New Nouveau Brunswick

Energy and Mines
Resources/Exploration/Development/Management

Limestone

Mineral Commodity Profile No. 11

Limestone and dolomite are sedimentary rocks, commonly referred to as carbonates. The difference between the two is defined by their mineralogy — limestone is composed mainly of the mineral calcite ($CaCO_3$) and dolomite is composed mainly of the mineral dolomite ($CaMg(CO_3)_2$). Various proportions of these two minerals can occur in the same rock; hence, the terms dolomitic limestone and calcitic dolomite.

Most limestone is the product of biochemical interactions that have taken place in a marine environment. Biologic activity in warm, shallow waters of the tropics results in the removal of carbon dioxide (CO_2) from seawater and incorporation of calcite into the skeletons and protective shells of marine organisms. When these organisms die, their remains sink to the seafloor to form limestone deposits composed of billions of shell and skeletal fragments.

Most dolomite deposits are of secondary origin, formed by the percolation of magnesium-rich water through porous beds of limestone (Rodriguez-Blanco et al. 2015).

Uses

Limestone usage can be divided into four major categories of processed material: 1) pulverized stone; 2) calcined stone, which is limestone that has been heated (burned) to drive off CO_2 to produce quicklime (CaO); 3) dimension stone (quarried and cut stone for building purposes); and 4) crushed stone aggregate. Pulverized limestone is used to neutralize mine tailings piles, as an explosion suppressant in coal mines, and to rehabilitate habitat in acidified lakes. Quicklime has several industrial applications including: the production of cement, as a flux in iron and steel making, for water purification and effluent treatment, for flue gas desulphurization, glass making, pulp and paper treatment, and sugar refining.

Dimension stone is used for interior and exterior building facings, monuments and ornaments, and landscaping. The interlocking crystal texture of most limestone and dolomite imparts considerable structural strength to these rocks. This property, coupled with resistance to freeze-thaw cycles, makes crushed limestone and dolomite a suitable aggregate for many construction applications.

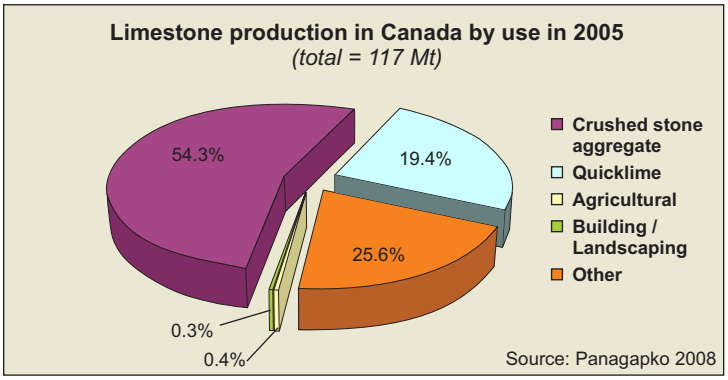
Production

Statistical data provided by Natural Resources Canada (NRCAN) for 2005 reports limestone production in Canada was about 117 million tonnes with a value of $835 million. Most of that production (74%) was composed of crushed stone aggregate and quicklime used for the manufacture of cement. With the exception of Prince Edward Island and Saskatchewan, limestone is produced in every province with Ontario and Quebec accounting for almost 84% of all active quarry operations (Statistics Canada 2008).

In 2013, the United States Geological Survey (USGS) reported that 781 million tonnes of crushed limestone and 42.5 million tonnes of crushed dolomite with a combined value of $7.7 billion were produced in the United States. In addition, limestone was used to manufacture 1.03 million tonnes of dimension stone with a value of $178 million. Limestone accounted for roughly 66% of all major rock types, including granite, traprock, marble, and sandstone, used to produce crushed stone and 45% of all major rock types used to produce dimension stone. Another 58.5 million tonnes of limestone with a value of $292 million was used in the manufacture of cement in the United States (Dolley 2015; Willett 2015).

