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BARYTES DEPOSIT AT PEMBROKE, HANTS COUNTY  
NOVA SCOTIA

A. E. CAMERON, Deputy Minister  
Department of Mines, Province of Nova Scotia

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### ABSTRACT

Exploration by surface trenching and diamond drilling have outlined a body of over 1,000,000 tons of high grade, light red color barytes in Paleozoic sediments near Pembroke, Hants County, Nova Scotia. The deposit is restricted to a subsidiary synclinal fold on the north limb of a broad syncline and appears to be due to replacement of an iron rich calcareous series of sediments representing either the base of the Windsor formation or the top of the Horton formation.

### INTRODUCTION

The south shore of Minas Basin between the Avon River at Windsor and the Shubenacadie River at Maitland has long been known as a potential source of mineral wealth. It attracted the attention of the early geologists and in the past has produced considerable tonnages of manganese and gypsum and, even, some barytes. Depletion of ore in surface and near surface deposits resulted in a dwindling production until today the only working deposits are the National Gypsum Company's quarries at Walton. The region is heavily drift covered, making prospecting exceedingly difficult and costly, and limiting the operations of the ordinary prospector. Outcrops of bed rock are few and scattered, being confined almost entirely to the seashore and the floors of the small sharp valleyed streams. The general rock structure is indicated by

the areal geology, but detailed structures which can be expected to control ore depositions are hidden by the drift and require subsurface evidence to delineate. Moreover, the known minerals are for the most part not the precious or heavy metals, such as gold, lead, zinc and copper, which have been the cause of exploration and the source of the great new mineral production of Canada in recent years. They are largely the common earthy minerals which, though of prime importance to our civilization, do not have the same lure and fascination for the prospector and miner. They enter a highly competitive market, with rigid specifications and, generally, because the cost of preparation far exceeds the cost of primary production, only high grade, easily accessible deposits are worked. They are a processing rather than a mining problem. It is, therefore, not to be wondered at that the deposit of barytes now in process of development at Pembroke has not been worked heretofore, although its surface outcrops were first noted over forty years ago, and although it lies within one mile of the abandoned workings of a manganese mine from which a considerable production of that metal was obtained at the end of the last century.

Barytes was mined in Nova Scotia as early as 1874 from a deposit at Five Islands on the north shore of Minas Basin (Poole. 1875). The first record of the presence of the mineral at the present site is given by Selwyn (1895), who states, "barite in considerable quantity occurs in veins in limestone at Walton and Pembroke". The exact site of the present workings was marked on the map published by Fletcher (1905). The economic possibilities of this deposit, however, were not recognized until McKee examined the outcrop in 1940.

#### GEOLOGY

The regional geology of the area, studied by Logan, Selwyn and Fletcher, was first compiled into a map by Fletcher in 1905. The whole region is heavily drift covered, recent drill records showing thickness up to 75 ft. of glacial gravels and tills. Bed rock consists of carboniferous limestone, sand-

stones and shales, for the most part stained with iron, and thus showing arid conditions of deposition. Gypsum beds are not infrequent and several saline springs are scattered throughout the area. Triassic sandstones and conglomerates with remnants of amygdaloidal flows and cut by basic dykes are exposed close to the shore of Minas Basin.

<u>Era</u>	<u>Period</u>	<u>Formation</u>	<u>Lithology</u>
Cenozoic	Recent	River and lake deposits	Silts and sands
	Pleistocene	Ground moraines	Gravels and boulder clays
UNCONFORMITY			
Mesozoic	Triassic		Lava flows, basalt and diabase dykes, etc. Sandstones and conglomerates
UNCONFORMITY			
Paleozoic	Carboniferous	Windsor—	Sandstone, shale, Limestone, gypsum
		Horton—	Shale, sandstone conglomerate

The Horton-Windsor contact appears to be the most important or significant geological feature of the area. The general arid condition of deposition at that time resulted in a widespread distribution of iron throughout the sediments. At the same time earth movements resulted in rapid changes, both in the extent of the sea and in the character of the sedimentation in the sea. Horton sandstones are replaced by shales and shaley limestones in rapid succession both vertically and laterally. At the beginning of Windsor times the seas cleared somewhat, but embayments were cut off by land changes and evaporation from these bays resulted in precipitation of calcium carbonate and calcium sulphate from the saturated sea waters.

The general structure of the region is a broad syncline, striking northeast, and pitching to the east. The axis of the syncline is well south of the area under consideration, so that in the vicinity of the barytes deposit the bed rock trends

northeasterly, and dips to the south. Local changes in dip are common and there are undoubtedly many minor structures superimposed on the major structure, but these have not yet been worked out in detail. It will be shown later that the barytes bed is clearly related to such a secondary structure and there is good reason to believe that the same condition will hold for the manganese ore bodies. The detailed study now being made of the barytes deposit may lead to a determination of features which will be a decided help in a further search for manganese in the area.

The primary structures are presumably due to broad earth movements that occurred at the close of Permo-Carboniferous period. The secondary structures may be contemporaneous, or, and more probably are, the result of movements in Triassic times associated with the lava flows and basic intrusions that make up North Mountain of the Annapolis Valley and the similar rocks exposed along the north shore of Minas Basin. The mineral deposits, both manganese and barytes, appear to be replacements of certain beds or portions of beds by percolating solution, but whether they were of supergene or hypogene origin remains to be proved. One is inclined to think that the primary source of these metals can most logically be placed to the igneous activity of the Triassic, although they may have been transported to their present positions by surface waters.

