# SUBTIDAL SEDIMENTARY FACIES, SOUTHERN MORETON BAY

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(with 3 Text-figures)

ABSTRACT. On the basis of the mud/sand and carbonate content, sediments are assigned to one of four facies: Clean Sand (non-carbonate), Muddy Sand (low carbonate), Mud (low carbonate), or High Carbonate Facies. The spatial distribution of these facies reflects a complex interplay of bathymetric, hydrodynamic, and provenance factors, sea level fluctuations, relict sediments, and changes in the sedimentation patterns during the Holocene.

## INTRODUCTION

This paper is a summary, prepared by P.G. Flood (Department of Geology and Mineralogy, University of Queensland), of the preliminary results of a sediment sampling and analysis programme conducted during 1974-75 and which covers the southern sector of Moreton Bay between Cleveland on the mainland and Dunwich on North Stradbroke Island. The area is traversed by vehicular and passenger ferries working between Toondah Harbour and Dunwich.

A comprehensive account of a combined sediment sampling and geophysical (high resolution boomer and side scan sonar) survey has been submitted by the author as a thesis for the degree of Master of Science at the University of Queensland.

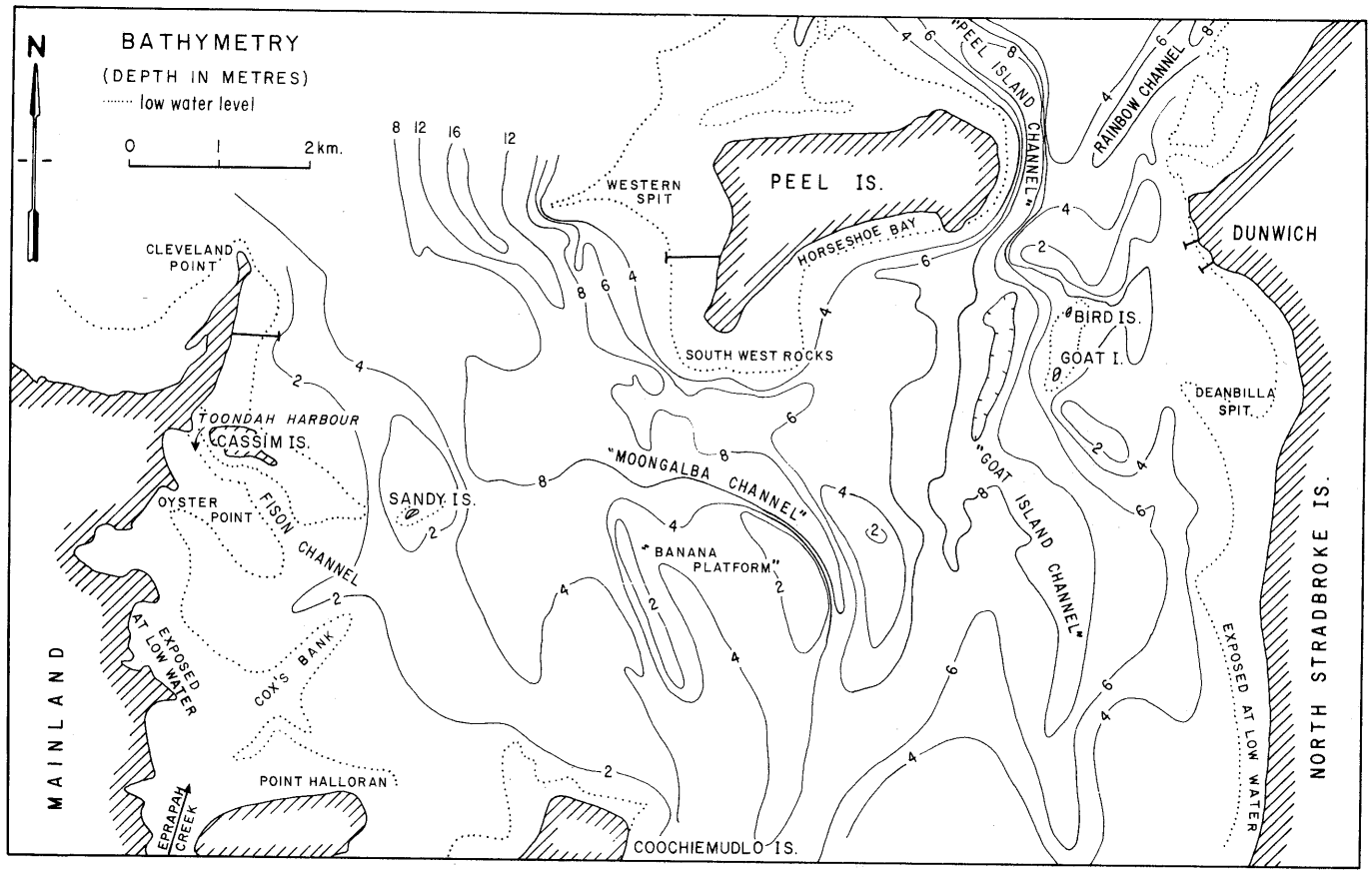
## ACKNOWLEDGEMENTS

Staff members from the Department of Geology and Mineralogy, and from other Departments of the University of Queensland, and officers of the Geological Survey of Queensland assisted in various ways. Professor G.E.G. Sargent supervised the thesis work.

## BATHYMETRY AND DEPOSITIONAL ENVIRONMENTS

The bathymetric character of the area as determined by the Queensland Department of Harbours and Marine is illustrated by Text-fig. 1.

