SEDIMENTARY EVIDENCE ON THE SEAWARD LIMITS OF SUSPENDED MATERIALS FROM RIVERS

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INTRODUCTION

The Marine Geoscience Group has been researching sedimentation.on the central Great Barrier Reef shelf for several years, concentrating on the sector from Cape Upstart to Cape Tribulation. The programme has two major themes : sea-level history and transgressive sedimentation during the last post-glacial sea-level rise, and the patterns and processes of modern sedimentation, particularly the transition from terrigenous sediments nearshore to carbonate sediments offshore. These studies have utilised a wide range of equipment, mainly shallow seismic (Uniboom and 3.5KHz) profilers, vibracorers and a frame-supported grab for recovering undisturbed samples of the sea-floor.

The central Great Barrier Reef shelf is up to 120km wide, with a reef tract occupying the outer shelf 30-50km offshore, in water depths of 40-80m. The middle shelf is a broad, featureless plain with a thin veneer of relict sediment covering the Pleistocene surface. The inner shelf is the area of active modern terrigenous input and extends up to 15km offshore to water depths of ca. 20m. Fringing reefs surround many of the bedrock islands on the inner shelf, and are subject to river influx, in contrast to the shelf reefs offshore which are beyond most river influence. A summary of recent work on shelf sedimentation is given by Johnson, Belperio & Hopley (1986).

This paper summarises some evidence on the seaward limits of deposition of suspended sediment introduced to the marine realm by rivers. While dissolved nutrients may be dispersed further in the water, it is clear that most nutrients attached to suspended materials are deposited initially very close to shore.

SEDIMENTARY EVIDENCE

Sedimentary Facies

Modern coastal deposition in the Bowen-Ingahm area has formed a seaward-thinning wedge of terrigenous sediment up to 20m thick, and up to 15km wide, consisting of an inner platform'of more. sandy sediment, overlying a thin wedge of muddy sediment (Johnson & Searle, 1984) (Fig.1). More recent, unpublished data has confirmed this pattern off Cape Tribulation (Johnson & Carter, 1987), off Innisfail (Gagan, unpubl. data), in Cleveland Bay off Townsville (Carter & Johnson, unpubl. data), and off the Burdekin Delta (Way, 1986). This wedge of inner shelf sediment displays, seaward-dipping seismic reflectors which indicate deposition at present sea-level.

