SALT

IN NOVA SCOTIA

BY G. PRIME

Information Circular 19

Cover Photo: Underground at The Canadian Salt Co. Ltd. Pugwash Mine, Cumberland County.

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Introduction

Common salt is a basic necessity to human survival and a fundamental material in our industrial society. It is a commodity having many uses and has served civilization for thousands of years. In general terms, it is found in quantity in three forms: underground in undisturbed bedded deposits; in salt domes; and in our oceans as natural brines. Salt is found worldwide, occurring throughout the geological record from the Precambrian to the present. The world's oceans are a major source of salt, averaging 3.5 per cent sodium chloride and containing an estimated 18.76 x 10^6 km^3 of the substance.

Background

Nova Scotia is a major salt producer in Canada, marketing almost one million tonnes annually in recent years *(Fig. 1)*. The earliest references to salt and salt springs in the Province date back to the early 1800s, however, very little if any production occurred prior to the 20th

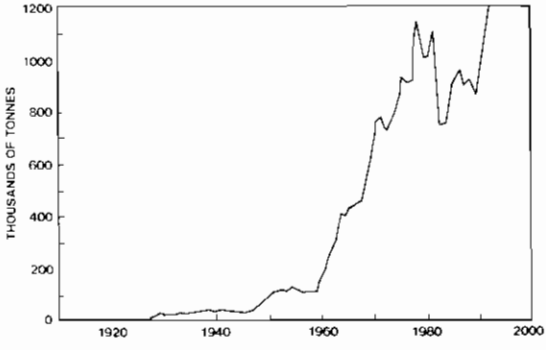

Figure 1. Annual salt production for Nova Scotia.

Century. In 1912 a water well in the Malagash, Cumberland County area was found to contain salt brine. Based largely on this finding, an extensive drilling program was conducted in the area, resulting in the discovery of a major salt deposit. In 1918, Canada's first underground rock salt mine was opened at Malagash. A drilling program for petroleum in 1931 resulted in the discovery of a thick salt deposit at Nappan, Cumberland County. In 1947 exploitation of the deposit commenced with the installation of a brining plant. Most recently, in 1959, a salt mine at Pugwash, Cumberland County began production.

Properties

Common salt or halite is a mineral composed of sodium and chloride, with the chemical formula NaCl. It is colourless to white when pure, however, other colours such as yellow, red and blue can result when there are impurities in the crystals. Halite is an isometric mineral with a cubic crystal form. Its specific gravity is 2.16 and it has a Mohs hardness of 2. It is readily distinguished by its salty taste. A very important characteristic of salt is its high solubility in water.

Uses

There are over 14 000 uses for salt in industry, medicine and the home. The earliest uses included the preparation and preservation of foods and the tanning of hides. In modern society the largest consumption of salt is in the manufacture of chemicals. It is used directly in the production of such substances as chlorine,

caustic soda and sodium, and indirectly for substances such as hydrochloric acid, soda ash and sodiuru sulphate. Salt is also importaut in transportation, especially in Canada, in the control of ice and snow on our roads. Other important salt related products are manufactured in the agricultural, pulp and paper, and textile industries. Salt is also important as a water softening agent, both in the home and industry.

Geology

Salt in Nova Scotia is almost exclusively restricted to Lower Carboniferous Windsor Group rocks *(Fig. 2)*. The Wiudsor Group in Nova Scotia generally occurs in the Carboniferous basins of the Fundy Basin System. It consists of a thick succession of interstratified marine and nonmarine sedimentary rocks which include fine grained siliciclastics, carbonates and evaporites. The cyclical nature of these intercalated strata indicates tbe occurrence of repeated marine invasions during the early Carboniferous. The salt occurs as part of the marine evaporite sequences wbich also

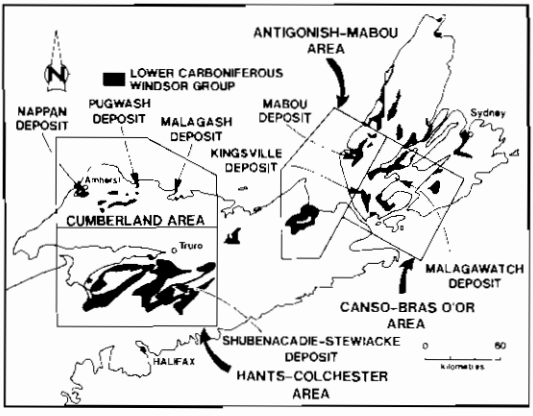

Figure 2. General areas in Nova Scotia where salt deposits and occurrences are found.

include anhydrite, gypsum and minor potash. Rhythmic interbedding of these strata with carbonates resulted from evaporation and deposition in saturated sea water. The evaporite deposits which formed were easily mobilized after burial. Diapiric salt structures or domes formed and are common in the Province. The result is that the salt deposits vary from undisturbed, stratified deposits to severely deformed deposits. They have recently been classified into four types, A, B, C and D, with type A being quite undeformed and type D being highly deformed (Boehner, 1986).