Limestone and Dolomite Resources in New Brunswick

In New Brunswick, limestone deposits of potential economic significance are associated with Neoproterozic (1000–542 Ma), Ordovician (488–444 Ma), Silurian (444–416 Ma), and Carboniferous (360–300 Ma) rocks (Figure 1). Dolomite deposits are less widespread: a few small deposits in parts of northeastern and southeastern New Brunswick are associated with Ordovician and Carboniferous rocks,



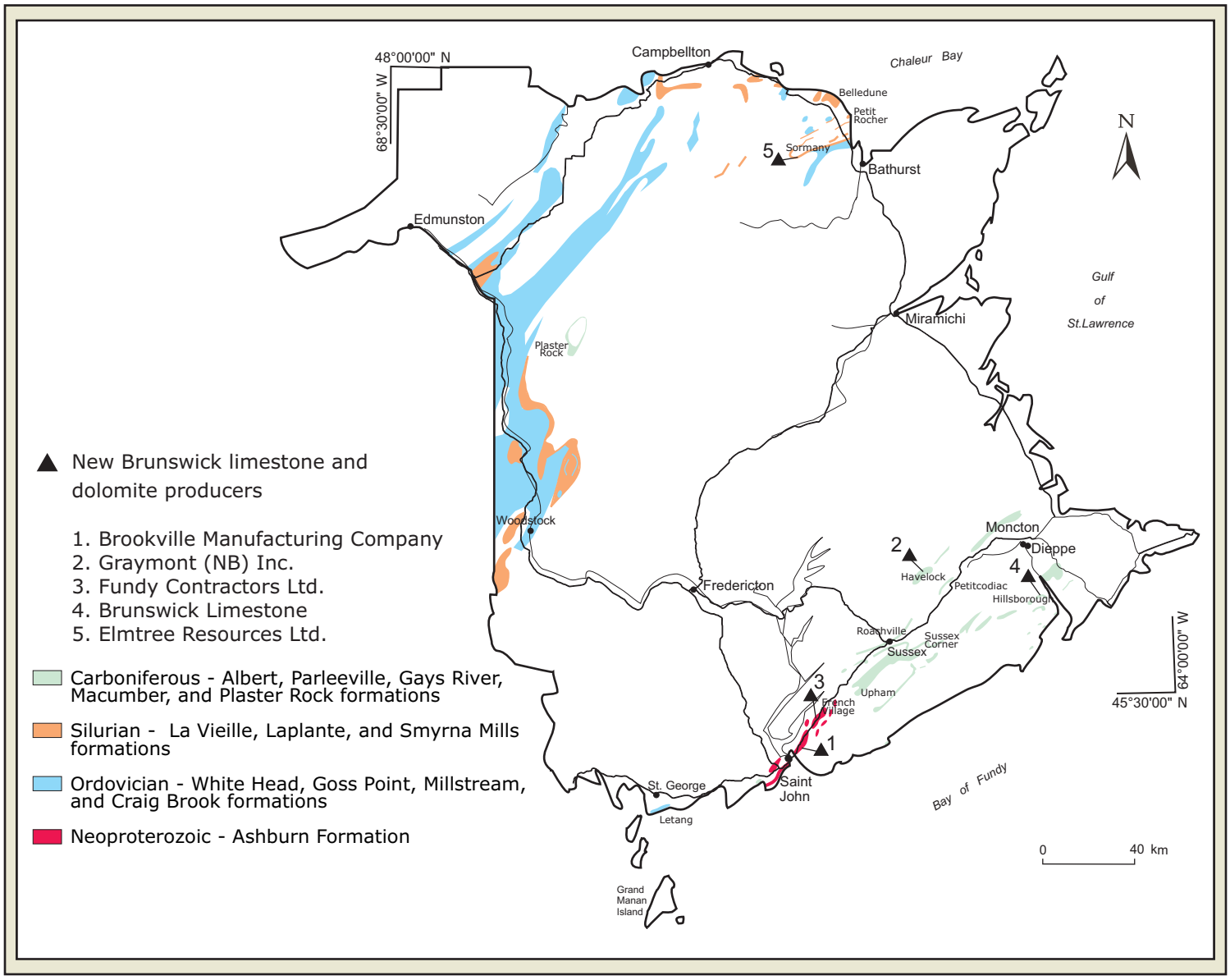


Figure 1. Geologic and geographic distribution of limestone and dolomite resources in New Brunswick.