The subtidal area consists of a gently northward sloping concave depression. Shallow areas (usually less than 4 m below low water datum) border the mainland, North Stradbroke Island, and the northern extremity of the bank complex related to the delta of the Logan River. The bathymetric character of the shallow area is related not only to the Holocene progradation of sediment from the tidal flats (mud from the mainland and sand from North Stradbroke Island), but also to a very complex pre-Holocene topo-




Text-fig. 1 Bathymetric character of the southern sector of Moreton Bay between Cleveland Point and Dunwich, and southward from Peel Island to Coochiemudlo Island (after Queensland Department of Harbours and Marine Survey).

graphy (Friederich 1975) related to drowned intertidal flats (see Hekel *et al.* 1976) which now appear as subtidal platforms (e.g. "Banana Platform").

A deeper area (generally about 6 m below low water datum) occupies the central portion. It is traversed by two distinct channel systems which flank Peel Island (nucleus of Mesozoic sandstone with fringing reef development) and which appear to represent palaeodrainage features related to the northward flow of the Logan River during the Pleistocene low stands of sea level (Friederich 1975). Tidal currents keep the mud-sized particles in suspension, whereas sand- and gravel-sized particles may result from the *in situ* addition of skeletal carbonate detritus or reef-derived material. Excluding the area of carbonate sediments west of Peel Island, the central area is characterised by minimal sediment deposition (Hekel *et al.* 1976) suggesting that sediments of Pleistocene age or older characterise any non-depositional areas.

