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Environmental Aspects of Foraminifers of Late Jurassic to Early Cretaceous Deposits, Mackenzie Delta, Northwest Territories, Canada

by

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Abstract

Foraminiferal assemblages in the Husky Formation and Buff Sandstone Member of Late Jurassic to Early Cretaceous age in the Mackenzie Delta — Richardson Mountains region, N.W.T., are divisible into four microfaunal facies. These are: coastal to intertidal, restricted marine, subtidal shelf, and normal marine. The stratigraphic distribution of the microfaunal facies suggests that the region underwent a major transgressive-regressive cycle during deposition of the Husky shale and Buff sandstone. The lateral distribution of the facies across the basin indicates well-defined areas of normal marine and of restricted conditions. Sedimentological evidence suggests that restricted conditions were the result of an influx of fluvial sediment.

Zusammenfassung

Im Spätjura und in der Frühkreide führte eine Meeresstraße vom Arktischen Ozean nach Südwesten, wobei sie das tektonische Hochland im Westen vom stabilen Craton im Osten trennte. Die Schiefer der Husky-Formation, die in der Meeresstraße abgelagert wurden, und der darüberliegende Buff-Sandstein wurden auf Foraminiferen untersucht aus Bohrproben vom Mackenzie-Delta und aus Aufschlußproben von den im Westen angrenzenden Richardson Mountains. Die Mikrofauna der beiden Gesteinseinheiten läßt sich in vier Foraminiferenfazies einteilen: Küsten- und Gezeitenfazies, beschränkt marine Fazies, Schelf unterhalb der Gezeitenzone und normal marine Fazies. Die stratigraphische Anordnung der vier Fazies weist auf einen größeren Transgressions-Regressionszyklus während der Ablagerung der Husky- und Buffsedimente hin mit maximaler Ausdehnung der Transgression im mittleren Husky. Die horizontale Verteilung der Fazies innerhalb der Meeresstraße läßt die Existenz von beschränkt marinen und normal marinen Faziesbereichen nebeneinander erkennen. Sedimentologische Untersuchungen zeigen, daß die fortgesetzte Zufuhr fluviatiler Sedimente sowohl für die beschränkt marinen Bedingungen als auch für deren Verteilung innerhalb der Meeresstraße verantwortlich sind.