respectively. More extensive dolomite deposits are associated with limestone resources in Neoproterozoic rocks of southern New Brunswick. Detailed descriptions of carbonate rocks in New Brunswick given by Alcock (1938) for the Neoproterozoic; by Alcock (1935), Noble (1976, 1985), Lutes (1979), Venugopal (1979), St. Peter (1982), and Wilson et al. (2004) for the Ordovician and Silurian; and St. Peter 1979, and St. Peter and Johnson (2009) for the Carboniferous. Limestone and dolomite resources in New Brunswick are described in detail by Wright (1950), Hamilton (1965), Davis (1987), Webb (1986, 1997, 1998, 2000, 2010), and Webb and Venugopal (1991). Martin (2003), and Miller and Buhay (2014) provide a history of development of the limestone industry in New Brunswick.

Neoproterozoic

Neoproterozoic rocks of the Green Head Group, confined to a 400 km^2 area in the vicinity of Saint John, represent the oldest and most extensive limestone and dolomite resources in New Brunswick. The Green Head Group is divided into two formations. The Ashburn Formation contains important carbonate deposits of limestone and dolomitic limestone associated with varying amounts of argillite and quartzite. The overlying Martinon Formation is a thick sequence of limestone breccia and siliceous siltstone.

Limestone horizons in the Ashburn Formation are steeply dipping and range from less than a metre to more than a 150 m thick. Although traceable over strike distances up to 1.5 km, it is more common for

individual horizons to pinch out or be terminated by faults. Generally speaking, the quality of Ashburn limestone is medium-grade, between 45–50% CaO. Medium- to high-quality limestone (50–53% CaO) deposits are found locally; however, the complex structural and deformational history of the Ashburn Formation complicates the task of locating large, high-quality deposits. Dolomitic limestone horizons grading up to 22% MgO have been reported at various locations throughout greater Saint John; however, deposits tend to be of limited size and lack consistency in grade.

Limestone and dolomitic limestone of the Ashburn Formation near French Village, south-central New Brunswick.

Ordovician

In general, Ordovician limestone and dolomite resources are characterized by low- to medium-quality deposits. Late Ordovician limestone of the White Head Formation (Matapedia Group) extends from just west of Campbellton in northern New Brunswick, southwest to Woodstock in the west-central part of New Brunswick. The White Head carbonates comprise a thick, deep marine sequence of dark grey to bluish grey, thin-bedded, very fine-grained argillaceous, lithographic, and crystalline limestone, which are regularly interbedded with varying amounts of calcareous shale. Typically, the presence of abundant argillaceous material results in low-grade, siliceous deposits that seldom exceed 35% CaO.

In southwestern New Brunswick, at a few locations along the Bay of Fundy coastline west of St. George, the Late Ordovician Goss Point Formation (Mascarene Group) comprises thin- to medium-bedded, grey limestone, dolomitic limestone, and argillaceous limestone interbedded with siliceous clastic sedimentary and felsic to mafic volcanic rocks. Most of these carbonate deposits are fairly limited in size and characterized by highly deformed zones of high-calcium and dolomitic material. Structural complexity reduces the overall quality of these deposits.

In northern New Brunswick near Bathurst, the Middle Ordovician Millstream Formation (Fournier Group) contains limestone and dolomitic lenses interbedded with clastic sedimentary rocks. Most of the limestone deposits are relatively impure. Isolated deposits of dolomitic limestone with MgO values as high as 19% are found near fault contacts and in areas intruded by mafic plutonic rocks.

Other deposits of Middle Ordovician limestone are found in west-central New Brunswick to the northeast of Woodstock. The Craig Brook Formation (Meductic Group) contains deposits of crystalline and lithographic limestone as lenses within calcareous slate and quartzite. Limestone beds are complexly deformed, moderately to steeply dipping, boudinaged, and sheared, resulting in small, isolated deposits of limited lateral and vertical extent. Most of these deposits are typically siliceous and low in MgO with CaO values ranging from 35–55%.

