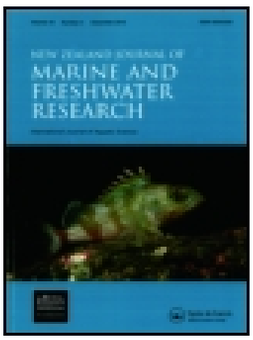

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Notes on a sediment map for the South Otago continental shelf

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Modern sand and silty sand cover the inner shelf, with silty sand accumulating off the mouth of the Clutha River. Palimpsest sediment dominated by shell debris and polymodal detrital gravel and sand covers the outer shelf. The detrital sediment is largely or wholly of Clutha River origin.

INTRODUCTION

Considerable information about the continental shelf sediments near the Clutha River was collected during an investigation of the continental shelf adjoining Otago Peninsula (Andrews 1973). Augmented by data held by N.Z. Oceanographic Institute, the information is sufficient for the preparation of a surficial sediment map for the South Otago continental shelf.

The map area (1650 km²) extends from the coastline out to the edge of the continental shelf, and from latitude 46° 14′S in the north to latitude 46° 37′S in the south (Fig. 1). The map is compiled from data obtained at 44 sampling stations.

During sampling to determine the southerly distribution of the mid- and outer-shelf quartz gravels so common off the east coast of the South Island (Herzer 1977), 27 stations were occupied by r.v. *Munida,* Portobello Marine Biological Station. The remaining 17 stations were occupied at various times by vessels under charter to N.Z. Oceanographic Institute. Sampling from r.v. *Munida* was by Agassis trawl; NZOI sampling was mostly by grab and corer.

SEDIMENT MAP

The map (Fig. 1) is a marked refinement of an earlier generalised sediment distribution map for the same area (Carter & Ridgway 1974), and is based on whole-sample (detritus plus organic skeletal debris) textural characteristics. The procedures followed in compiling it are the same as those used by Andrews (1973, fig. 4).

The main feature of the sediment map is, as on much of the continental shelf to the east of the South Island (Andrews 1973, Herzer 1977), a two-part division into an inner shelf zone of detrital sand and muddy sand, and an outer shelf zone of pebble and organic debris-rich gravel, sandy gravel, and gravelly sand. Inner shelf sand and muddy sand characteristically contain less than 10% organic debris (mostly about 5%), which consists of benthic Foraminifera and whole and fragmented minute bivalves. The detrital fraction consists of fine and very fine sand and silt-grade particles (Fig. 2) dominated by chlorite, micas, and metamorphic rock fragments. Clay-size particles are rare. Outer shelf sand in the southern part of the map area consists of fine sand and is richer in organic skeletal debris (measured values 14% and 38%).

A distinctive feature of inner shelf sediment distribution is the large area of silty sand immediately seaward of the mouths of the Clutha River. Fine-grained sediment commonly accumulates off the mouths of major rivers (Curray 1960, Pantin & Gibb 1968) because the rate of sediment influx and accumulation is too rapid for waves to rework and remove all mud. A large tongue of silty sand in the southwest may also be related to river inflow; the mouth of Catlins River lies just west of the mapped area.

The inner shelf sand passes abruptly into the organic debris-dominated gravelly sediments of the outer shelf (Fig. 1). Organic content jumps from less than 10% to 42–63% of the whole sediment in less than 2 km. The boundary between the two lies at a depth of 65 m in the north, gradually deepening southward to about 115 m in the extreme south. A pelecypod-bryozoa epibenthic assemblage dominates the outer shelf sediments; some samples also contain abundant turritellid gastropods and clusters of serpulid worm tubes. The sand-size fraction is dominated by pelecypod fragments, minute bivalves, and Foraminifera, with planktonic Foraminifera prominent in the more offshore positions.

The detrital component of the outer shelf sediments is notably polymodal (see also Andrews 1973).

