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THE PALYNOLOGICAL AND GEOCHEMICAL STRATIGRAPHY OF LAKE SEDIMENTS, SOUTH-CENTRAL NEWFOUNDLAND

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ABSTRACT

During July 1989, sediment cores were collected from five ponds along the Bay d'Espoir Highway, Newfoundland. Analyses of the palynological and geochemical stratigraphy of these cores reveal information about the final deglaciation and postglacial environmental changes in this part of the island. Chronologies will be determined by radiocarbon dating. To date, field work and preliminary laboratory analysis have been completed, and these results are presented here.

INTRODUCTION

The primary objective of this project is to provide further information on the Quaternary history of south-central Newfoundland; in particular, the timing and pattern of deglaciation, and also, possibly the extent of Late Wisconsinan ice on the south coast, which is not yet clearly defined (Grant, 1975, 1977; Rogerson, 1982; Leckie and McCann, 1983). The secondary objective is to describe the early postglacial environmental history of the area, from the initial colonization of the area by pioneer tundra vegetation to the establishment of forest; this will be reconstructed using the pollen and geochemical stratigraphy. Finally, the degree of variation in the geochemical composition of lake sediments with time, will be considered. Natural variations of metal values with time, and therefore with depth in the sediment, may have implications for interpreting lake sediment data in regional geochemical surveys.

PREVIOUS WORK

Several authors have used pollen analysis of lake sediments to reconstruct the late glacial and early postglacial history of Newfoundland, including Macpherson (1981, 1982, 1985), Mellars (1981), Anderson (1983), Macpherson and Anderson (1985), and Dyer (1986) on the island; and Morrison (1970), Short and Nichols (1977), Short (1980), Lamb (1980, 1982, 1984), Engstrom and Hansen (1985), and King (1985) in Labrador. Geochemical stratigraphy of lake sediments has been used in conjunction with pollen stratigraphy to reconstruct the paleoenvironment of southeastern Labrador (Engstrom and Hansen, 1985), but the present study is the first to use this approach in insular Newfoundland.

FIELD AND LABORATORY WORK

In July 1989, sediment cores were collected from five ponds along the Bay d'Espoir Highway (Route 360, Figure 1). Duplicate cores were recovered from each site to provide enough sediment for loss-on-ignition analysis, radiocarbon dating, and pollen and geochemical analysis. Pollen analysis has previously been completed on a core from the Conne River site by Dr. J.B. Macpherson, Memorial University (unpublished data). A duplicate core has been taken from this lake for geochemical analysis.

