

Mesozoic Stratigraphy and Kaolin Exploration in the Sibley Road Area (NTS 11E/03), Halifax County

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Introduction

Geological mapping of the Musquodoboit Valley by the Nova Scotia Department of Natural Resources and Geological Survey of Canada has led to the recognition that vast hidden valleys, filled with up to 200 m of Cretaceous sediment, are buried under a veneer of glacial deposits (Lin, 1970; Fowler, 1972; Stea and Fowler, 1981; Dickie, 1986; Stea *et al.*, 1996; Finck *et al.*, 1998). In 1996, Kaoclay Resources Inc. (Kaoclay) was formed to explore the Cretaceous basins of Nova Scotia for industrial minerals, including paper-grade kaolin.

Kaoclay's main area of interest in Nova Scotia is in the Musquodoboit Valley where Cretaceous sediments covering an area of approximately 42 km² have been delineated through seismic surveys and drilling (Stea *et al.*, 1996). The company has identified several areas of interest within this area and has chosen for its initial detailed evaluation an area of approximately 3 km² in the Sibley Road area, located just west of the village of Middle Musquodoboit (Fig. 1). This area of Mesozoic sediments straddles a proposed fault in the Musquodoboit Valley termed the Rutherford Road fault (Stea and Pullan, 1998), south of which lies the thickest Mesozoic section. Mesozoic-Cenozoic faulting has created a trough in which Cretaceous sediments have been preserved below regional base-levels (Stea and Pullan, 1998).

Initial results from this detailed exploration program were very encouraging and resulted in the identification of a consistent stratigraphic package, referred to by Kaoclay geologists as the Sibley Road unit. This unit includes light-grey kaolinitic clay and sand of economic interest. Beneficiation of initial test pit and drill core samples returned encouraging results with a number of samples meeting brightness specifications established by the paper industry.

A systematic grid, referred to as the Sibley Road grid, was established over this area with the initial lines spaced at 200 m for a total of 21 km of grid lines (Fig. 2). A reflection seismic survey was completed over the entire grid area in January 1998, and a drilling

program was carried out at 200 m intervals along the grid lines at the end of May 1998. This drilling program identified an area of 3.2 km² underlain by the Sibley Road unit.

Based on drilling and seismic results from the 200 m grid, several areas were selected for a more detailed drilling program at 100 m intervals. This detailed grid-drilling program was carried out over an area of approximately 1 km² and resulted in a more detailed understanding of the stratigraphy underlying the Sibley Road area.

Stratigraphy

A coherent stratigraphic picture has emerged as a result of the drilling program. The entire area is covered by glacial till, varying in thickness from 1 m to 10 m. The till is underlain by Cretaceous sediments including the Sibley Road unit, which can be subdivided into the lower, middle and upper units.

The lower Sibley Road unit consists of interbedded medium- and light-grey clay, grey-brown clay, lignitic clay and minor silica sand intervals. Although this lower unit is commonly found in the northern Sibley Road area, in the vicinity of the Rifle Range Road, it is absent south of this area in the vicinity of Highway 224 (Fig. 2).

The middle Sibley Road unit consists of red, black and dark grey clay with varying amounts of charcoal and lignite fragments. This unit has an average thickness of approximately 3 m and is a distinct marker unit separating the upper and lower Sibley Road units. The middle unit is crucial in our understanding of the stratigraphy of the Sibley Road unit, although it is not always present in the stratigraphic sequence. It is analogous to the Middle Member of the Chaswood Formation, a much thicker organic unit that serves to divide the Mesozoic sequence south of the Rutherford Road fault (Stea *et al.*, 1997; Stea and Pullan, 1998).