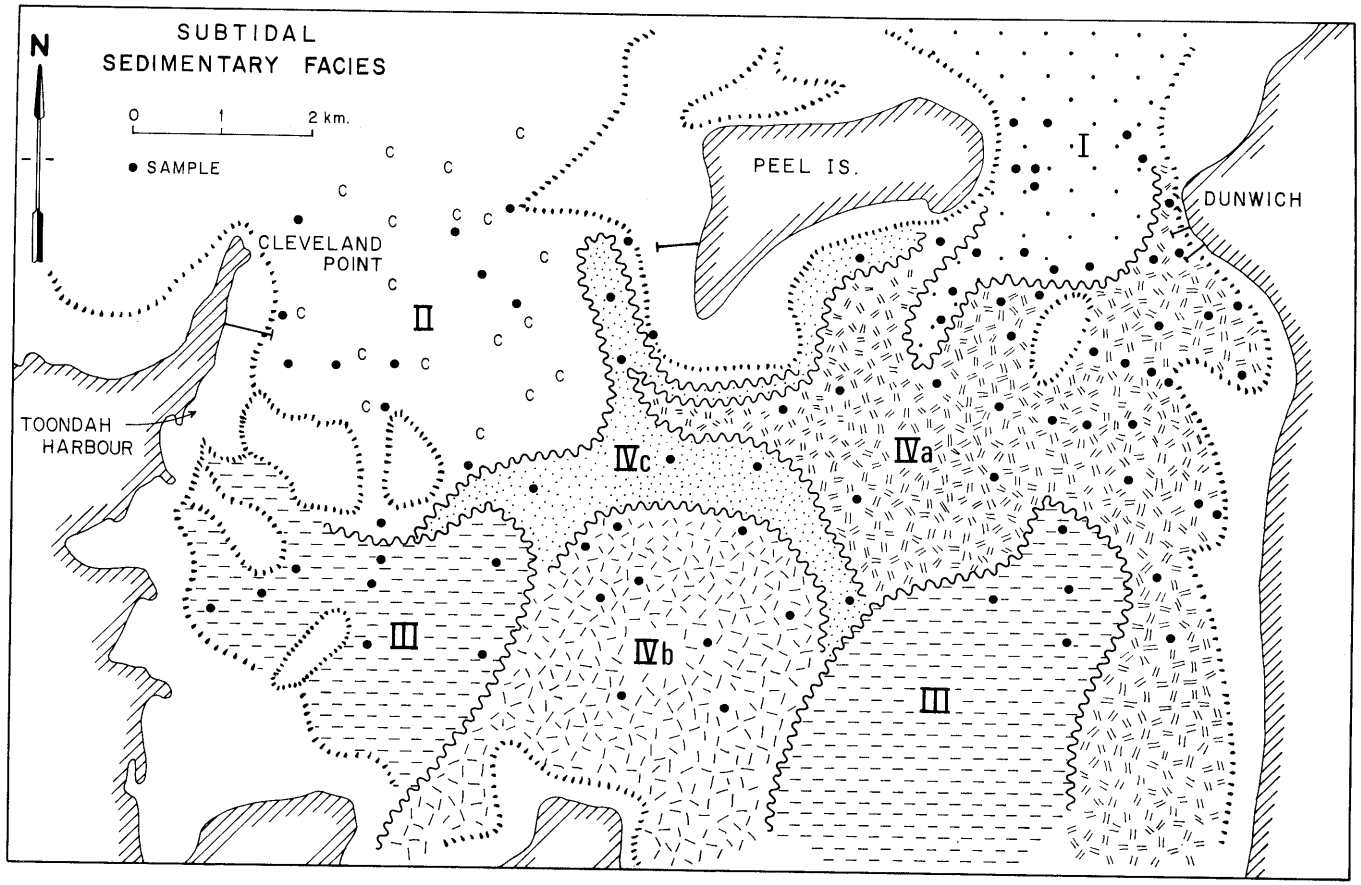
A tidal delta complex occurs between Dunwich and the eastern end of Peel Island. It represents a Holocene accumulation of quartz sand. Flood tide currents transport sand which is derived from the ocean side of the barrier island and which enters Moreton Bay through South Passage (14 km to the north of Dunwich). Ebb tide currents maintain the "Peel Island Channel" and the Rainbow Channel (depths up to 20 m). The prograding margin of the delta has advanced more than 100 m between 1955 and 1972 and it appears that the sand mass eventually will encircle the Bird and Goat Island platform.

Fringing reef complexes occur at Peel, Bird, and Goat islands. Individual reefs are localised on pre-existing topographic highs which have the appearance of resistant lateritic platforms similar to the wave-cut platforms occurring about Toondah Harbour. Features such as the platforms which underlie Sandy and Cassim islands, the bank opposite Oyster Point, and Cox's Bank may represent early Holocene(?) reefal growth which is now covered by up to 0.3 m of mangrove mud indicating a significant environmental change.

