

PLEISTOCENE MOLLUSCA IN OCEAN DRILLING PROJECT CORE SITE ODP 1119, CANTERBURY BIGHT

By Margaret S. Morley, Bruce W. Hayward and Alan G. Beu

SUMMARY

We record 19 species of gastropod and 25 species of bivalve from Pleistocene sediment recovered from Ocean Drilling Programme core site 1119 at 393 m deep in the Canterbury Bight. These are additional to the 15 species of larger gastropod and 5 species of larger bivalve previously recorded from this drill core. Most of the molluscs recorded here are still living today in mud on the upper slope (200-600 m) around New Zealand.

INTRODUCTION

In 1988, one of us (BWH) was lucky enough to be a participating scientist on an eight-week leg of the Ocean Drilling Programme, which was drilling holes in the sea floor east of New Zealand. The first site drilled was in the shallowest water (393 m) and located in the Canterbury Bight. BWH's task was to process sediment samples from the retrieved cores and use the fossil foraminiferal shells within them to provide geological dates on when they were deposited. In addition to the fossil foraminifera, some of the samples contained a number of fossil mollusc shells. These were later shown to MSM, who identified them all.

ODP SITE 1119

The drill site was located 96 km east of the Canterbury coast, off Timaru ($44^{\circ} 45.332' S$ $172^{\circ} 23.598' E$; Fig. 1). It was drilled in August 1998 by the RV Joides Resolution drillship (Fig. 2) at a water depth of 393 m on the upper continental slope. Three offset holes (1119A, 1119B and 1119C) were drilled to obtain a complete sequence. Hole A was designed to recover only a single core to a depth of 6 m below the seafloor. Hole B went to a depth of 155 m below seafloor recovering sediment in 17 9-m-core lengths. Hole C was sunk to a depth of 407 m below seafloor recovering sediment in 52 9-m-core lengths.

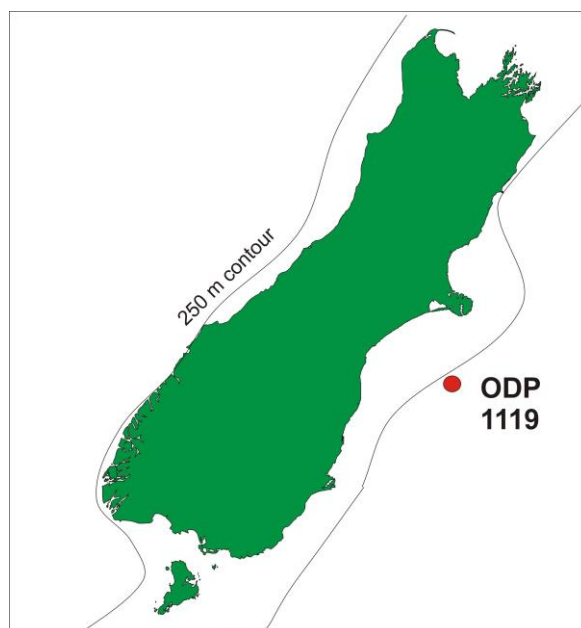


Fig. 1. Location of ODP Site 1119, Canterbury Bight.



Fig. 2. ODP drilling ship RV Joides Resolution.

Mollusc-bearing samples

The sediment down the core was dated using the known succession of the fossilised shells of the microscopic planktic groups foraminifera, calcareous nannoplankton and diatoms. BWH was on board as a foraminiferal micropaleontologist and obtained samples of sediment that were processed to reveal the microfossils present. This involved washing the sediment sample with water over a sieve with 63 micron openings to remove all the mud and leave the sand or larger sized grains and fossils. Thirteen of these samples contained a number of small (<5 mm) mollusc shell fossils that have been identified and are listed below. Because BWH was on-board ship he was able to get access to larger sediment samples (50-100 ml) from the core catchers (CC) than are usually provided from the ODP sediment repositories in USA or Germany (10-20 ml). These larger samples had more mollusc fossils than are usually found in deep-sea cores.