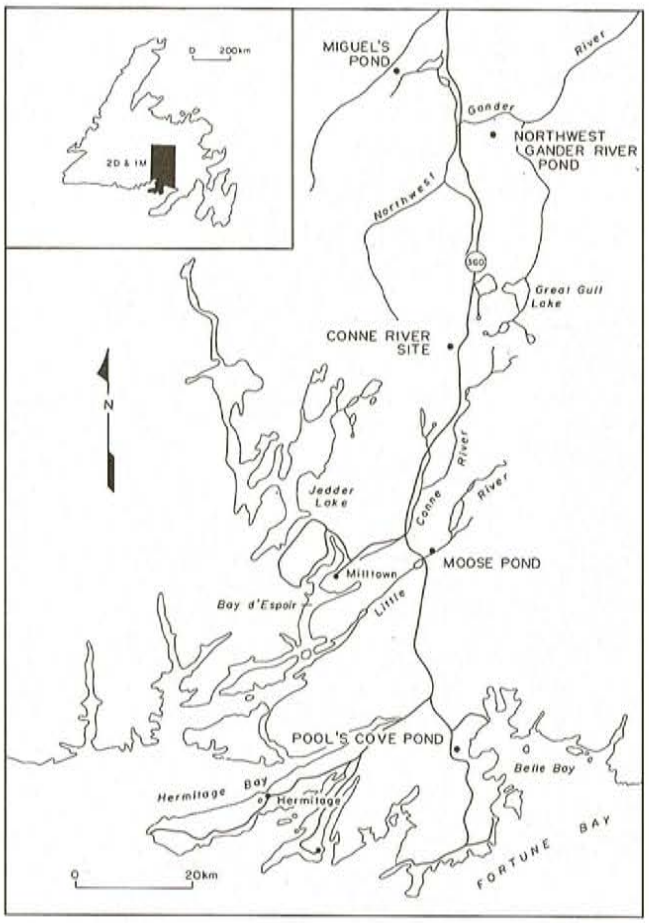

Figure 1. *Location of study area.*

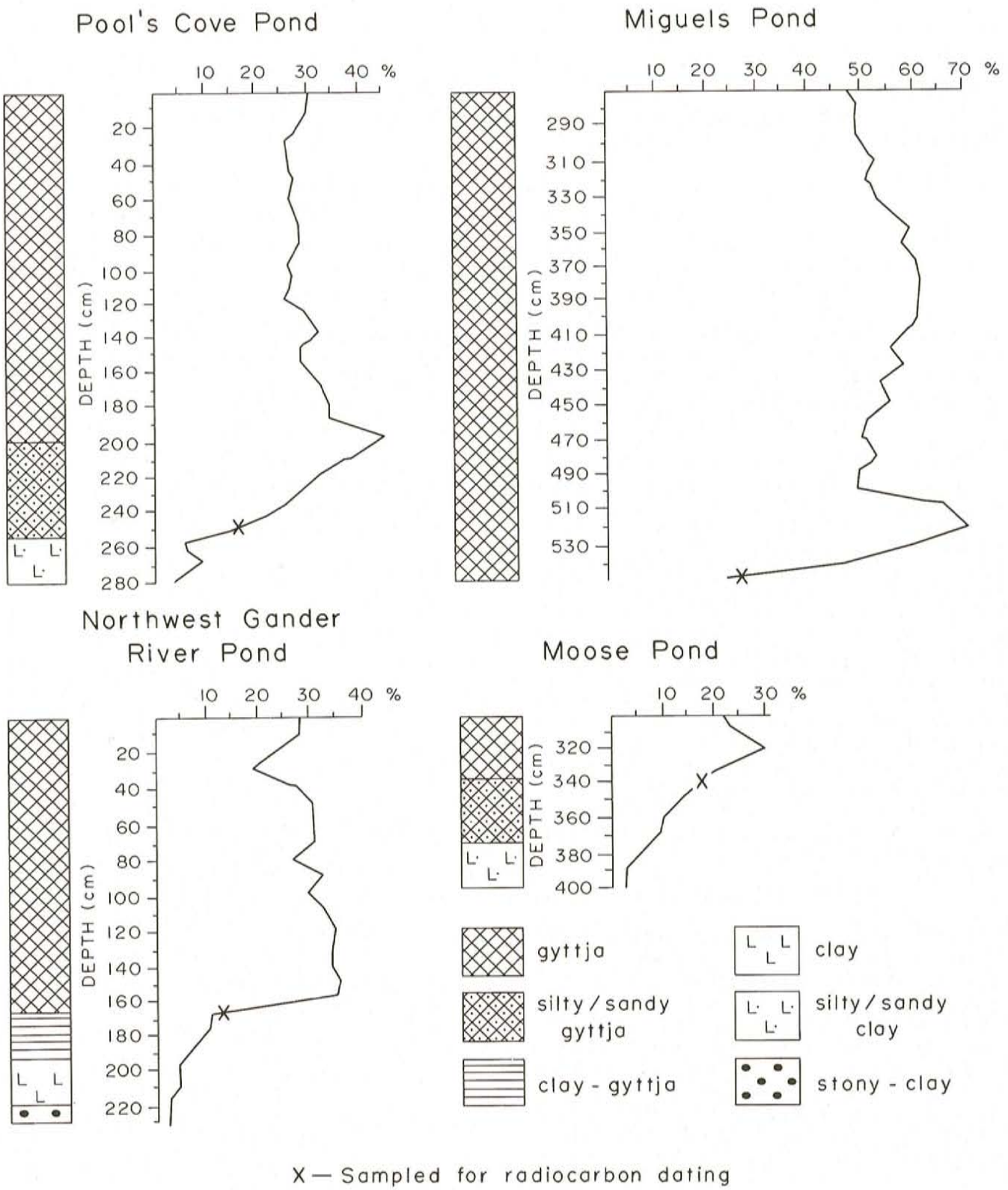

Figure 2. *Sediment stratigraphy and loss-on-ignition profiles of sediment cores collected from four ponds along the Bay d'Espoir Highway.*