## SEDIMENTARY FACIES

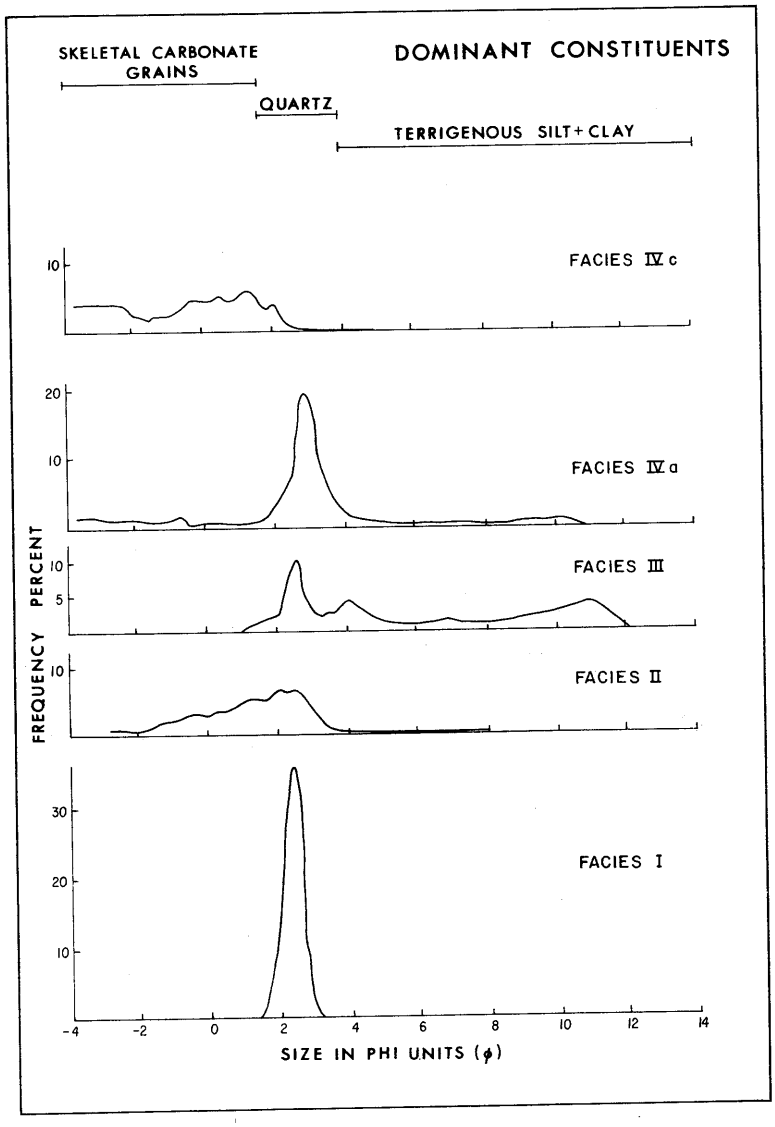
Maxwell (1970), on the basis of the mud/sand or terrigenous/carbonate distribution patterns, recognised six sedimentary facies within Moreton Bay: Mud Facies (greater than 50% mud), Muddy Sand Facies (1 to 50% mud), Clean Sand Facies (less than 1% mud), Non-Carbonate Facies (less than 5% carbonate), Low Carbonate Facies (5 to 40% carbonate), and High Carbonate Facies (greater than 40% carbonate).

In the study area it has been possible to integrate the mud/sand and the terrigenous/carbonate distribution patterns into the following mutually exclusive facies: Clean Sand (Non-Carbonate) Facies (less than 1% mud; less than 5% carbonate); Muddy Sand (Low Carbonate) Facies (1 to 50% mud; 5 to 40% carbonate); Mud (Low Carbonate) Facies (greater than 50% mud; 5 to 40% carbonate); High Carbonate Facies (less than 10% mud; greater than 40% carbonate). The 40% and 50% contour lines of the carbonate contents of the sediments are almost co-linear and therefore the area of the




Text-fig. 2 Subtidal sedimentary facies: I, Clean Sand (Non-Carbonate); II, High Carbonate; III, Mud (Low Carbonate); IV Muddy Sand (Low Carbonate). Subfacies: IVa, Oceanic Sand; IVb, Relict Sand; IVc, Shelly Sand. (All facies' boundaries are approximate).