The upper Sibley Road unit can be identified by a number of distinct features, including the presence of light-grey (nearly white) and minor cream-coloured

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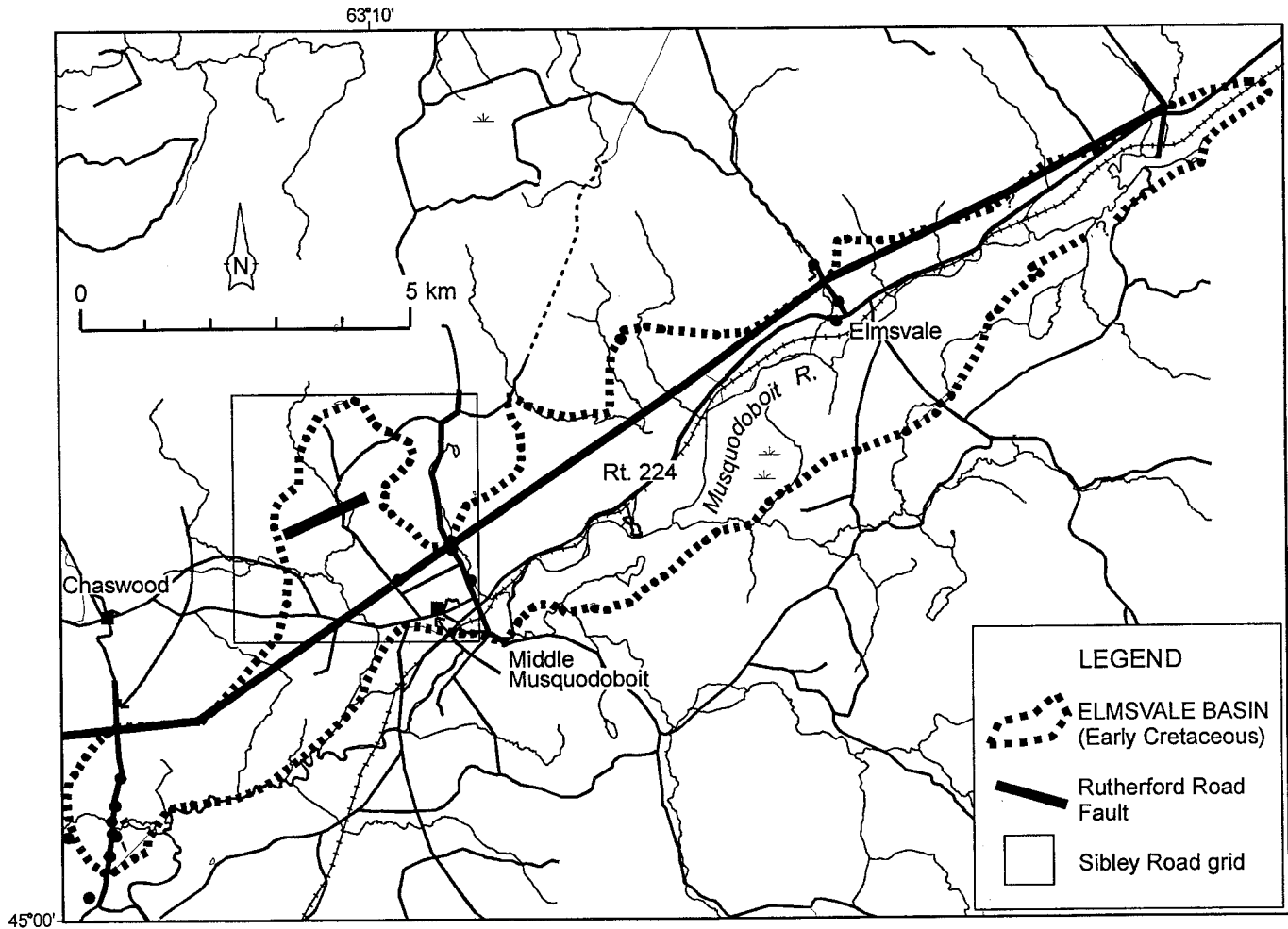


Figure 1. Location of the Elmsvale Basin (Chaswood Formation-Early Cretaceous) in the Musquodoboit Valley.

clay, massive to mottled purple and pink fine-grained clay, and fine to coarse, poorly-sorted light-grey silica sand which is commonly micaceous and contains clay balls (Fig. 3). This unit also has small amounts of red and yellow, ochre-stained clay and sand, and red-brown clay. Beds of dark grey to black lignitic clay are also found in the upper Sibley Road unit but are not always present in drillhole intersections. Drill data from the 200 m grid drilling program indicate that the upper Sibley Road unit varies in thickness from 2.2 to 68.6 m with an average thickness of 36.2 m. The upper Sibley Road unit appears to have the greatest potential for hosting large volume, commercial-grade clay deposits, based on exploration and analytical testing to date.