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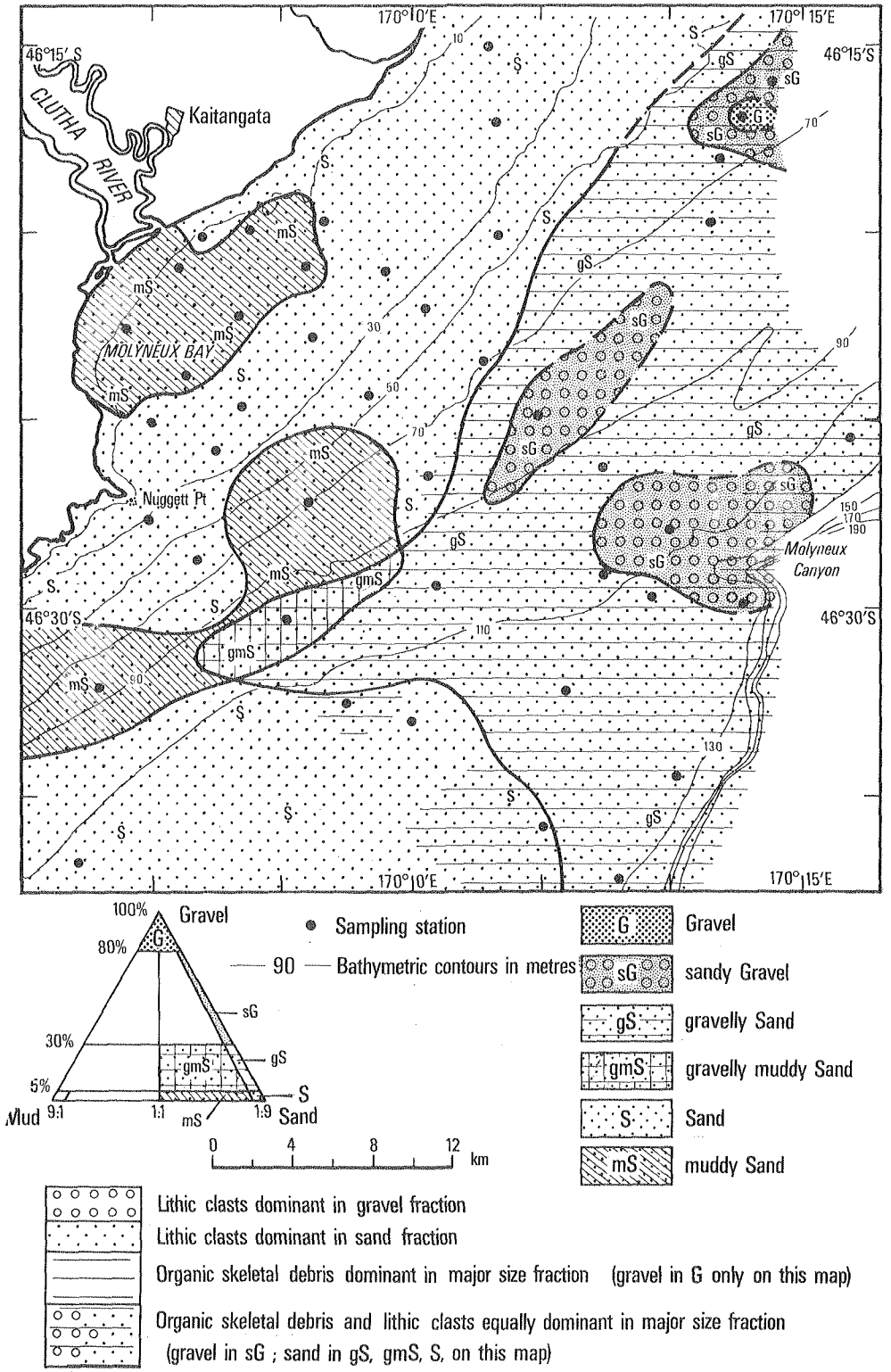
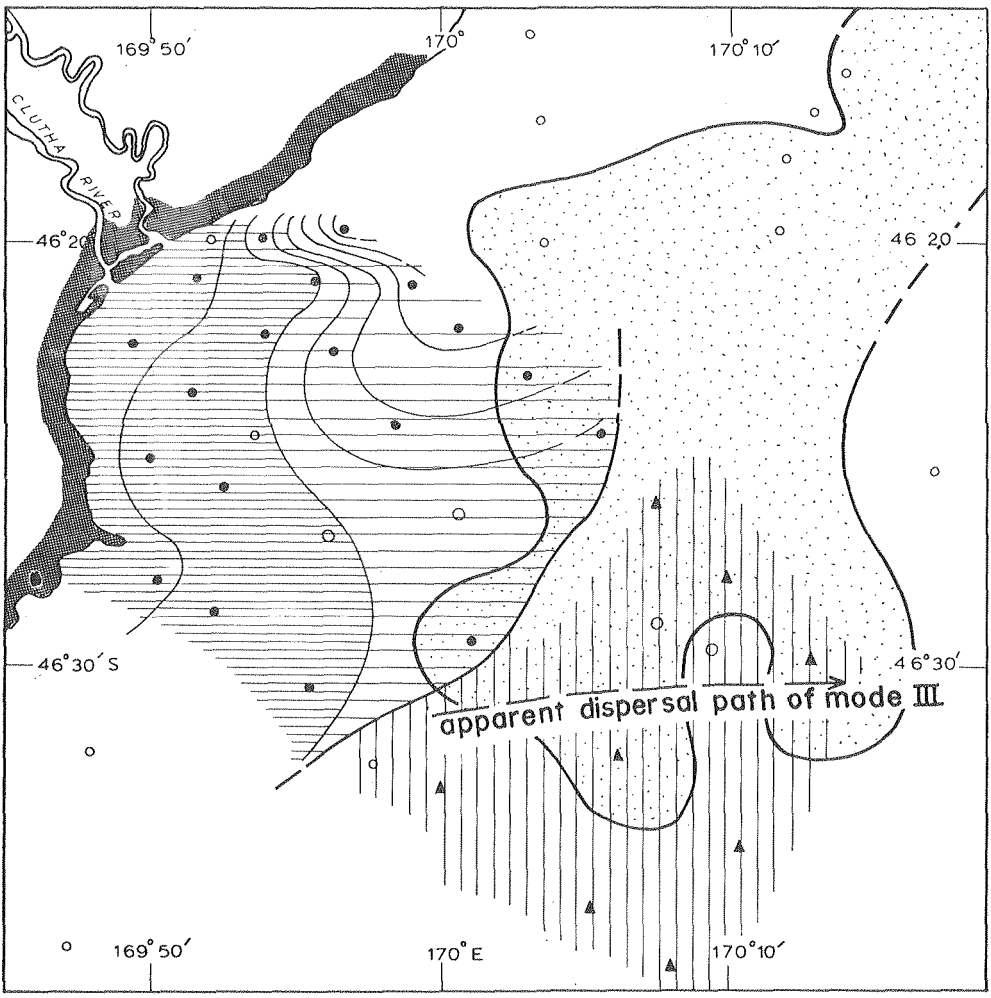