High Carbonate Facies almost corresponds with the distribution pattern of the carbonate vs. terrigenous sediment types. The spatial distribution of these facies and subfacies is shown in Text-fig. 2, and their grain-size characteristics are shown in Text-fig. 3.




Text-fig. 3 Frequency curves of the weight frequency percent at quarter phi intervals (sieving results) for the sedimentary facies. The dominant constituents which reflect the source of the particles are indicated. See Text-fig. 2 (page 21) for facies names and distribution.

The Clean Sand (Non-Carbonate) Facies is restricted to the area of influence of the tidal delta which is transporting oceanic sand (including reworked dune and beach sands) from the entrance at South Passage south-

ward to the vicinity of Dunwich and Peel Islands. Sediments of this facies are characterised by a sand mode of between 1.75 to 2.25 phi. The sands are very well to moderately well sorted, near symmetrical, and mesokurtic. The sediments reflect the energy of the tidal current regime.

The High Carbonate Facies is restricted to the western part of the bay between Cleveland and Peel Island and northward of Cassim and Sandy Islands. It includes both iron-stained (probably relict) and recent skeletal carbonate particles that are related not only to reefal growth fringing the mainland and Peel Island, but also to the *in situ* addition of molluscs and foraminiferids. The quartz sand component of this facies is dissimilar to the sand of the above-mentioned facies as it derived from sandstone or coastal deposits on the mainland, or the sandstones on Peel Island. The mud contribution rarely exceeds 10%. Sediments of this facies display considerable textural variability because of the *in situ* addition of particles too large to be removed by the prevailing energy conditions.

The Mud (Low Carbonate) Facies is restricted to both the low energy areas in the lee of the intertidal banks and the near shore zone. The western area bordering the mainland derives some of its mud-sized material from Eprapah Creek, whereas the area to the east of Coochiemudlo Island receives its mud-sized particles in discharge from the Logan River (especially before the sea broke through at Jumpinpin in 1898). The sand mode size is between 2.00 and 3.50 phi.

The Muddy Sand (Low Carbonate) Facies covering the central zone is characterised by minimal deposition. Three distinct subfacies have been recognised, namely, Oceanic Sand Subfacies, Relict Sand Subfacies, and Shelly Subfacies. The Oceanic Sand Subfacies characterised by the presence of modern quartz sand identical with that occurring in the tidal delta (mode between 1.75 and 2.25 phi). This subfacies covers the area east of the Moongalba Channel to North Stradbroke Island.

The Relict Sand Subfacies, which is characterised by the presence of terrigenous iron-stained quartz sand with modal size between 2.00 and 3.40 phi, derived from the mainland sandstones, coastal deposits, or relict oceanic sand, covers the area to the west of the Moongalba Channel.

The Shelly Subfacies which is restricted to the area of the "Moongalba Channel" is characterised by the presence of an abundance of molluscan skeletal particles.

## CONCLUSIONS

The composition and spatial distribution patterns of the subtidal sedimentary facies are related not only to recent (Holocene) events but also to a complex history of reef growth, sea level changes, river meandering etc. during the Pleistocene. Sediments from the central portion of the area may represent relict material that is now being veneered by a layer of Holocene sediments. The shallow subtidal areas and the zone of influence of the tidal delta of oceanic sand represent Holocene sediment accumulations. Conditions

markedly different from those that prevailed when profuse corals and coral reefs developed now exist in the southern sector of Moreton Bay.

## REFERENCES

FRIEDERICH, M.C. 1975. Marine Geology of an area near Peel Island Moreton Bay, Southeast Queensland. Thesis submitted for the Degree of Master of Science, University of Queensland (unpubl.).

HEKEL, H., JONES, M. & SEARLE, D.E. 1976. Relict sediments in Moreton Bay. *Qd Govt Min. J.* 77 (891) 36-45.

MAXWELL, W.G.H. 1970. The sedimentary framework of Moreton Bay, Queensland. *Aust. J. Mar. Freshwat. Res.* **21**, 71-88.

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