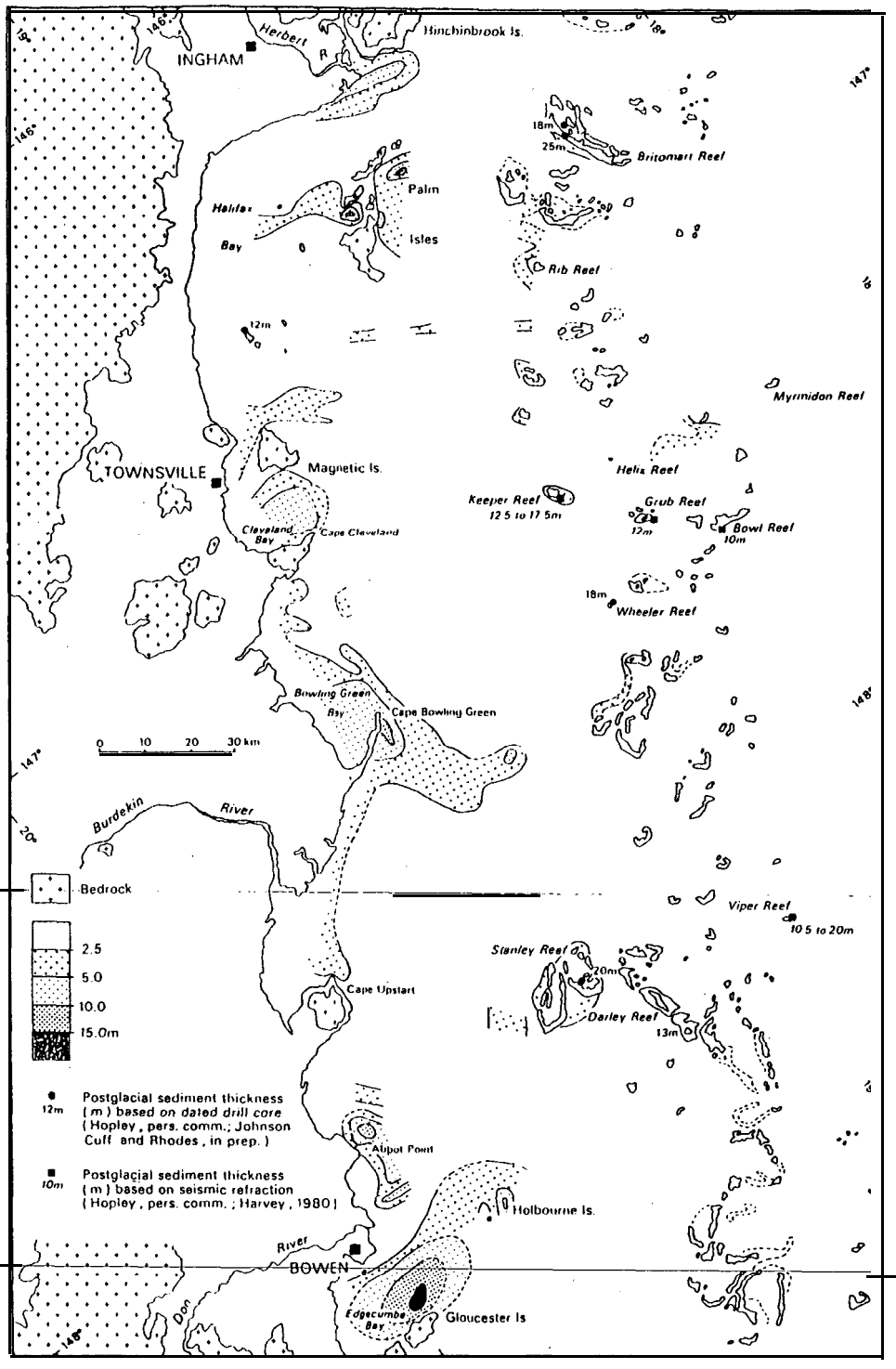

Figure 1. Isopach map showing distribution of post-glacial sediment on part of the central Great Barrier Reef shelf. **Note** the wedge of sediment nearshore (from Johnson & Searle, 1984).

Sediment brought to the coast by rivers tends to stay nearshore for the following reasons. Sand is deposited on river mouth bars due to the drop in river velocity and the onshore transport induced by waves. Longshore drift of sand is predominantly northwards in response to the prevailing southeasterly weather (Belperio, 1983). Muddy plumes of suspended sediment extend further seawards but are generally also held nearshore by the weather (e.g. Belperio, 1983; Wolanski & van Senden, 1983).

Stable Carbon Isotopes.

,A study of the top 10mm of undisturbed sediment samples from the shelf off Innisfail before and'after Cyclone Winifred crossed the shelf on 1 February 1986 showed the seaward extent of deposition of terrestrial organics (Gagan, Sandstrom & Chivas, 1987)' (Fig.2). Terrestrial organics have a sta'ble carbon isbtope (del 13C/12C) ratio of about -26.5 per mil in this region, while the shelf marine organics have a ratio of around -18 per mil. Figure 2 shows the mixing of these two end-member sources of organics to give intermediate ratios for organics from samples across th.e shelf. It is clear that significant amounts of terrestrial orqanics do not extend more than 12km offshore since the isotope ratios are essentially marine at this distance from the coast. It is also clear that the distribution of orqanics is much the same after as before the flood of terrestrial sediment caused by rainfall associated with the cyclone.