In 31 of the 72 holes drilled as part of the 200 m drilling program, the upper Sibley Road unit is overlain by darker coloured clay and sand of the middle member of the Chaswood Formation where Cretaceous sediments are thickest. Cretaceous sediments were intersected in all but 12 of the 153 holes drilled in the Sibley Road area as part of the initial exploration program and the

200 m grid drilling program. All 12 of these holes were drilled along the edge of the Cretaceous basin and have helped to define the extent of Cretaceous sediments in this area.

In 1998, Kao clay carried out a program of bulk sampling in the Sibley Road area to acquire sufficient material for beneficiation tests. A bucket auger was used to extract large volumes of samples from the upper Sibley Road unit. Approximately 45-50 tonnes of material were taken from carefully selected locations to ensure that samples representative of the entire deposit were collected.

Of the 45 to 50 tonnes of sample material taken from the upper Sibley Road unit, approximately 30 tonnes (185 samples) have been sent to Kao clay's laboratory in Eatonton, Georgia. This material has been subdivided into seven economic categories (K-1 to K-7), based on texture and amount of impurities. These include five primary clay types with two variants based on the amount of sand; for example, K-2 and K-7 have a

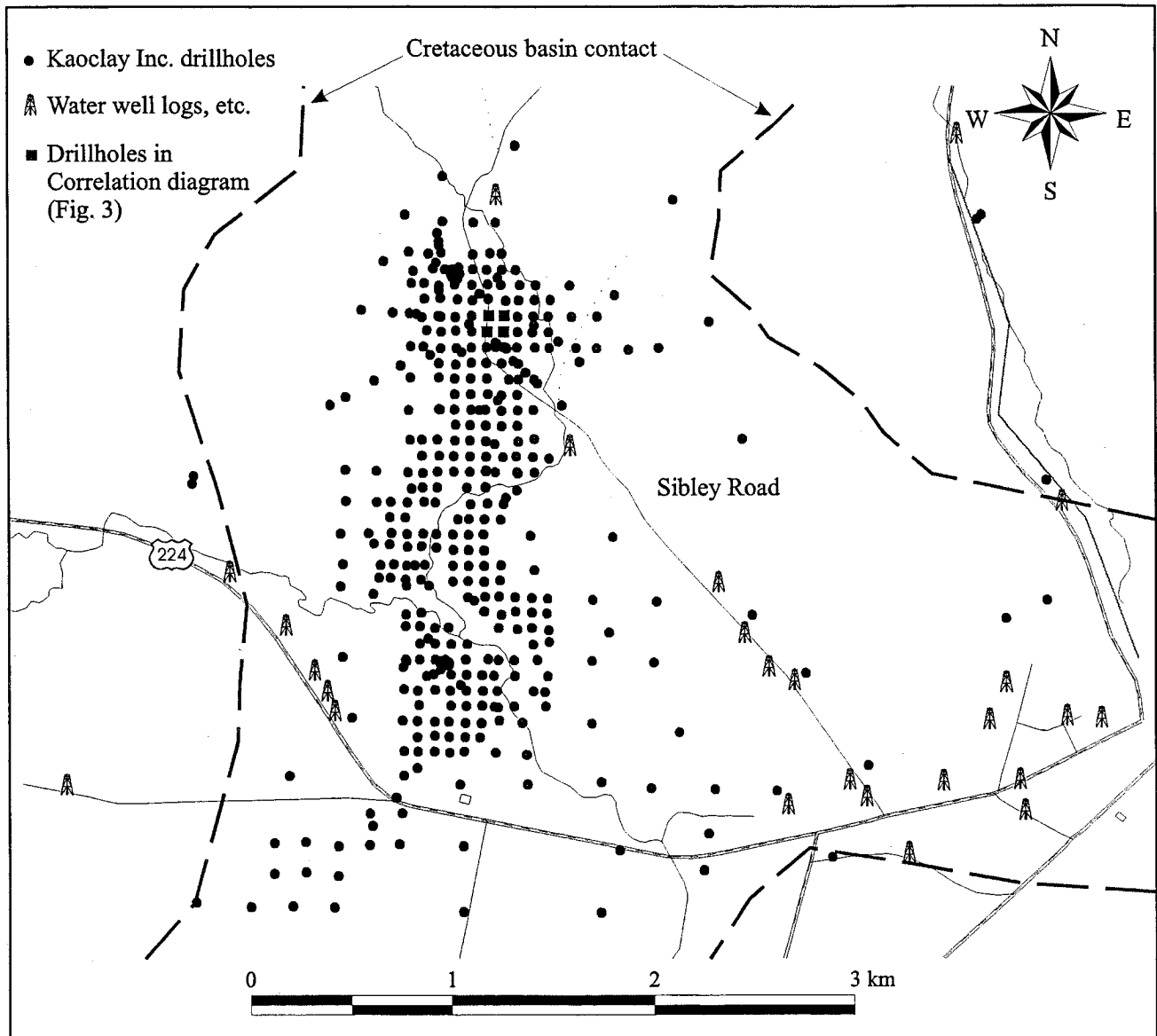


Figure 2. Detailed map showing the Sibley Road drill grid area and locations of the type drillholes of the upper Sibley Road unit.

similar clay type as K-1 and K-6, but have a higher grit content. These categories were determined by colour, the amount of visible oxidization, and grit content (the amount of sand versus clay) and represent discrete stratigraphic intervals within the upper Sibley Road unit (Fig. 3). The seven economic clay categories may be described as follows:

- K-1 - light grey clay, minor yellow iron staining
- K-2 - light grey silty clay, micaceous, minor yellow iron staining
- K-3 - clay and silty clay, light grey with moderate yellow iron staining
- K-4 - clay, pink and light to medium purple in color

- K-5 - clay and silty clay, iron yellow and light to medium purple in color
- K-6 - sand, minor clay and clay lenses, light grey, micaceous with minor yellow iron staining
- K-7 - sand, minor clay, light grey with minor yellow iron staining

Approximately 80% of the upper Sibley Road unit has been classified as categories K-1 through K-7. The portion of this 80% that represents economically viable kaolin once the grit has been removed has yet to be determined. Of the seven categories, K-1, K-2, K-6 and K-7 have the highest potential for making kaolin product. The sand-dominated units (K-6 and K-7) have