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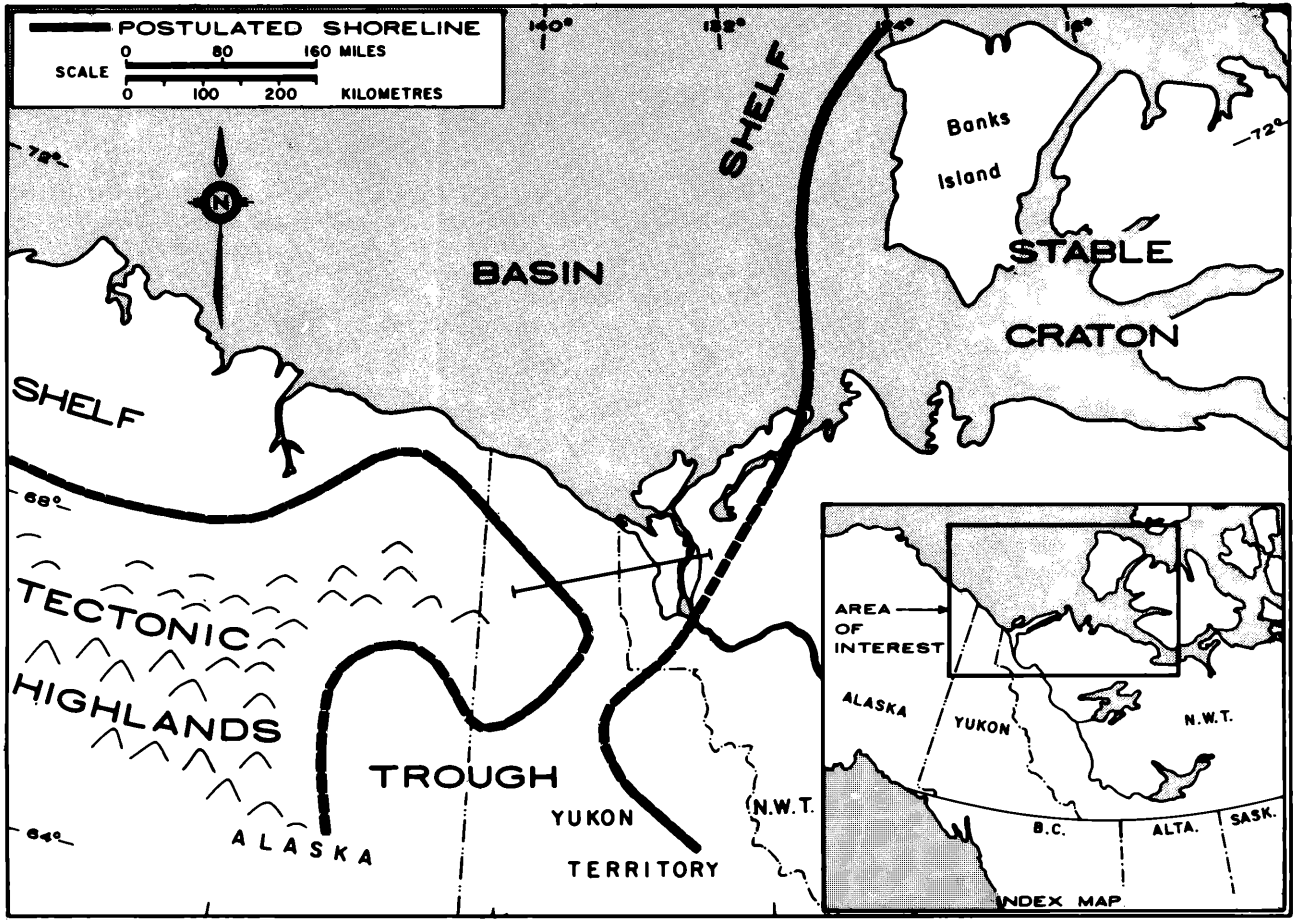

Introduction

During Late Jurassic and Early Cretaceous the area of the present Mackenzie Delta and Richardson Mountains formed part of a major northeat-southwest trending seaway that separated the craton to the east from the tectonic highlands to the west (Fig. 1). The seaway was bounded on the east by the Eskimo Lakes Arch, a linear, Paleozoic, anticlinal structure which became submergent in mid-Mesozoic time (COTÉ et al, 1975). On the western flank of the arch is a series of growth faults, the Eskimo Lakes Fault Zone, across which Mesozoic and Tertiary strata thicken rapidly basinward (Fig. 2).

The Husky Formation which was deposited in this seaway consists of marine shale which in its lower part is Late Jurassic, and in its uppermost part earliest Cretaceous in age. The overlying Buff sand is the basal member of the Early Cretaceous Parsons Sandstone which has been extensively drilled for its hydrocarbon reserves. The occurrence of bioturbation and burrowing as well as current structures in the Husky and Buff sediments indicate that both units are relatively shallow water deposits (COTÉ et al, 1975; MYHR and YOUNG, 1975).

The purpose of this paper is to reconstruct the palaeoenvironment of the Husky Formation and the Buff Sandstone Member using primarily microfauna data obtained from subsurface samples of ten wells across the Mackenzie Delta area, and from two outcrops in the adjacent Richardson Mountains.

Foraminiferal Environments

On the basis of contained faunal assemblages the Husky Formation and the Buff Sandstone Member are divisible into four microfaunal facies interpreted as coastal to intertidal, restricted marine, subtidal shelf, and normal marine (Fig. 3).

The stratigraphic variation of the microfaunal facies provides a record of transgressive and regressive events between early Berriasian and early Valanginian time. A major transgression which had begun with deposition of the basal Husky shale culminated with deposition of the middle Husky in middle Berriasian time. Following the transgression a regressive phase began which continued throughout deposition of the upper Husky and Buff Sandstone Member, and by the close of the Buff Member deposition widespread restricted conditions prevailed across most of the seaway. In addition to the major events numerous minor transgressive and regressive fluctuations occurred.

