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New Discoveries of Silica Sand and Kaolinite near Brierly Brook, Antigonish County

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Introduction

In 1986, the senior author discovered an unusual occurrence of white silica sand and variegated clay beneath a surface till while mapping surficial deposits near Antigonish. In this report we will briefly describe the occurrence and evidence for a widespread extent of these pre-Quaternary sediments in the Antigonish Basin. Similar deposits in Nova Scotia are used to make bricks and glass, and for other economic uses.

Location and Geological Setting

The Brierly Brook occurrence is located on a hillslope along the Brierly Brook back road, 5 km west of Antigonish (Location A; Fig. 1). It is situated along the northern flank of the Antigonish Basin on the north side of Brierly Brook. The steep hillslope represents the contact of the Precambrian Antigonish Highlands basement massif with Carboniferous lowland rocks, including gypsum which outcrops south of Brierly Brook (Fig. 2; Boehner and Giles, 1982).

Description and Chemical Analyses

The exposure shows 3 m of brownish, coarse- to medium-grained quartzose sand which appears white in weathered sections (Fig. 2). Overlying the quartz sand is a reddish-brown silty till 2-5 m thick. The base of the sand deposit is not exposed. The coarse sediment features subrounded granules to pebbles and subangular to subrounded sand-sized grains. Its brownish colour is likely derived from downward-percolating clay and soil from the till cap. The sediments exhibit fining-upward cycles of pebbly-gravelly sand to medium sand and clay-silt layers. 10 to 20 cm thick bands of sediment stained dark purplished-red appear discordant to bedding in parts of the section.

A sand sample (# 95-1-4) was submitted to the Minerals Engineering Centre (Technical University of Nova Scotia, Halifax) for chemical analysis. The sample was wet-screened at 0.063 mm, to remove clay and fine-grained Fe-Mn oxides derived from overlying tills. The sand fraction (-2.0 mm +0.063 mm) was used for analysis. SiO_2 content of the sand fraction exceeded 99% with trace amounts of other major oxides (Table 1).

Spherical and lenticular clay masses armoured with coarse quartz pebbles were found within the coarser sediment layers. Some of the clay masses were imbricated. The clay contained within some of the armoured clay balls is whitish and very plastic.

Table 1. *Chemical analysis of sample #95-1-4. Sand analysis from Shaw Resources West Indian Road silica sand quarry.*

Major Oxides	Sample # 95-1-4	Sand-Blast Sand	Glass Sand
SiO_2	99.40	97.80 %	99.5 %
Al_2O_3	0.26	0.30 %	0.25 %
Fe_2O_3	0.096	0.44 %	0.025 %
Ti_2O_3	0.03	0.70 %	0.05 %
CaO	0.49	0.30 %	0.03 %
MgO	0.20	0.01 %	0.005 %
LOI		0.30 %	0.14 %

A clay ball sample (# 95-1-2) was beneficiated using a centrifuge to remove sand and silt impurities and analyzed for major oxides (Table 2), also at the Technical University of Nova Scotia. Differential thermal analysis (DTA) was used to identify the clay mineral phase present. DTA