Typical dark grey to bluish grey, massive to laminated, very fine-grained argillaceous to crystalline limestone, regularly interbedded with varying amounts of calcareous shale of the White Head Formation, northern New Brunswick.

Silurian

In northern New Brunswick, Silurian rocks of the Chaleurs Group, situated north and northwest of Bathurst and west of Campbellton, contain important deposits of limestone. Deposits in the Early Silurian La Vieille and Late Silurian Laplante formations include massive to medium-bedded limestone interbedded with thick sequences of calcareous sandstone and siltstone; highly fossiliferous, nodular limestone; and reefal limestone. Silurian limestone in this part of New Brunswick, particularly those of reefal origin, offer the most prospective development potential for high-calcium resources often exceeding 50% CaO. However,

Grey, thin-bedded limestone of the Goss Point Formation at Letang, south of Saint George, southwestern New Brunswick.

the distribution of these deposits is somewhat erratic and the size of the resource at specific sites is usually limited to a few million tonnes.

In west-central New Brunswick, massive, steeply dipping beds of crystalline limestone occur locally in the upper part of the Silurian Smyrna Mills Formation (Perham Group) to the northeast of Woodstock.

Carboniferous

The most widespread and most widely used carbonate deposits in New Brunswick are those associated with Carboniferous rocks in the southeastern and, to a lesser extent, the northwestern areas of the Province. These Carboniferous deposits are restricted to three main depositional settings associated with sedimentary rocks of the Horton, Windsor, and Mabou groups.

The Frederick Brook Member of the Albert Formation (Horton Group) contains thin- to medium-bedded, fine-grained, grey limestone and orangey brown dolomitic limestone beds interstratified with kerogenous shale and mudstone. These lacustrine deposits are not well exposed and are primarily known from subsurface boreholes. Where dolomitized strata does outcrop it is restricted to very thin beds commonly interstratified with shale and mudstone and it therefore lacks sufficient quality and extent to be considered an economic source.

Carbonate rocks of the Windsor Group are distributed regionally among three laterally equivalent formations: the Parleeville, Gays River, and Macumber formations. Of the three, Gays River limestone is the most favoured for potential sources of high-calcium and, locally, high-magnesium material. The thick (up to 30 m), irregular-bedded, algal carbonate build-ups (boundstone), and intra-clastic bedded limestone (wackestone), which dominate the formation, generally vary between 52 and 54% CaO. Extensive Gays River limestone resources are widespread near Havelock, west of Moncton. The Macumber Formation is a thin-bedded, parallel-laminated, limestone (packstone) sequence comprising a mixture of arenaceous, argillaceous, and high-calcium carbonate material. Excellent exposures can be seen near Upham, about 30 km southwest of Sussex; at Sussex Corner, in south-central New Brunswick; and near Petitcodiac and Hillsborough in the southeastern part of New Brunswick. Qualitatively, Macumber limestone can be categorized as a uniform, medium-grade material containing up to 52% CaO. From a development perspective, the Macumber Formation seldom exceeds a thickness of 18 m and the size of the resource is limited at most locations. Apart from considerations as a potential source of high-calcium limestone, the uniquely laminated bedding style of the Macumber makes it a desirable material for flagstone and various landscape and building stone applications. High-calcium algal build-ups (boundstone) are also present, locally, in the Parleeville Formation. An exposure several kilometers west of Sussex suggests these types of algal structures are smaller and much less extensive than those associated with Gays River strata and are commonly associated with variable amounts of siliciclastic sedimentary rocks that significantly lower the qualitative properties of the limestone. In general, Parleeville limestone-bearing strata offer very limited development potential as a source of high-calcium limestone or calcitic dolomite.