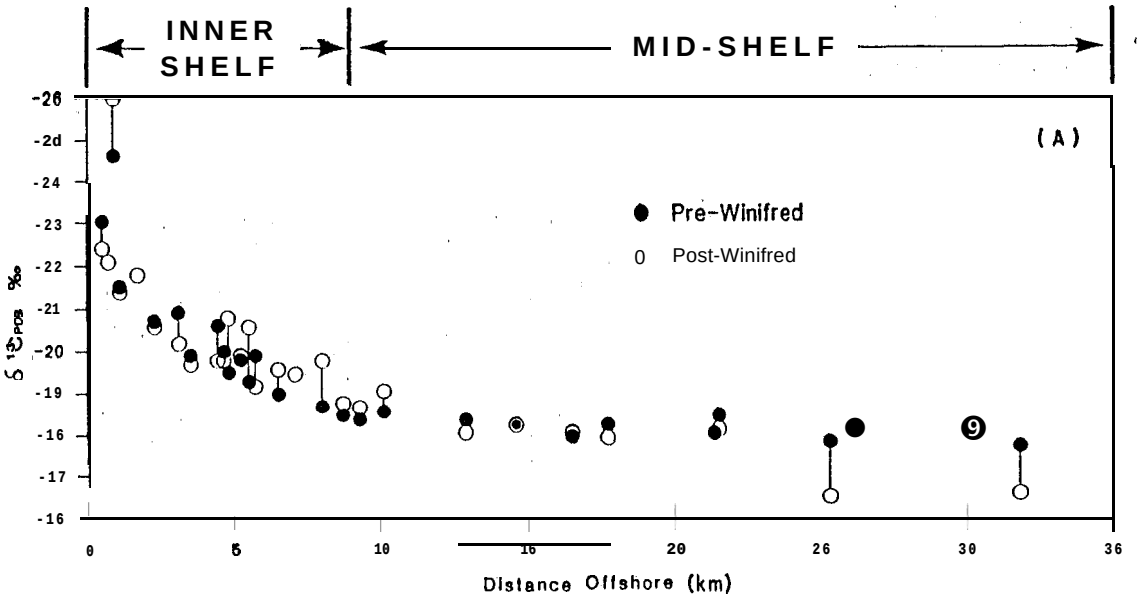

Figure 2. Comparison of the stable carbon isotope ratios of organics from surficial shelf sediment before and after Cyclone Winifred (from Gagan and others, 1987).

Evidence from Reefal Sediments

Analyses of reef *cores* confirms that terrigenous sediments are largely restricted to inner shalf areas, and further that htis has been the pattern during the Holocene, i.e. during the major recent phase of reef accumulation. Isdale (1984) showed that coral cores from inshore reefs preserved the influence of terrestrial flooding as fluorescent bands, an effect very rarely seen 'in offshore shelf reefs. Many'analyses of surficial sediments from shelf reefs have'shown they are carbonate sediments (e.g. Orme & Flood, 19801, with minor terriqenous sediment, only in the deeper parts of cores (e.g. Johnson, Cuff & Rhodes, 1984). These deeper sediments would have accumulated at lower sea-levels when the coastline was, consequently closer. In contrast the fringing reefs around bedrock islands on the inner shelf contain up to 50% terrigenous sediment in the matrix

between larger coral and shell fragments (Johnson & Risk, 1987). Further the terrigenous input has been essentially constant during the Holocene.

CONCLUSIONS

(1) Sedimentary evidence from seismic profiling, isotope studies of surficial sediments, and the nature of reefal sediments indicates most suspended terrigenous sediment is deposited within 15km of the coast, and in water depths of less than 20m.

(2) However it may be that some of this sediment is moved gradually across the shelf in the longer term, but present evidence is that such amounts are insignificant under the wave-dominated environment of the central Great Barrier Reef. Such cross-shelf transport is more likely in areas with higher tidal currents such as the Whitsunday region.

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