

REGIONAL REVIEW OF THE NOVA SCOTIAN OUTER MARGIN

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INTRODUCTION

This paper reviews the literature pertaining to the marine geology of the outer continental margin off Nova Scotia, eastern Canada. It was carried out as part of a more detailed study of the late Quaternary stratigraphy and sedimentation of the area (Stow 1975, 1976, 1977a, b), and is now written to include some of the results of that work. The final section is the author's interpretation of the depositional history of the outer margin (Stow 1977a and in preparation). Several studies are still in progress in the region. It is hoped that the present synthesis will be of use to these, and also serve to summarize some of the more interesting features of outer margin deposition.

GEOLOGY OF EASTERN CANADA

Mainland eastern Canada bordering the West Atlantic Ocean lies within the Appalachian orogen (Fig. 1). It has been affected by a series of orogenic disturbances of varying intensities and ages in different parts (Neale *et al* 1961, Poole 1967); and now comprises areas of highlands, uplands and lowlands rarely exceeding 600 m in elevation. The rocks are mostly Palaeozoic in age with metamorphosed Precambrian outcrops in Cape Breton, southern New Brunswick and Newfoundland representing crystalline basement (Williams *et al* 1972, 1974). Flysch sequences are common, comprising quartz metawacke, slate, graywacke and argillite; and are followed by Carboniferous to Triassic molasse - carbonates, red beds, some coal measures and diabase sills and dykes; and the Devonian granite uplands of Nova Scotia. The extension of this geology offshore has been reviewed by Sheridan and Drake (1968), Williams *et al* (1974) and King *et al* (1975).

Other regions of eastern Canada which are of importance as source areas for the outer continental margin sediments are the St. Lawrence lowlands (Loring and Nota 1973) and the Laurentian region of the Grenvillian province (Wynne-Edwards 1972). The former comprises low-lying (mostly below 200 m), flat-bedded, Palaeozoic sediments (shales, limestones, and dolomites) and minor alkali igneous rocks. The latter is a rocky, stream-dissected plateau of about 600 m elevation and more than 1000 m in places. It is made up largely of old, hard, Precambrian crystalline rocks including granites, granodiorites, anorthosites, gneisses and schists, overlapped by thin Ordovician limestones and shales.

QUATERNARY HISTORY AND SEA-LEVEL CHANGES

There have been several extensive studies of the Quaternary of North America (Flint 1951, Wright

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and Frey 1965), and of late Quaternary glaciations in eastern Canada (Prest and Grant 1969, McDonald 1971, Dreimanis 1971, Grant 1975, Tucker 1976). The chronology of events is not entirely clear as much of the record on land is patchy and incomplete.

It appears that the Wisconsin glaciation was less severe than earlier ones, and local ice caps were developed over eastern Quebec, New Brunswick, Nova Scotia (Grant 1971, Grant and Prest 1975), and Newfoundland (Jenness 1960, Brookes 1970). Ice-flow centres on the present continental shelf have been proposed by Grant (1971) and Gravenor (1974). The effect of these various ice centres was to divert the Laurentide ice through the Laurentian Channel to the Atlantic Ocean. A major ice stream was proposed for this area by Hughes *et al* (1977).

King (1969) and King *et al*. (1972) have noted a submarine moraine complex on the inner Scotian Shelf, which they believe marks the terminal position of the late Wisconsin ice sheet. Relict iceberg furrows in the Laurentian Channel are direct evidence for an ice front and berg-carving, probably in Wisconsin times (King 1976).

Sea-level changes on the eastern Canadian continental margin have been complex. The pattern of ice retreat in the Maritimes has been shown to relate to a rising sea level from about 18,000 to 11,000 years B.P. (Prest and Grant 1969, Prest 1970). Wightman (1976) discussed evidence of emergence in northern Nova Scotia and surrounding areas. He showed that emergence decreased in a southeast direction across the Province. Specific loci of glacial rebound at St. John and Chaleur Bay, New Brunswick, were related to nearby outflows of Laurentide ice, and significant rebound in northern Newfoundland was thought due to the proximity of Labrador ice. Submergence in the eastern Prince Edward Island-Cape Breton region, he interpreted as a result of ice thinning adjacent to deep ice in the Gulf of St. Lawrence Channel. The various problems related to isostatic rebound after glacial loading and crustal warping are discussed by Walcott (1972) Farrel and Clark (1976) and Beaumont (1977).

It seems clear from evidence of submerged terraces on the outer Scotian Shelf that the maximum low stand of sea level in this area was about 120-m between 19,000 and 15,000 years B.P. (Shepard 1963, Stanley *et al* 1968, King 1970). The existence of salt marshes and freshwater peat on Georges Bank suggest that this was a tree-covered island at about 11,000 years B.P. Vilks and Rashid (1976) infer marginal marine to estuarine conditions for Emerald Basin at about 15,000 years B.P. from foraminiferal and geochemical evidence. Much of the Scotian Shelf, then, was exposed to sub-aerial influences through the last glacial period. Earlier

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