Quarries Presently Operating in Newfoundland and Labrador

Mount Peyton – Borney Lake Gabbro, Central Newfoundland.

The Mount Peyton gabbro was prospected and sampled by government geologists for its dimension stone potential during the early 1980's. The first trial quarry was opened in the late 1980's on the side of a modest, north-south trending ridge. Several additional sites were opened further north along the same ridge during the early 1990's, but it wasn't until 1994 that stone with characteristics suitable for the monument industry was identified from a fourth site. A detailed geological assessment of the Mount Peyton gabbro dimension stone potential did not begin until 1995, when detailed geological mapping and diamond core drilling was carried out at the new Quarry # 5 site. Subsequent detailed geological assessment has led to the discovery of the Upper Christmas Pond quarry site in 1997 and the Finger Pond Quarry site in 2002. Small size block production from these sites provides material to the Jumper's Brook monument plant run by *Cabot Granite Fabricators Inc.,* a subsidiary of the *International Granite Corp*. The Mount Peyton monument grade gabbro is comparable to in quality to Zimbabwe Black, which currently sells at $600 to $1000 US per cubic meter. Present production at the Jumper's Brook plant includes finished monuments for the local and regional marketplace, monument blanks for export to other provinces, and custom stone fabrication and installation in the province.

Newfoundland Slate, Nut Cove, Eastern Newfoundland

In the late 1880's a small slate quarry was opened at Nut Cove, on the north side of Smith Sound, to supply roofing slate for export markets. In 1986, *Newfoundland Slate Inc.* was formed to reactivate the old quarry site. *Newfoundland Slate Inc.* entered into a joint venture in 1992 with *Miller-MacAsphalt* to open a state-of-the-art processing plant at nearby Burgoyne's Cove. The company shipped 4,700 tonnes of purple and green roofing tiles to Canada, USA, Europe, Australia and Japan in 1995. The plant closed in the late 1990's, and the equipment was auctioned off. The Nut Cove quarry was reactivated in 2000 by Hurley Slate Works and a small plant was opened in the quarry.

Ten Mile Bay Anorthosite Quarry, Nain area, Labrador

The site of the Ten Mile Bay anorthosite quarry was evaluated for dimension stone by *Brinex Limited* in the early 1960's. Small blocks were quarried and shipped south, but Brinex could not establish a market at that time. The site was re-evaluated and promoted by government geologists in the mid 1980's. An Italian geologist/marketing expert visited the site in 1990, and in1992 began working with the *Labrador Inuit Development Corporation* (LIDC) to develop a modern quarry at Ten Mile Bay. The anorthosite is known as "Blue Eyes", and it is unique in that it contains 1 centimeter crystals of iridescent blue labradorite, giving the stone an extremely attractive blue sparkle appearance. Premium quality, large gangsaw size blocks of anorthosite are produced from Ten Mile Bay and sold throughout the world for a very high price of $2,500 US per cubic meter. Exploration in the Nain area for other quarry sites, has led to the development of a second quarry at Igiak Bay, 20 km south of Nain, with limited production beginning in 2000. The anorthosite stone from this quarry contains larger, multi-colored labradorite crystals. The LIDC has recently built a stone processing plant in Hopedale to fabricate furniture and monuments from smaller and/or irregular shaped blocks.

(3) Dimension Stone Products Currently Produced in Newfoundland and Labrador

The dimension stone industry in the province of Newfoundland and Labrador is currently producing a range of stone products including; finished (dressed) granite (anorthosite) gangsaw blocks, honed and polished granite slabs, finished and blank granite monuments, slate roofing and floor tiles, and landscaping sandstone. These products are produced at quarry sites and fabrication plants throughout the province for distribution into the local, national and international marketplace (Table 4).

TABLE 4: Dimension Stone Products Currently Produced in Newfoundland and Labrador.