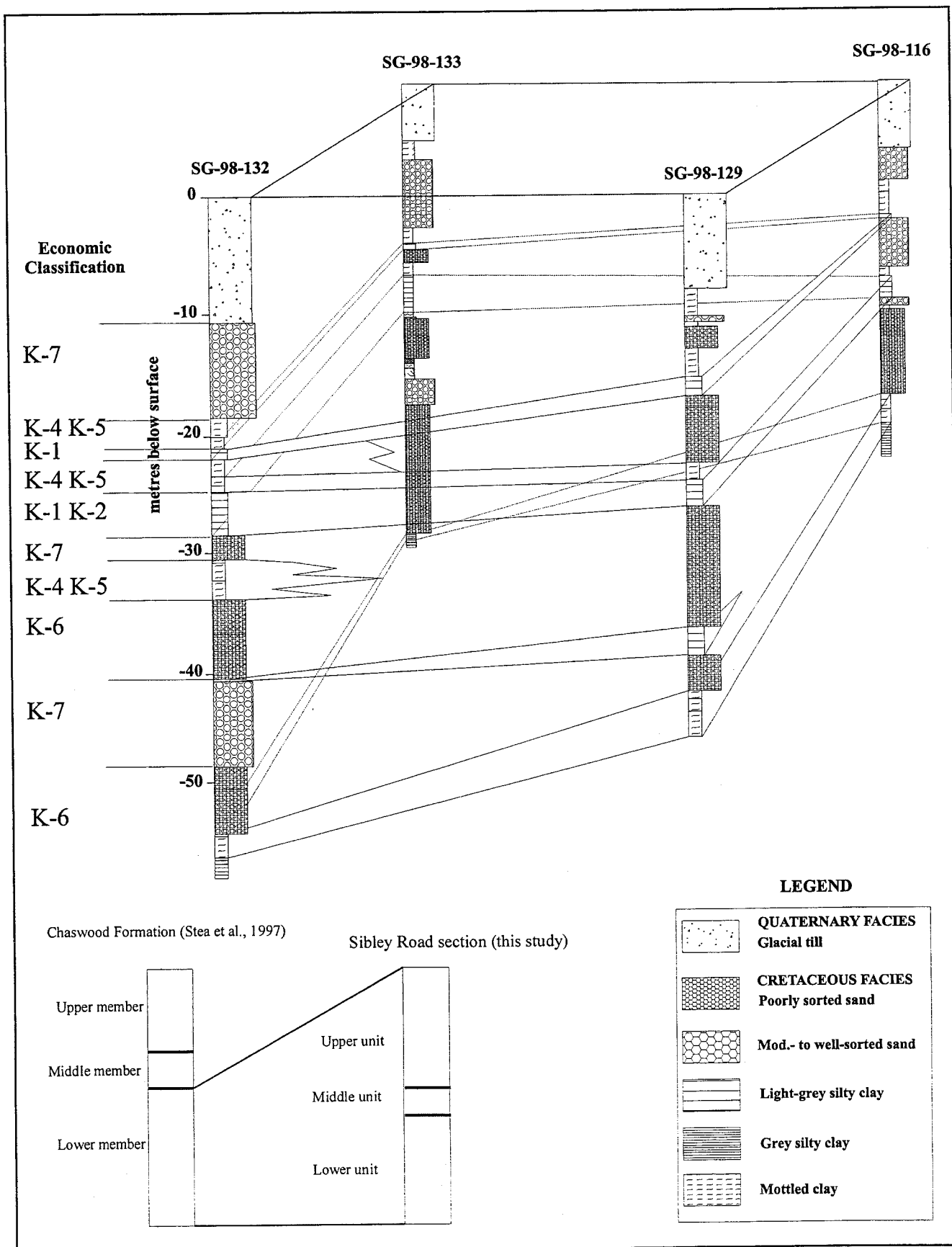


Figure 3. Stratigraphy of the upper Sibley Road unit in the Sibley Road drill grid and correlation of economic units.

produced high-brightness kaolin but the clay yields are lower (Finck *et al.*, 1998). Figure 3 is a correlation of the K units and sediment lithofacies from four representative drillholes from the upper Sibley Road unit on the Sibley Road grid. The K-1 and K-2 units are roughly 2 m thick in this section and, if consistent within a 100 m by 100 m area, would represent approximately 20,000 m³ of raw clay or 42,000 tonnes. Across the entire 3 km³ grid in the Sibley Road area the total tonnage of clay units K-1 to K-7 is estimated to be 172 million tonnes. To confirm correlation of individual clay layers and to test the consistency of the clay layers, drilling at 50 m centres is now being undertaken.

Kaolin Beneficiation Trials

To date, Kaoclay's technical consultants have developed effective lab-scale beneficiation processes for all of the clay units that achieved paper-grade specifications for brightness. Pilot plant testing of selected samples is required in order to verify the lab-scale work and to determine the economic viability of the beneficiation processes developed for the various clay types. Detailed processing results of kaolin samples from other areas in the Musquodoboit Valley are available (Finck *et al.*, 1998) and have shown that production of a variety of filler-grade and calcined-coater grade kaolin products is possible.

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