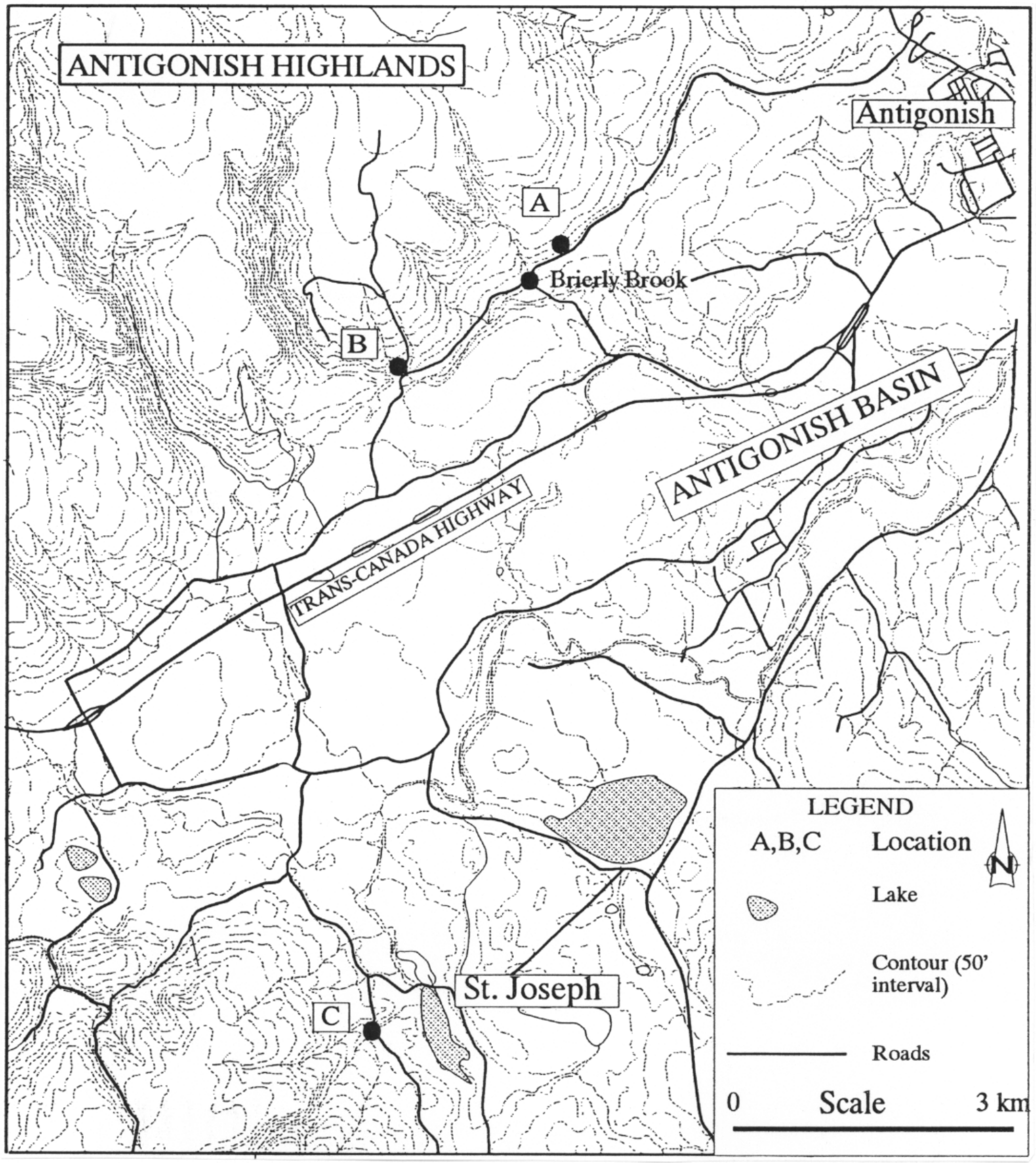

Figure 1. Location of silica sand occurrences in the Antigonish Basin, Antigonish County.

records exothermic and endothermic reactions upon heating. The clay mineral phase in the ball is kaolinite based on the similarity of DTA reactions between the sample and a control sample of kaolinite (Fig. 3) and chemical analysis (Table 2).

Extent of Deposits

Variegated clay deposits with lignite were also found at the base of a gravel pit along the Brierly Brook back road (Location B; Fig. 1). A drillhole near St. Joseph (Location C; Fig. 1) described by Burton (1974) encountered quartz (silica) sand underneath 40 ft. of gravel forming part of a kame terrace (Stea and Myers, 1990). The hole was abandoned in silica sand after 110 ft. These occurrences are all situated along the flank of the Antigonish Basin (Fig. 1) and may either be isolated, sheltered remnants of formerly extensive deposits (possibly stripped by glaciations), or may represent 'windows' into a much thicker and more extensive paleovalley hidden beneath thick drift cover in the basin centre. These outcrop 'windows' could be produced by stream-gulley erosion into thinner drift at the valley sides. The latter interpretation has been borne out by detailed seismic surveys and drilling in the Shubenacadie Basin.