The only planktonic foraminifers in the Husky Formation occur adjacent to the margins of the seaway. The occurrence of planktonics there suggests the presence of an open sea connection, or at least a decreased influx of sediment from the adjacent low land areas. The absence of planktonic and other calcareous species

Fig. 1: Location map with paleogeographic features at Husky — Buff time. Modified from Lerand, 1973, Fig. 35. Location of section shown for Figs. 2 and 3.

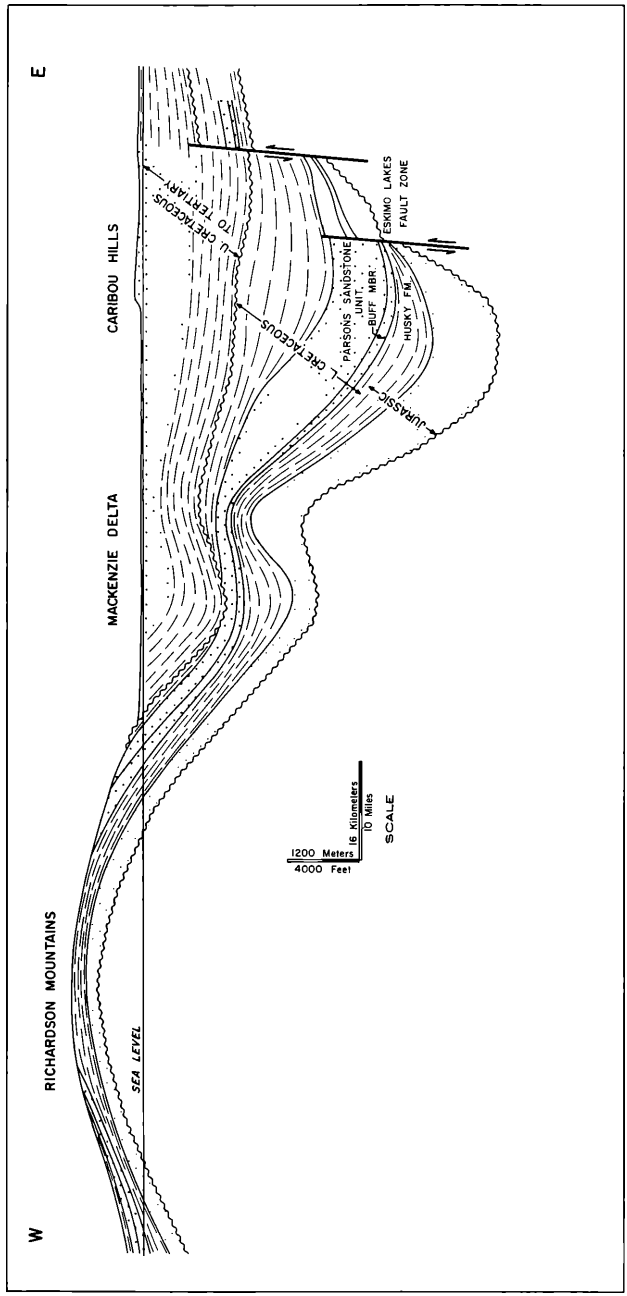

Fig. 2.: Structural cross section through Richardson MTNS. to Mackenzie Delta, N.W.T.

in the central region of the seaway suggests adverse conditions existed throughout deposition of the Husky Formation and Buff Sandstone Member.

From the pattern of the faunal facies (Fig. 3) it is apparent that environments were distributed nearly symmetrically across the seaway, presumably in response to similar environmental processes on each side. Sedimentological studies (MYHR and YOUNG, 1975; YOUNG, et al 1976) suggest that, apart from sediment being introduced from opposite sides of the seaway which caused broad fluctuations of the shorelines, a large river system became a major influence beginning in Late Jurassic time. This river is considered to have shed its sediment into the basin from the southeast near the Yukon – N.W.T. border. The sands were dispersed by marine currents to the northeast and northwest and formed offshore sand shoals on the flank and crest of Eskimo Lakes Arch and in the west central part of the seaway. During late Husky time the main depocentre shifted northward fairly close to the location of the line of section (Fig. 1). The resulting environment proved inhospitable to foraminifers in the central section of the seaway for the remainder of the Husky and the Buff Sandstone as shown by the paucity or absence of the microfauna. Only one or two species with an average of less than ten individuals were recovered from well samples in this region. Paucity of species is normal for a restricted environment. However, because of the diminished competition, individuals of the few species adapted to the environment may become numerous if the food supply is sufficient. The reason for an impoverished microfauna in this instance was probably a combination of several factors such as turbulence and rapid sedimentation, which inhibit bottom dwelling foraminiferal communities. Furthermore, there is evidence of subaerial exposure and truncation of the Buff sandstone over Eskimo Lakes Arch and in the west-central basin (COTÉ et al, 1975; YOUNG et al, 1976), the localities which yielded a poor microfauna. It is, therefore, likely that the sand shoals which had been deposited during Buff time may have been periodically emerged.