On board the ship, all sediment cores are cut in half lengthwise to reveal their sequence of sediment, which is described, tested and sampled. One of the chief scientists, Dr Bob Carter, collected all shells (usually >8 mm in size) that were revealed in the cut face (Fig. 3) and these larger fossils were identified by himself and Dr Alan Beu. These identifications were published in a table by Carter and Beu (1999) and are included in the species list below for completeness.

The cored sedimentary sequence

The full cored sequence at ODP site 1119 extends back in time to about 3.9 million years ago in the Pliocene Period (Carter, 2005). It contains sediment deposited through almost all of cold and warm cycles of the Ice Ages (last 2.6 million years). The sediment consists of a cyclic succession of grey mudstone deposited during cold intervals (glacials) and thin shell-bearing sand beds deposited during the warm intervals (interglacials) (Carter et al., 2004). During the glacials sea-level was a lot lower (up to 120 m lower) and the coast of South Canterbury was a lot closer to the drill site. Thus during glacials a vast quantity of glacial flour eroded off the Southern Alps was carried down rivers to the Canterbury Bight and across the narrowed continental shelf to be deposited on the continental slope as massive mud (Site 1119). During the higher sea levels of the interglacials, there was far less sediment being carried down the rivers and the continental shelf was far wider and deeper. Thus most of the mud in suspension that reached the sea was swept northwards along the shelf by the strong Southland Current. Only a small amount of sand that was reworked from the outer shelf by bottom currents was deposited down the continental shelf in the vicinity of the drill site.



Fig. 3. Section of core from ODP 1119 showing the fossil gastropods *Cominella alertae* (left) and *Aoteatilia* sp. (right).

The fossil molluscs

Based on the larger molluscan fossils picked out of the split cores, it has been noted that the most common bivalves in the glacial muds were *Zygochlamys delicatula* and that the most common shells in the interglacial sands were *Tawera spissa* and *Limopsis peteri* (Carter and Beu, 1999; Carter et al., 2004; Carter, 2005). The glacial muds also contain archibenthal gastropods, including *Cominella alertae*, *Aeneator recens*, *Provocator mirabilis* and *Uberella denticulifera* (Carter and Beu, 1999). This molluscan fauna is similar to the upper bathyal fauna that occurs today on mud substrates on the New Zealand upper slope. Today the northernmost living records of *Z. delicatula* is 45 deg S, slightly south of ODP site 1119 (Carter, 2005). During glacial periods, fossil records from around the North Island indicate that the cool-water fan shell *Z. delicatula*, migrated hundreds of kilometres northwards and retreated again during the interglacials.

Almost all the samples that we obtained small molluscan fossils from were in mud deposited during glacial periods, because there is far more of it than the interglacial sand. As with the larger gastropods, the majority of the smaller molluscan fossils are the same as those that are common today at upper slope depths (200-600 m) around New Zealand. This can be seen by the depths recorded by Powell (1979) listed in the Species List below.

SPECIES LIST OF MOLLUSCA IDENTIFIED IN PROCESSED MICROFOSSIL SAMPLES FROM ODP SITE 1119, CANTERBURY BIGHT

Samples:

A = 1119B-1H-1, 135-139 cm, 14000 yrs ago	H = 1119B-15H-CC, 1 million yrs ago
B = 1119A-1H-2, 25-29 cm, 15,000 yrs ago	I = 1119C-22X-CC, 1.6 million yrs ago
C = 1119A-1H-CC, 18,000 yrs ago	J = 1119C-23X-CC, 1.7 million yrs ago
D = 1119B-2H-CC, 24,000 yrs ago	K = 1119C-27X-CC, 1.9 million yrs ago
E = 1119B-3H-1, 40-44 cm, 24,000 yrs ago	L = 1119C-36X-CC, 2.6 million yrs ago
F = 1119B-3H-3, 25-29 cm, 36,000 yrs ago	M = 1119C-41X-CC, 3 million yrs ago

G = 1119B-3H-4, 120-124 cm, 47,000 yrs ago

Many of the mollusc specimens in the above samples were hard to identify because they were small, juveniles, damaged or only pieces.