Deposits and Occurrences

There are 20 deposits and 13 occurrences of salt which have been identified in Nova Scotia *(Table 1)*. Most of the deposits are found in the following four general areas in the Province *(Fig. 2)*: Hants-Colchester, Cumberland, Antigonish-Mahou and Canso-Bras d'Or. A fifth area, the Sydney area, has a smaller number of deposits. In the Hants-Colchester area the primary deposit is in the Shubenacadie-Stewiacke Valley. This deposit is undisturbed with estimated reserves of 50 Gt of 85 per cent NaCl. The Cumberland area is the major salt producing area iu the Province with important deposits at Malagash, Pugwash and Nappan. The Malagash deposit was mined from 1918-1959 when it ceased operations due to mining and ore grade problems. The Pugwash deposit, which is currently being mined, began operation in 1959. It is estimated to contain 725 Mt of salt of unknown grade. The Nappan deposit is also being mined and is approximately 1400 m in thickness with a

Table 1. Nova Scotia salt deposits and occurrences**.

	Deposit or Occurrence	Potential for Salt Exploration	Potential for Potash Exploration
Hants-Colchester Area			
Beaver Brook	Deposit	good	poor-fair
Clarksville	Occurrence	fair	fair-good
Falmouth	Occurrence	poor	poor
Kennetcook	Occurrence	poor	poor
Shubenacadie-Stewiacke	Deposit	very good	poor
Stanley	Occurrence	fair	poor
Summerville	Occurrence	very poor	very poor
Upper Walton River	Occurrence	poor-fair	poor-fair
Walton	Occurrence	poor-fair	poor-fair
Cumberland Area			
Beckwith	Occurrence	fair	good
Malagash*	Deposit	fair	good
Nappan*	Deposit	fair	poor
Oxford*	Deposit	fair	fair-good
Pugwash*	Deposit	very good	good
Roslin	Occurrence	fair	fair
Antigonish-Mabou Area			
Antigonish	Deposit	fair	fair
James River*	Deposit	fair-good	fair-good
Mahou	Deposit	fair-good	fair-good
Ohio	Occurrence	poor-fair	poor-fair
Pomquet River	Occurrence	poor	poor
Southside Antigonish Harbour*	Deposit	good	fair
Canso-Bras d'Or Area			
Cleveland*	Deposit	fair	fair
Estmere	Deposit	fair	fair
Kingsville	Deposit	very good	fair-good
MacIntyre Lake*	Deposit	very good	good
Malagawatch*	Deposit	good	good
Orangedale*	Deposit	good	good
Port Richmond*	Deposit	very good	fair
Seaview	Occurrence	fair	fair
St. Patricks Channel	Deposit	fair-poor	fair-poor
St. Peters*	Deposit	fair	fair
Sydney Area			
Boularderie	Deposit	good	good
East Bay	Occurrence	fair	poor

*Potash salts reported.
**Modified after Boehner, 1986.

96.6 per cent NaCl content below the 600 m depth. The Antigonish-Mabou area contains several deposits including a large structurally-complex diapir at Mabou. It occurs at depths ranging from 425-2900 m with a maximum thickness of 1500 m. Among deposits occurring in the

Canso-Bras d'Or area are significant ones at Kingsville and Malagawatch. The Kingsville deposit has proven reserves of 28.6 x 10^6 Mt based on 12 drillholes in the deposit. The Malagawatch deposit, along the western shore of Bras d'Or Lake, is largely undefined. Its main significance is as a potash occurrence up to 9 m thick.

Producing Mines

Pugwash Mine, Cumberland County
The discovery of salt in the Pugwash area occurred in 1953 while drilling a water well. An exploration drilling program in 1954 found significant thicknesses of salt. With the impending closure of the Malagash Salt Mine, the Malagash Salt Company had heen looking elsewhere for new deposits. The result was the sinking of a shaft in 1956 in the Pugwash deposit and the mine opening in 1959. In 1961 the Malagash Salt Mine reorganized to become the Canadian Rock Salt Company and later the Canadian Salt Company.

Mining at the Pugwash Mine is by room and pillar method in which drifts 9 m high by 17 m wide are separated by pillars 23 m x 23 m. Crosscuts are driven at intervals to connect drifts. The ore is removed by blasting and scaling the face, advancing 4 m at a time. The rock salt is refined at the surface in a mill through crushing and screening. The fines are then processed through an evaporation plant to produce pure, fine salt. Most of the salt is shipped in bulk by truck and self-unloading vessels to several locations along the eastern seaboard including Quebec, Prince Edward Island, Newfoundland and New England. Approximately 90 per cent of the milled product is used for ice and snow removal

on our highways. Most of the remainder is used in the chemical industry in the production of chlorine with small amounts being used in the curing of hides. The evaporated product is used in the food manufacturing industry. The largest users are fish packers, vegetable processors and the makers of water conditioning units.