Conclusions

The distribution pattern of foraminiferal assemblages in the Husky Formation and Buff Sandstone Member appears to be largely related to depositional processes. Fluvial influx was the major factor governing the foraminiferal communities. Low abundance of species and individuals characterize the off-shore sand shoals derived from river sediment. Foraminifers are known to be good environmental indicators, and this study substantiates their reliability for use in paleoenvironmental reconstruction. However, in some instances the palaeoenvironment cannot be determined from the microfauna alone but must be resolved in conjunction with the sedimentological evidence.

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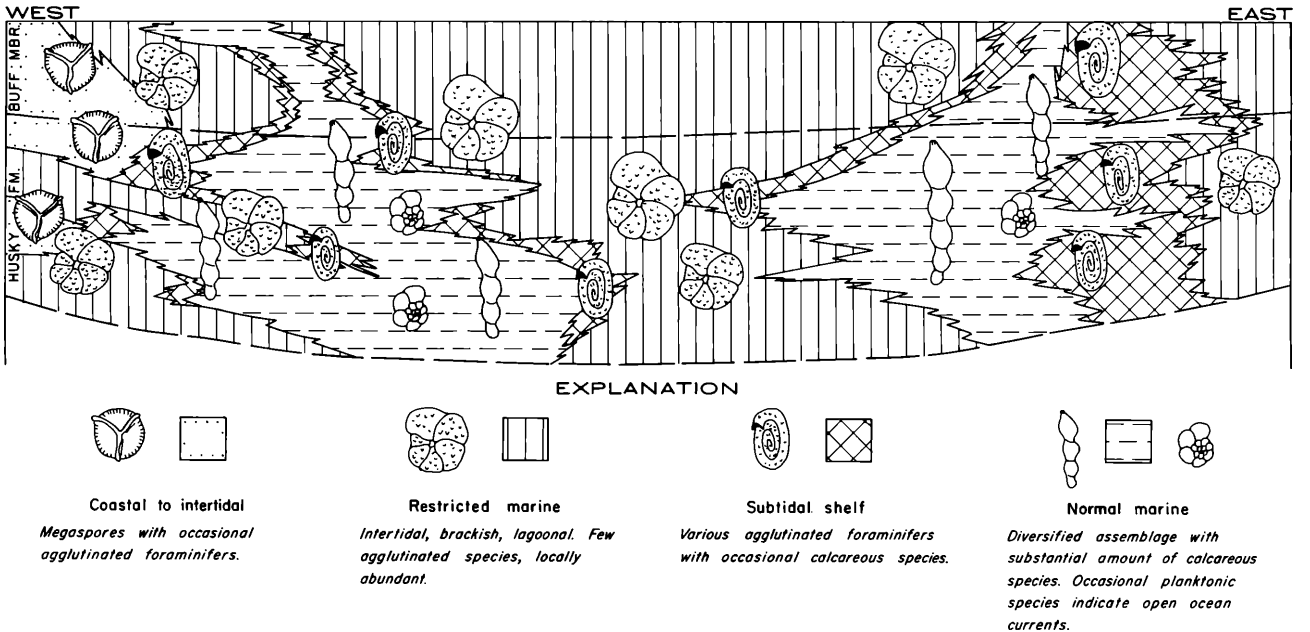

Fig. 3: Schematic biostratigraphic cross-section showing faunal facies within the Husky Formation and the Buff Sandstone Member.

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