Discussion

The unique, quartz-dominated mineralogy of these

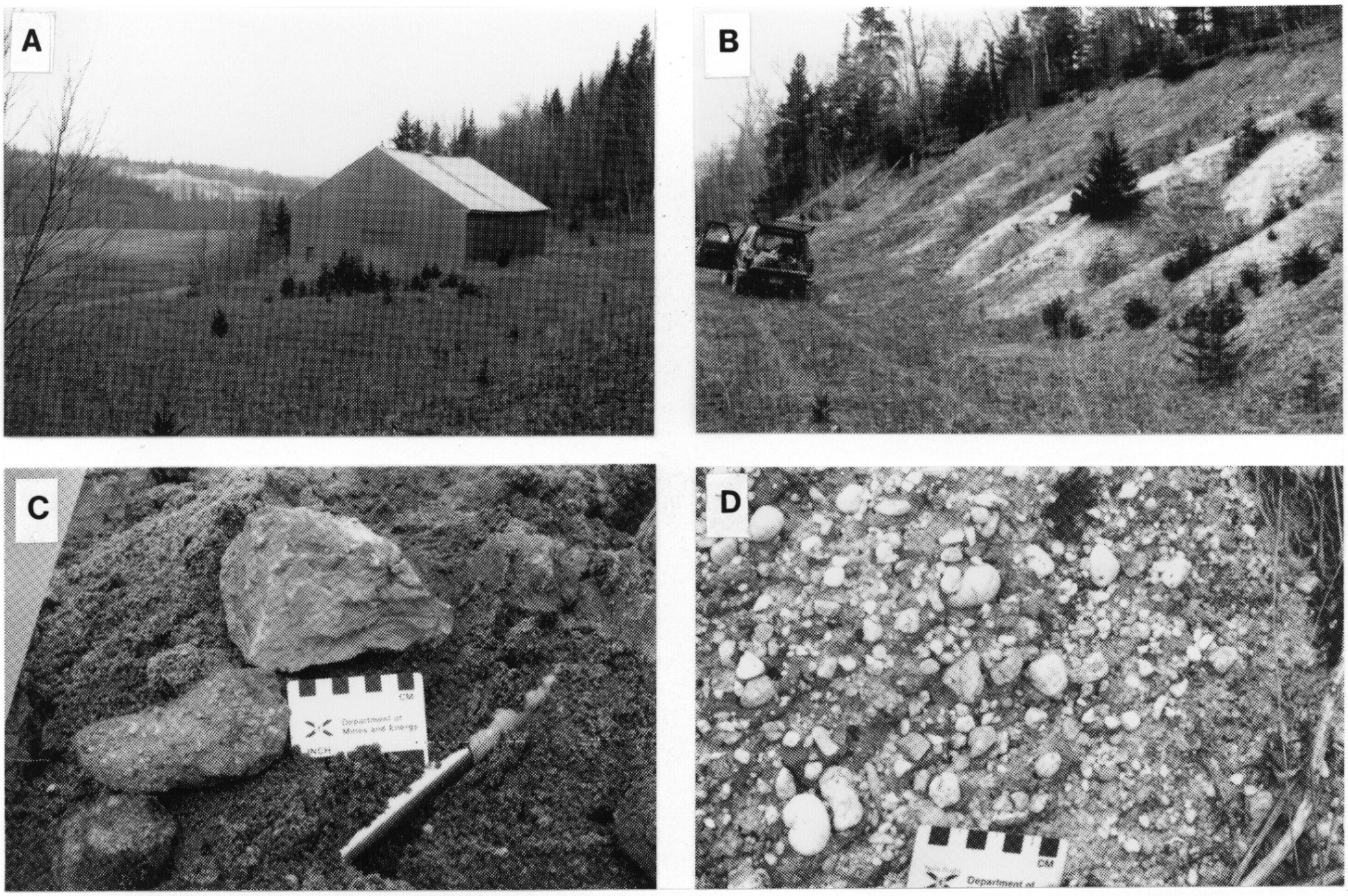

Figure 2. Photographs of the Brierly Brook silica sand occurrence. (A) View of local terrain. (B) View of section. (C) Close-up of armoured clay balls. (D) Close-up of section.

Table 2. Oxide analyses of clay ball, sample 95-1-2, compared to industry standards (units are percentages).

	SiO_2	Al_2O_3	Fe_2O_3	K_2O	Na_2O	CaO	MgO
Sample # 95-1-2	47.28	37.44	0.45	0.49	0.07	0.07	0.39
Standard porcelain	47	38	0.39	0.80	0.15	0.10	0.22
Earthenware tableware	48	37	0.07	1.85	0.10	0.06	0.30
Sanitary ware	48	37	1.00	2.00	0.10	0.07	0.30

sediments and the presence of lignite suggest that they are related to the Lower Cretaceous (Barremian to Aptian) sediments found in the Shubenacadie Basin (Dickie, 1989). The presence of armoured mud balls (Pettijohn, 1975) and fining-upward cycles suggests a fluvial origin (Stea and Fowler, 1981). The absence of feldspar in fluvial sediments is a paradox (Table 1). Either feldspar was removed post-depositionally by intrastratal solution (Dickie, 1989) or the mineralogy represents intense weathering of the source areas prior to deposition (Stea and Fowler, 1981).