Nappan Deposit, Cumberland County

The Minudie Anticline, which contains the Nappan deposit, was first described in the middle 1800s. Salt in the structure was discovered as brine in a water well in 1927. In 1931 Imperial Oil Limited drilled into the deposit. In 1947 the Nova Scotia Department of Mines drilled two holes which intersected salt. Subsequently Maritime Industries Limited drilled brine wells and began salt production in 1947. The Nappan Mine is now operated by Sifto Canada Inc.

The method of production at the Nappan deposit is solution mining. Using this method, water is pumped into a cavity at depth, dissolving the salt and forming a brine which is forced back to the surface by the pressure of a well pump. The brine is treated with caustic soda before being placed in a settling pond where the impurities are removed. The brine then passes through a mechanical vapour recompression evaporating process. This highly efficient process includes a heat exchange system and dewatering pusher centrifuge which permit high purity salt to be produced at considerable energy savings. The annual production of this plant is 90 000 t. Approximately 65 different salt products are produced including table, pickling and fishery salts.

Underground Storage Potential

A strong interest has been generated in underground storage potential in rock caverns in Canada. This has come about largely as the result of our energy requirements and the need to produce large-volume storage facilities to contain these resources. In Nova Scotia the main area of interest is the storage potential in salt caverns. This is based primarily on the interest in offshore petroleum and the need to find storage facilities in anticipation of future production. In addition to hydrocarbon storage potential, the salt caverns are also being considered for the storage of compressed air. The salt caverns are the focus of attention because of the abundance and size of salt deposits in the Province, their impermeability and the low cost of producing storage facilities from them. Three major areas of interest are the Strait of Canso, Hants-Colchester Counties and Cumberland County. The Strait of Canso area has been the focus of attention, mainly because of its thick salt deposits in proximity to a tidewater shipping port. The Hants-Colchester area is considered important because of its location near potential natural gas pipeline routes. The Cumberland area deposits are of interest because of the extensive mining operations in them. Initial studies suggest that many of the salt deposits have the qualities, including impermeability, which would allow them to make suitable storage facilities.

Potash

Potash is not a mineral, but rather a term used to describe naturally occurring potassium salts or products derived from them. It is expressed as potassium oxide or K_2O. Minerals included in this group are sylvite (KCl), carnallite ($KMgCl_3 \cdot 6H_2O$), niter (KNO_3) and kainite ($MgSO_4 \cdot KCl \cdot 3H_2O$).

The primary use for potash is in the manufacture of fertilizers, which accounts for 90-95 per cent of annual world production. It is the third most important ingredient in fertilizers and is used to replace deficiencies in potassium in the soil. Its primary function is to aid in the production of healthy plants and is especially important in the growth of crops such as cereal grains, alfalfa, tobacco, sugar beets and potatoes.

The remainder of the potash salts are used in the chemical industry in the production of potassium chloride and other potassium compounds. In addition to potash being an important source of potassium, carnallite is also an important source of Mg for producing magnesium metals and alloys, magnesium oxide, magnesium chloride and magnesium anodes.

Potash in Nova Scotia is present as potash salt, sylvite and carnallite. The occurrences are generally small and noneconomic, however, they have provided encouragement for future exploration. They are restricted to the Windsor Group evaporites, generally occurring in association with halite. The major occurrences in the Province are illustrated in *Figure 3* and are present primarily in strata bound layers with minor showings in veins. The most

important occurrence is located in the Malagawatch salt deposit where it is found as stratified units. It is present in three stratigraphic levels with good potash occurring up to 9 m thick. Other important occurrences are present at Orangedale, Inverness County, Kempt Head, Victoria County, Malagash, Cumberland County, and James River, Antigonish County.

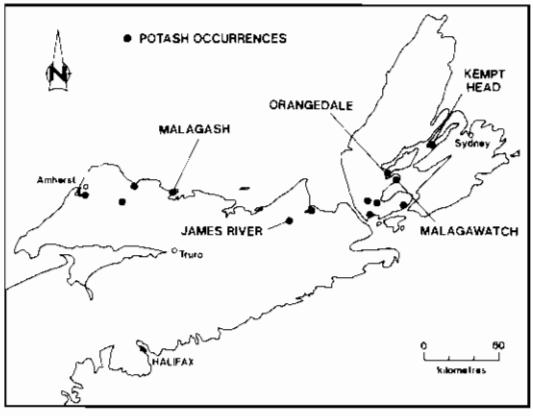

Figure 3. Locations of potash occurrences in Nova Scotia.

Mineral Rights

Salt and potash are considered to be minerals under the Mineral Resources Act of Nova Scotia. Exploration for these commodities in the Province requires issuance of a special licence by Order In Council through the Nova Scotia Department of Natural Resources. Mining Permits are required to mine salt and potash.

Reference

Boehner, R.C., 1986: Salt and potash resources in Nova Scotia; Nova Scotia Department of Mines and Energy, Bulletin 5, 346 p.

Nova Scotia

Department of Natural Resources

Honourable C.W. MacNeil, M.D.
Minister

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Canada

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on Mineral Development

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