In the laboratory, the cores have been described in terms of their stratigraphic changes in physical properties and composition. The sedimentology of the cores from all ponds, except the Conne River site, is depicted in Figure 2, along with the corresponding loss-on-ignition curves. Loss-on-ignition analysis has been done on the sediment samples, at 10-cm intervals, from the base of the cores from each of the four sites. This provides an approximation of the organic matter content of the sediment.

POLLEN ANALYSIS

For this study, pollen analysis will be carried out on only the basal sections of cores from the Pool's Cove Pond, Moose Pond, and Northwest Gander River Pond sites. Samples processed for pollen analysis have been extracted at intervals of 5 cm, and analysis will be done up to the level where the pollen spectra indicate the presence of a complete forest cover. Sediment samples will be processed using the standard method of Faegri and Iverson (1975), which involves the treatment of 1 ml samples with a variety of acids and bases to remove most of the unwanted sediment matrix, leaving a residue rich in pollen and spores. The pollen-rich residues will be stained with safranin to bring out the surface characteristics of the grains and mounted on glass slides in silicone oil for pollen identification and counting. A known quantity of exotic Eucalyptus pollen will be added to each sample prior to processing, to allow calculation of pollen concentration and influx values. Sections of sediment from the lowest part of each core having enough datable sediment, as determined by loss-on-ignition analysis, have been extracted and sent to the Geological Survey of Canada (GSC) for radiocarbon dating. An additional sample from each core will be radiocarbon dated, to provide control for the calculation of sedimentation and pollen influx rates. The levels from which samples for dating have been extracted are indicated in Figure 2.

GEOCHEMICAL ANALYSIS

Geochemical analysis provides a further method of paleoenvironmental reconstruction, and will be used in this study to complement the evidence obtained from pollen analysis. Geochemical processing of samples from the lake sediment cores will be done in the laboratory of the Department of Mines and Energy. The elemental composition of the lake sediments (Al, Ca, Fe, K, Mg, Mn, Na, P, Si and Ti) will be divided into allogenic and authigenic fractions by selective geochemical extraction, as recommended by Engstrom and Wright (1984) and Engstrom and Hansen (1985). This separation should help define the geochemical history from heterogeneous lake muds, as different environmental information may be obtained from each sedimentary component.

According to Engstrom and Wright (1984), the geochemical sequence should begin with predominantly inorganic sediments deposited in the early Holocene under pioneer tundra vegetation, having a high concentration of allogenic Na, K, Mg and Ca derived from the erosion of barren soils. With the gradual expansion of shrub cover and then coniferous forests, there should be an increase in the organic content of catchment basin soils and a decrease in mineral erosion and the allogenic component of the lake sediments. Concentrations of humic materials and redox-pH-sensitive elements of authigenic origin, such as Fe, Mn, P and Al, should increase markedly with the invasion of conifers. This represents decreased erosion of clastic minerals and increased mobilization of organometallic complexes from waterlogged soil, produced through humus accumulation under coniferous vegetation.

In addition, the lake sediments will be analyzed for other elements, including Ag, Au, Ba, Br, Co, Cu, F, Ni, Pb, U, Zn and others, to determine the degree of variation of elemental concentrations with depth in lake sediments. This data may have implications in the use of lake sediments as a sample medium for geochemical mapping (cf., Davenport, 1982).

SUMMARY

The objectives of this study are to use pollen and geochemical analysis of lake sediments to:

1) provide information about the timing and pattern of the last deglaciation of south-central Newfoundland, and about the extent of the Late Wisconsinan ice in the southern part of the study area;
2) reconstruct the early postglacial environmental history of the area, from the initial colonization of the area by pioneer tundra vegetation through to the establishment of forest; and
3) determine how much natural variation exists in the geochemical composition of lake sediments with time.

Analysis and interpretation will continue and the results are expected to be completed by fall 1990.

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