PRODUCT	**PRODUCER**	**ROCK TYPE**	**MARKET**
Gangsaw blocks ($6 – 10m^3$) (10-40 mt)	L.I.D.C. Ten Mile Bay Quarry Igiak Bay Quarry	Anorthosite	International National Local
Polished slabs (2cm & 3cm thick)	Epoch Rock Inc. Argentia Plant	Granite - sourced from around the world	International National Local
Monuments – Slabs, blanks & finished Slabs & installations	NFLD. Quarries Group Jumpers Brook Plant	Gabbro – Borney Lake quarries, Granite – Hodges Hill granite	Local National
Slate roofing & floor tiles	NFLD. Slate Inc. Nut Cove Quarry	Slate	Local International
Landscaping stone Flagstone: 3cm-10cm and 30cm-60cm thickness	Carew Services Ltd. Fisher Hills Bluestone Pynn's Brook Quarries	Sandstone	Local

Major Geological Features to Consider in Prospecting for Dimension Stone

There are numerous geological features which a prospector needs to both recognize and record during the prospecting and early stage evaluation of a dimension stone site (Table 5). These characteristics critically influence the long term marketability / commercial value of a specific dimension stone.

The geological features or characteristics of a dimension stone can be divided into two main groupings; (1) the **visual or aesthetic features** including color, grain size, and textures; and (2) the **technical features** including petrography and mineralogy, brittle deformation, physical-mechanical properties, and available volumes. Consistent visual or aesthetic features are of prime importance when evaluating the market potential of a stone. The technical features influence the performance of a stone and the choice of stone for particular uses (i.e.: indoor, outdoor, intense sunlight exposure, pollution, exposure to chemicals, grease, oil etc.). Higher technical ratings led to increased acceptance for various uses in the marketplace.

Note that although the physical-mechanical properties of a particular dimension stone are of prime important; it is the visual or aesthetic appearance and prestige of the stone (as dictated by the preferences of architects and designers) that drives the stones marketability for both residential and commercial usage.

(1) Visual or Aesthetic Features:

Color

The color and overall tone of a dimension stone must be compatible with the present market trends. For example; if yellow granite is in, then the shade of yellow and consistency of the shade of yellow across the block or slab is evaluated. If the stone is green colored granite, then the shade of green, whether dark or light or olive-green, will make or break the sale of the stone. Black granite “gabbro” must fall within a range of black to gray black, not greenish-black or brownish black in order to sell at a profit. The presence of mottled color or distinct discoloration or tonal changes must be noted and evaluated.

Grain size

The grain size refers to the actual size of the individual grains or crystals that together make up the stone. Some stones are homogenous, showing a consistent grain size throughout the rock. The grain size may be fine grained (i.e.: individual grains are < 1mm in size and difficult to see with the naked eye), medium grained (i.e.: individual grains are 1-2mm in size with individual grains visible to the naked eye), or coarse grained (i.e.: individual grain area $\geq$2mm in size). Other stones are inhomogenous, showing larger clasts, grains, phenocrysts or augen surrounded by, or "floating" in, a groundmass of smaller grains. The grain size characteristic of a stone is extremely important during the evaluation of the stone's dimension stone potential. The grain size affects the overall color and texture of the stone, and therefore it's distinct visual character.

Textures

The texture of a stone refers to the characteristic visual features including: mixtures of larger and smaller crystals, regular or irregular banding (i.e.: primary igneous banding, sedimentary layering, secondary gneissic banding or foliation, styolitic banding in marble, etc.), linear alignments or lineations (i.e.: primary mineral alignment, grain elongation, inequant clast alignment, etc.), and individual spots or clusters of grains. A visual evaluation for both the presence and the consistency of these features through a deposit are of prime importance, even during the earliest stages of prospecting over the surface exposure of a granite body. These features are very important when selling a product, and therefore they play a large part during the evaluation of a stone's dimension stone potential.

Flaws and Irregularities

The occurrence of flaws or irregularities such as xenolith inclusions, unusual mineral clusters or bandings, penetrative fine microfracturing, vugs and gas cavities, or sporadic dykes and cross-cutting vein structures must be carefully evaluated as their presence within severely compromise production of marketable block material.