Silica content in sand from the Brierly Brook occurrence meets glass-sand standards (Table 1), after only a crude

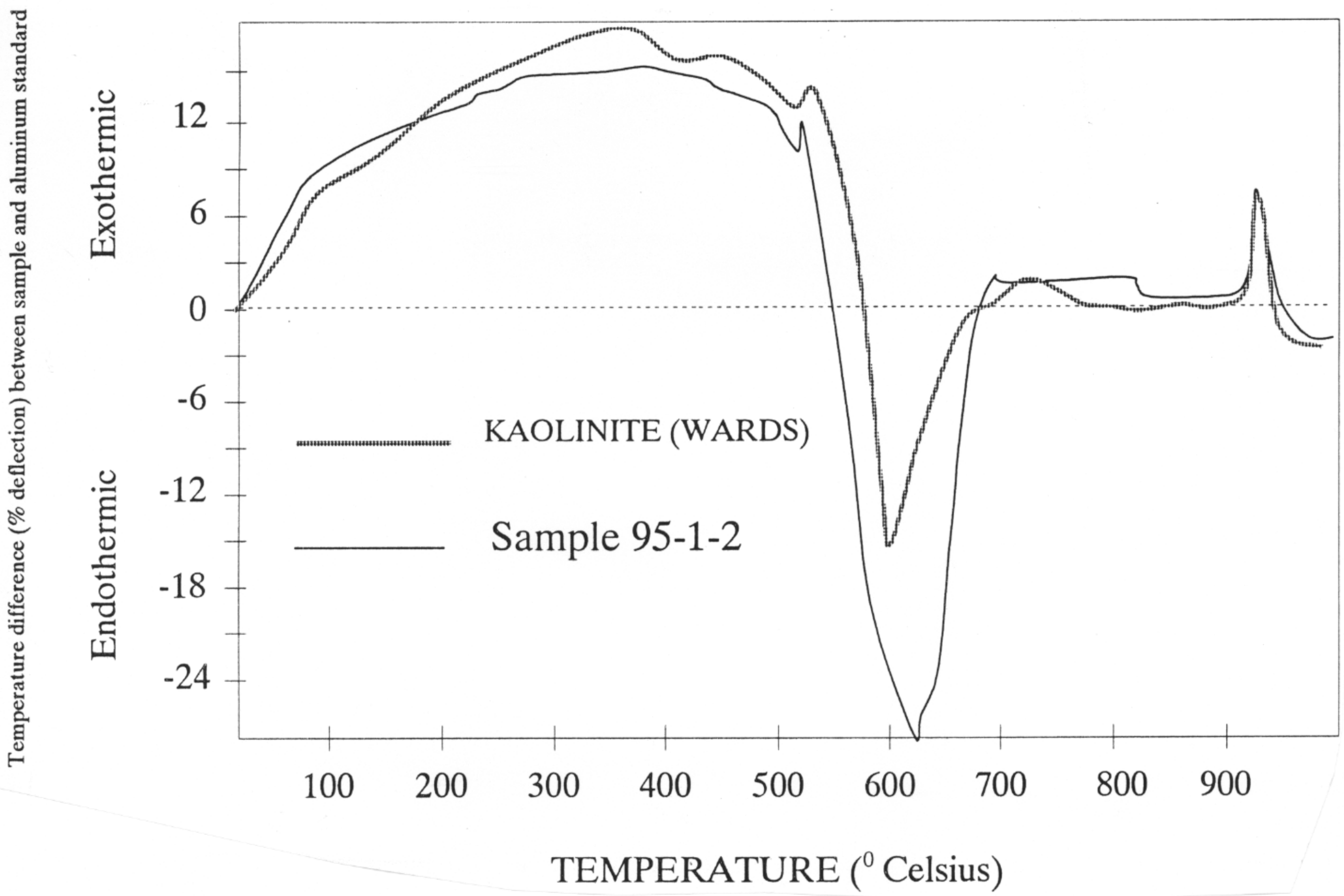

Figure 3. *Differential thermal analysis of clay in the clay ball sample (#95-1-2) compared to standard (Ward's) kaolinite.*

grain-size beneficiation. Kaolinite from the clay ball is close to ceramic-grade, based on oxide analysis (Table 2), again with only a crude grain-size beneficiation. These results are promising and further work is warranted on this site to determine extent and tonnages.

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