Fig. 1. Surficial sediment distribution on the South Otago continental shelf showing texture and gross composition.



Mode I (pebble gravel)

Mode III (2·4-2·65 ϕ, fine sand)

Mode IV (fine and very fine sand)

- 2·8-2·95 ϕ
- 3·0-3·15 ϕ
- 3·2-3·5 ϕ

● sampling stations for which full size data is available.

○ sampling stations for which presence or absence of gravel is the only size information available.

▲ sampling stations at which mode III occurs.

Fig. 2. Distribution by modes of the detrital fraction of the surficial sediment on the South Otago continental shelf.

Detailed analysis of the *Munida* samples revealed four detrital modes; Mode I (–1.0 to –4.1ϕ, very fine to coarse pebble gravel), Mode II (1.1–1.9ϕ, medium sand), Mode III (2.4–2.65ϕ, fine sand), and Mode IV (2.8–3.5ϕ, fine and very fine sand). Rounded quartz pebbles (Mode I) are characteristic of the outer shelf sediments, though they are patchily distributed. At a few places they are sufficiently concentrated to form a pebble gravel (Fig. 1); elsewhere they form a minor component of the sediment. Mode II (medium sand) was found in only four samples. It is associated with gravel in each instance, and is confined to the outer half of the shelf. Mode III (fine sand) is confined to the outer shelf in the southern half of the area (Fig. 2). Though only limited data are available, mode diameter decreases from west to east, suggesting that Mode III was transported in an easterly direction from a position just south of Nuggett Point (Fig. 2).