(2) Technical Features:

Mineralogy and Petrography

The mineralogy describes the types and composition of the minerals that together comprise a stone. Petrography describes the detailed characteristics and genesis of these minerals that comprise a stone. Knowing the mineralogy and petrography of a stone takes on particular importance when determining the method of extraction and the workability of a stone (how and why the stone reacts to different cutting techniques). These factors also help to understand (and possibly prevent) problems of alteration in the stone (i.e. susceptibility to color variation or decreased mechanical resistance under different polishing conditions, or color alteration under exposure to different pollutants in a variety of conditions). These factors are also important in assessing a stones natural degree of alteration, mineral alignment and internal strain (i.e.: degree of clay or sericitic alteration of the major rock forming minerals, preferred mineral orientation in relation to the preferred cutting direction, degree of internal straining of larger crystals as relates to brittle failure under external strain, etc.)

Brittle Deformation

The brittle deformation features include the orientation and spacing of dominant and subordinate joint system(s), as well as and micro-fracturing. The density and orientation of joints is critically important in determining the potential for extraction of usable block size. The presence of penetrative micro-fracturing or cleavage influences the stones performance under cutting, polishing and weathering conditions.

Physical-Mechanical Properties

The physical-mechanical properties of a rock describe the specific workability and durability of a stone which aid in determining the limits for usage under particular installation conditions. The physical-mechanical properties of a dimension stone are evaluated using ASTM (American Society for Testing and Materials) testing. The standard tests for stone (granites, marble) are: (a) Absorption (porosity and imbibition - a stone's ability to absorb liquids), (b) Specific Gravity (weight per unit of volume), (c)

Modulus of Rupture, (d) Compressive Strength (before and after freezing), (e) Abrasion Resistance, (f) Slip Resistance, and (g) Flexural Strength.

Available volumes (i.e.: consistency of material, raw material volume and block size)

A consistent, even if perhaps limited, supply of a specific dimension stone is also required to maintain confidence in supply of raw material to the marketplace. Unless a material is of unusually high demand and/or high value, the marketplace demands large gangsaw block size to yield large slab sizes for most residential and commercial uses. In the case where a specific cut orientation is required, then the squaring of the blocks must maintain a minimum length to height ratio to satisfy the consumer needs.

TABLE 5:

Major Geological Features to Consider in Prospecting for Dimension Stone

GEOLOGICAL FEATURES	SPECIFIC CHARACTERISTICS
(1) VISUAL – AESTHETIC	Color, Grain Size, Textures, Flaws & Irregularities
(2) TECHNICAL	Mineralogy & Petrology, Brittle Deformation, Physical-Mechanical Properties, Available Volumes

A Logical Approach to Dimension Stone Exploration and Quarry Site Assessment

Prospecting for dimension stone can be a very focused activity if the prospector keeps in mind the following steps when carrying out exploration and early stage potential quarry site assessment. The following steps, as outlined in Table 6, provide a systematic approach to designing and implementing a time and cost effective dimension stone prospecting and exploration program.

(1) Defining the regional exploration focus area

The initial stage in organizing for exploration for potential dimension stone sites is to gather and examine all of the relevant information available from existing resources, including topographic maps, geological maps, geology reports, and airphotos. The geology reports and maps aid the prospector in focusing upon specific stone outcrop areas. Topographic maps and airphotos provide information pertaining to access and proximity to transportation routes and processing or shipping infrastructure, amount of outcrop exposure, contour elevations, vegetation, overburden and drainage conditions. Keep in mind that if the aerial extent of a particular stone is limited by the presence of structural faults, contacts with other rock types, bodies of water, topographic depressions etc., then the volume of economically extractable material may be too limited. Likewise, the proximity of a potential dimension stone deposit to environmentally sensitive areas (i.e.: the headwaters of rivers leading to town water systems, designated salmon rivers etc.) must be recognized in the early stage of exploration planning.

(2) Prospecting (delineating the target zone, general mapping and sampling) ***

The prospecting for dimension stone requires a systematic coverage of the regional area to pinpoint the specific target areas. Once targeted, then it is important to conduct general mapping and careful observation of the surface rock exposure to make an initial assessment of the rock's major geological characteristics (that is: jointing or cleavage, color, grain size, textures including all planar and linear elements, flaws or irregularities, mineralogy). Again, the consistency of the stone's aesthetic or visual as well as brittle deformation features need to be evaluated at this early stage. *Samples collected from the site must be: (a) representative of the stone, in general; and (b) be of large enough size to show the true color and texture of the stone in polished surface.* The sampling can be carried out using a sledgehammer, plugs and feathers and a pionjar drill. Mineral exploration license(s) should be in place.