The Early Carboniferous Plaster Rock Formation (Mabou Group) near Plaster Rock in northwestern New Brunswick is composed of nodular to locally massive calichi-type limestone intermixed with a matrix of red and green shale. The limestone is of low-quality, rarely exceeding 50% CaO. It may locally contain material

Grey, nodular to thin-bedded, highly fossiliferous limestone of the La Vieille Formation west of Belledune on Chaleur Bay, north-central New Brunswick.

Grey to red grey bedded algal boundstone and dark grey mounded algal bafflestone from the Gays River Formation from a quarry near Havelock, southeastern New Brunswick.

capable of satisfying selected industrial applications; however, expected lateral variations in quality and excessive overburden thickness tends to place limitations on its development potential.

New Brunswick Limestone and Dolomite Producers

Five limestone quarry and processing facilities are currently operating in New Brunswick (Figure 1). The Brookville Manufacturing Company, located east of Saint John, was incorporated in 1921. Havelock Lime Works Ltd. in Havelock was incorporated in 1964 and sold to Graymont (NB) Inc. in 1999. In the early 2000s, Hammond River Aggregates Ltd., a subsidiary of Fundy Contractors Ltd., took over an existing limestone quarry east of Saint John to supply crushed stone on a demand basis. Brunswick Limestone has operated a limestone quarry near Hillsborough since the year 2000. Elmtree Resources Ltd. acquired a limestone quarry west of Bathurst in 1978 initially to supply Brunswick Mining and Smelting Corporation Limited with flux for its lead smelter at Belledune. In the early 1990s Elmtree Resources' operations were moved to a higher quality limestone site near Sormany. Combined production from all the quarry operations in New Brunswick is estimated between 700 000 and 1 000 000 tonnes annually. Materials produced from these operations are listed in Table 1.

Table 1. New Brunswick limestone and dolomite producers and their products.

Producer:	Brookville Manufacturing Company	Graymont (NB) Inc.	Fundy Contractors Ltd.	Brunswick Limestone	Elmtree Resources Ltd.
Quarry location: **County:** **Lat.:** **Long.:**	Saint John Saint John 45°20′13″ -66°01′30″	Havelock Kings 45°59′58″ -65°18′32″	French Village Saint John 45°20′13″ -66°01′30″	Hillsborough Albert 45°54′10″ -64°38′18″	Sormany Gloucester 47°39′06″ -66°02′29″
Geology:	Ashburn Formation (Green Head Group)	Gays River Formation (Windsor Group)	Ashburn Formation (Green Head Group)	Macumber Formation (Windsor Group)	LaPlante Formation (Chaleurs Group)
Product:	*Aglime*: pulverized limestone and dolomite; *Crushed stone*: landscape stone, armour stone, variously sized construction aggregate	*Aglime*: pulverized limestone and dolomite; *Crushed stone*: landscape stone, armour stone, scrubber reagents, feed supplements, variously sized construction aggregate; *Calcined stone*: quicklime and hydrated lime	*Crushed stone*: variously sized construction aggregate	*Crushed stone*: landscape stone, dimension stone, flagstone, armour stone	*Aglime*: pulverized limestone and dolomite; *Crushed stone*: landscape stone, variously sized construction aggregate, flue gas and scrubber reagent, flux stone

Summary

Although limestone is a relatively plentiful resource, given its chemical, physical, and structural variability, not all limestone is capable of meeting the high standards required for certain applications. It is also important to note, the economic viability of high-quality deposits quite often depends on location with respect to intended end use.

In New Brunswick, the distribution of limestone is widespread; however, strategically located, high-quality deposits are limited. Demand for limestone products manufactured and used by the construction, agricultural, industrial, and environmental sectors is ongoing. New Brunswick's limestone industry is capable of supplying these markets at current levels of consumption for the near future.

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For More Information

For more information on limestone and other New Brunswick Mineral commodities, please see the NBDEM Industrial Minerals database (NBDEM 2015) or contact:

geoscience@gnb.ca

Telephone: 506.453.3826

Geological Surveys Branch
Resources/Exploration/Development/Management Division
New Brunswick Department of Energy and Mines
PO Box 6000, Fredericton, NB E3B 5H1

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