Mode IV (fine and very fine sand) is confined to the inner half of the shelf. The pattern of decreasing mode diameter (Fig. 2) suggests that it is being transported seaward and northeastward from points south of the area. However, Mode IV sand is rich in metamorphic detritus (see Carter & Ridgway 1974, Bardsley 1977). It is almost certainly being supplied by the Clutha River and not from south of Nuggett Point, where the modern beach sediment, at least, consists of plutonic minerals derived from western Southland and Stewart Island (Bardsley 1977). Although the effective direction of sediment transport over much of the continental shelf east of the South Island is northeast (Andrews 1973, Bardsley 1977, Herzer 1977), north of major promontories (Banks Peninsula, Otago Peninsula, and here Nuggett Point) 'back-eddy' transport resulting from the combined effects of deflection of the north-flowing Southland Current and southward longshore drift induced by periodic northeast winds (Carter & Ridgway 1974), produces local southward sediment transport. It is this phenomenon that accounts for dispersal of Mode IV sediment south of the Clutha River, as well as seaward and northeastward.

In mid-shelf positions Mode IV sand mixes with the inner edge of the pebble belt, its pattern of distribution suggesting that the pebble gravel is gradually being covered by sand. This relationship, the detailed pebble dispersal pattern focusing on the Clutha River mouth (Andrews 1973, fig. 18), and the quartz pebble gravel extending as a continuous belt northeastward to beyond Otago Peninsula, but to the south cutting out off Nuggett Point, all indicate a Clutha River origin for the gravel, probably at a time of Pleistocene low sea level. The coarsest pebbles (coarser than –3ϕ diameter) are completely encrusted with epizoa, suggesting that they are rarely moved and that the gravel is relict. However, finer pebbles are clean, suggesting that they are moved sufficiently frequently (probably by the strongest storm-augmented currents; see Carter & Heath 1975) to prevent the accumulation of epizoa. I conclude that the gravel and its associated Mode II sand, though Pleistocene in age, is gradually being reworked and mixed with finer modern sediment. It therefore is a palimpsest (Swift *et al.* 1971) deposit.

Mode III sand forms a pattern that appears to transgress the gravel zone discordantly (Fig. 2). It either postdates the gravel and predates the modern Mode IV sand, so that it is also likely to be palimpsest (or relict), or is currently being transported northward from a source south of the area, in which instance it could be modern. That Mode III is confined to the outershelf and forms a southern extension of the gravel belt favours the former interpretation. Although the inferred dispersal path of Mode III (Fig. 2) suggests a sediment source south of Nuggett Point, at times of Pleistocene low sea level the extended course of the Clutha River would debouch on to a restricted continental shelf near the origin of the dispersal arrow. A Clutha origin is therefore possible for Mode III, and as its mineralogy is similar to that of Modes I and IV (Andrews 1973), most probable.

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REFERENCES

ANDREWS, P. B. 1973: Late Quaternary continental shelf sediments off Otago Peninsula, New Zealand. *N.Z. Journal of Geology & Geophysics 16(4)*: 793–830.

BARDSLEY, W. E. 1977: Dispersal of some heavy minerals along the Otago-eastern Southland coast. *N.Z. Geographer 33(2)*: 76–9.

CARTER, L.; HEATH, R. A. 1975: Role of mean circulation, tides and waves in the transport of bottom sediment on the New Zealand continental shelf. *N.Z. Journal of Marine & Freshwater Research 9(4)*: 423–48.

CARTER, L.; RIDGWAY, N. M. 1974: Hydrology and sedimentation off the Clutha River. *N.Z. Oceanographic Institute Oceanographic Summary 2.*

CURRAY, J. R. 1960: Sediments and history of Holocene transgression, continental shelf, Northwest Gulf of Mexico. Pp. 221–66 in SHEPARD, F. P., PHLEGER, F. B. & VAN ANDEL, TJ. H. (Eds) *Recent Sediments of the Northwest Gulf of Mexico.* American Association of Petroleum Geologists. Tulsa, Oklahoma.

HERZER, R. H. 1977: "Late Quaternary geology of the Canterbury continental terrace." Ph.D. thesis, Victoria University of Wellington, N.Z.

PANTIN, H. M.; GIBB, J. G. 1968: Coastal Chart Series 1:200 000. Mahia Sediments. N.Z. Oceanographic Institute, Department of Scientific and Industrial Research, Wellington.

SWIFT, D. J. P.; STANLEY, D. J.; CURRAY, J. R. 1971: Relict sediments on continental shelves: a reconsideration. *Journal of Geology 79(3)*: 322–46.