#### BARYTES DEPOSITS AT PEMBROKE

As previously stated, the examination of the Pembroke barytes deposit was commenced in October, 1940. The deposit outcropped on the crest of a low ridge and was exposed for an area of a few square feet only. Systematic trenching and pit digging outlined an area of 200 feet square with barytes at depths of not over 5 feet from the surface. A composite sample taken from these trenches showed the barytes to be of exceptionally good quality, although stained somewhat by iron. An aggressive exploration by diamond drill has proceeded throughout the winter and a large body has now been proven.

The trend of the ore body is fairly definitely known and its general form is outlined. Further drilling is required before the full size of the deposit will be known and detailed knowledge of the character and quality of the whole mass must await complete study of the many feet of drill core obtained. The information available at present is factual only, but certain deductions can be made which may or may not be proved by further studies.

The drilling operations completed to date show clearly that the barytes occupies a sharp synclinal fold which strikes east and west and pitches east at an angle of about 28°. The axis of this secondary structure may be conformable with or is obliquely angular to that of the major structure. The dense, relatively insoluble barium sulphate in its synclinal position has resisted erosion and solution so that the upper end of the pitching syncline has been left at the surface to form an elongated hill.

The ore body occurs in and appears to be limited to an iron rich calcareous series of sediments where they are caught in the secondary syncline. This series consists of interbedded calcareous sandstones, limy shales and impure limestones. Variations in character of sedimentation show both vertically and horizontally. Roof rocks of the series have not yet been definitely determined. Pavement consists of a persistent thin bed of impervious grey argillite overlying a bed of grey sandstone.

Cores of all the holes have shown angular portions and thin layers of sandy red shales and red sandstones enclosed in the barytes. There is no apparent continuity of these but they appear at different horizons in different holes. There is thus considerable evidence to show that the deposits are formed by replacement of an iron rich calcareous material. The persistent sandy character of the remaining fragments indicates a tendency towards selective replacement or lime-iron rich portions, leaving silica rich portions incompletely replaced.

The barytes makes a gradational contact with underlying feruginous calcareous sandstones. The cores of the holes show

gradually increasing content of red sandy fragments until the majority of the core appears as a barytes impregnated material. A sufficient number of the holes have cut the pavement material to establish the position of this horizon. The most easterly hole shows increasing quantities of sandy fragments within the barite zone.

We may summarize the evidence obtained to date in the statement that, it tends to indicate that this barytes deposit is a replacement deposit formed by descending supergene solutions percolating down through an iron rich calcareous series of sediments and replacing the lime rich portions of that series with barium sulphate. Descent of the solution appears to have been restricted to a secondary synclinal structure superimposed upon the broad general structure of the region.

As stated previously, information to date indicates a very substantial quantity of barytes. With the eastern extension still unproven, calculations show well over a million tons now blocked out by drilling. Throughout all the cores quality is generally good; specific gravity determinations made on random pieces of core average better than 4.3 and a composite sample from the thirteen (13) surface trenches—after washing—averaged 4.41.

Chemical analysis shows:

Barytes.....	(BaSO <sub>4</sub> )	97.1%
Lime.....	(CaO)	0.1
Ferric Oxide.....	(Fe <sub>2</sub> O <sub>3</sub> )	0.8
Silica.....	(SiO <sub>2</sub> )	1.1
Not determined.....		0.9
		100.0%

#### MARKETS AND USES

The immediate present day market for this material is as a component in circulating drilling fluids used in the British West Indies oil fields. The finely ground barytes (-300 mesh) is used with bentonite and a dispersing medium in water suspensions in the drill hole. The heavy fluid so formed, weighing about 120 lbs. to the cubic foot (1.93 S.G.), acts both as a liquid seal against gas and oil pressures encountered when the

oil sands are pierced by the drill and as a means of removing rock cuttings from in front of the rotating bit of the drill.

Specifications for barytes for this use are strict, both as to fineness of grinding and specific gravity. Normal specifications are:

Screen analysis . . . . .	98% through -300 mesh
Specific Gravity . . . . .	4.15—4.25
Water soluble content . . . . .	less than 2%

From the analysis already quoted it can be seen that, if milling operations of the Pembroke barytes are satisfactory, it should have no difficulty meeting this specification.

**EDITOR'S NOTE:** Since presentation of this paper before the Institute on April 7, 1941, development of the barytes deposit has proceeded rapidly. A mill was erected at Walton, Nova Scotia and was placed in operation by the middle of May. First shipment was made to Trinidad on June 14. Average specifications for this shipment was as follows:

Barium sulphate . . . . .	96.85 %
Specific Gravity . . . . .	4.42
Water Soluble . . . . .	0.127
Screen Analysis . . . . .	99.005 through 325 mesh (Tyler)

A complete description of mining and milling operations at this deposit was presented to the Nova Scotia Mining Society at its annual meeting, Pictou, Nova Scotia, June 25, 1941.

#### REFERENCES

- Fletcher, Hugh. Map No. 879, Walton Sheet No. 74, 1 inch—1 mile, Geological Survey of Canada, 1905.
- Poole, H. S. Ann. Rep. for 1874. Nova Scotia Dept. of Mines, p. 57, 1875.
- Selwyn, A. R. C. Geol. Survey of Canada for 1892-93, p. 66A, 1895