(3) Initial assessment of the quarry potential

The initial assessment of the quarry potential provides the prospector with the exercise of gathering all of the known factors relating to the stone, and analyzing this data before proceeding with more expensive and time consuming exploration and assessment work. If the geological factors are positive, the geographical location favorable, and the market response to test samples positive, then the detailed geological work should proceed along with further market analysis and product development

(4) Detailed quarry potential assessment

The detailed geological mapping of the site will provide an understanding of the spatial distribution and orientation of any fabric elements (i.e.: rift, run, hardway for quarrying based upon planar and/or linear mineral alignments) in the deposit. It will also identify how these geological elements relate to the topography of the site, and how to incorporate these factors, as well as environmental and logistical considerations, into the initial stages of quarry planning

(5) Diamond core drilling program

If the information obtained to date from the ongoing resource assessment and marketing investigations are positive for quarry development, then the next logical step is to proceed to a targeted program of diamond core drilling. The purpose of this drilling is to aid in determining: (a) the overall geometry of the deposit, (b) the consistency and spatial (lateral and vertical) distribution of the visual and technical characteristics of the stone, (c) the block size potential, (d) the resource calculations for the deposit and (e) the detailed quarry plan.

(6) Trial quarrying, test block extraction and processing, physical-mechanical properties and market response

Test block extraction and processing should proceed with early stage quarry planning and trial quarrying. The results of the drilling program will fed directly into the quarry plan. The test block material must be collected from outcrop that is truly representative of the deposit. Physical-mechanical testing should be carried out at this time to provide this specific information to the ongoing market analysis.

(7) Quarry development plan, assessment of site specific quarrying techniques and the environmental impact

All of the geological information collected from the detailed geological mapping, core drilling, trail quarry and test block programs, evaluation of block size and reserve calculations, identification of specific quarrying extraction techniques, excavation equipment, and block dressing equipment, in combination with geographical constraints and marketing analysis will all be formulated into a comprehensive quarry development plan. This information will then be incorporated into the economic feasibility study (i.e.: including all information to delineate capital costs, production costs, rehabilitation costs and revenue generation and determine the true economic viability of the quarry development).

TABLE 6:

A Systematic Approach to Dimension Stone Exploration and Quarry Site Assessment

STEP	EXPLORATION ACTIVITY
1	Defining the regional exploration focus area
2	Prospecting (delineating the target zone, general mapping and sampling) ***
3	Initial assessment of the quarry potential
4	Detailed quarry potential assessment
5	Diamond core drilling program
6	Trial quarrying, test block extraction and processing, physical-mechanical properties and market response
7	Quarry development plan, assessment of site specific quarrying techniques and the environmental impact

AFTERTHOUGHT

In summary, the dimension stone industry is really in its infancy here in Newfoundland and Labrador. The prospecting, discovery, geological evaluation, market promotion and quarry development requires a lot of money and time. The stone must be of suitable quality and have a unique appeal to compete in the international market place in an economical price range. It is an industry that, like any other successful business venture, requires careful planning, scientific analysis, and ongoing economic and market evaluation. Although we have vast areas of the province yet to be thoroughly assessed for dimension stone, the job of discovering economically viable deposits is not easy, rather like a "needle–in-a-haystack". The exploration and evaluation is as difficult as looking for base or precious metal deposits, and the marketing is subject to highly demanding and ever changing international trends. As a province, we should promote the local use of our stone. However, the true industry potential lies in supplying product for the international marketplace.

Biographical Information:

Sherry Dunsworth, M.Sc., P.Geo., is a professional geologist with over 20 years of geological experience. She has carried out dimension stone exploration and drilling programs throughout the province, and has supervised the opening of new quarry sites. As a block buyer for Epoch Rock Inc, she has visited international quarries (i.e.: Norway, Italy, Brazil, USA), and is currently working as a dimension stone consultant. Sherry serves as a Geoscience representative on the APEGN council, and member of the Department of Mines and Energy Mineral Adjudication Board.