* Extinct taxa

	A	B	C	D	E	F	G	H	I	J	K	L	M	Depths in Powell,79	Specimens Carter & Beu, 99
Gastropoda															
<i>Aeneator elegans</i>															C-5H
<i>Aeneator recens</i>															C-23X
<i>Aequispirella finlayi</i>	x	x												260m	
<i>Amalda</i> cf. <i>novaezelandiae</i>															C-9H to B-12H
<i>Antimelatoma buchani</i>															C-9H to C-22X
<i>Aoteatilia</i> sp.		x		x											B-6H
<i>Bathytoma murdochi</i>															
<i>Belomitra aoteana</i>													x	400-680m	
<i>Brookula prognata</i>			x											180m	
<i>Brookula</i> sp.	x			x											
<i>Calagrossor aldermenensis</i>		x												366-475m	
<i>Cominella alertae</i> *															B-6H
<i>Cominella</i> cf. <i>elegantula</i>															C-27X
<i>Comitas</i> cf. <i>onokeana</i> *															C-15H
<i>Frignatica conjuncta</i>				x										360-640m	B-11H
<i>Fulsilunatia ambigua</i>															C-9H to C19X
<i>Limacina</i> sp.	x	x												planktic	
Marginellidae indet.															C-52X
<i>Melanella ?alertae</i>									x						
<i>Odostomia cryptodon</i>													x	73m	
<i>Odostomia hyphala</i>	x									x	x		x	1260m	
<i>Uberella denticulifera</i>															C-14H to C29X
<i>Powellisetia ?gradata</i>													x	130-300m	
<i>Powellisetia subtenuis</i>	x	x								x				0-260m	
<i>Powellisetia tenuisculpta?</i>				x										310m	
<i>Powellisetia</i> sp.										x					
<i>Provocator mirabilis</i>															B-6H
<i>Puncturella</i> cf. <i>analoga</i>							x							361m	
<i>Pusillina otagoensis</i>				x						x				540m	
<i>Splendrilla majorina</i>															C-15H
<i>Stiracolpus pagoda</i>				x	x									4-110m	
<i>Stiracolpus</i> sp.															C-23X
<i>Taranis nexilis ?bicarinata</i>										x				36-55m	
<i>Terelimella benthicola</i>													x	460-630m	
Turridae indet.											x	x			
<i>Zeatrophon ambiguus</i>				x									x	0-90m	
<i>Zerotula</i> sp.					x										
Bivalvia															
<i>Bathyarca cybaea</i>			x											200m	
? <i>Bathyaerus cuneata</i>			x											170m	
<i>Cycloclamys aupouria</i>	x	x		x		x	x		x	x	x	x		540m	
<i>Cycloclamys transenna</i>					x									90m	
<i>Cycloclamys</i> sp.										x					
<i>Ennucula strangei</i>				x										6-450m	

<i>Ennucula strangeiformis</i>			x			540m	
<i>Hiatella arctica</i>	x	x	x		x	x	0-180m
<i>Hamacuna</i> sp.							x
<i>Lissarca benthicola</i>					x		470-640m
<i>Lissarca</i> aff. <i>stationis</i>	x	x					85m
<i>Lissotesta otagoensis</i> *			x				470m-630m
? <i>Lucinoma galathea</i>			x				260-640m
<i>Limopsis peteri</i> *						x	C-25X
<i>Monia</i> sp.	x			x			
<i>Neolepton antipodum</i>		x	x	x	x		0-310m
<i>Neolepton sublaevigatum</i>			x?		x		260m
<i>Neolepton subobliquum?</i>		x					260m
<i>Neilo australis</i>							C-23X
<i>Nuculana</i> sp.							C-32X
Nuculidae indet. pieces			x		x	x	
Pectinidae indet.					x		
<i>Philobrya meleagrina</i>		x					90m
<i>Pronucula maoria?</i>		x			x		260m
<i>Pronucula tenuis?</i>		x		x	x		310m
<i>Purpurocardia purpurata</i>			x				0-180m
<i>Tawera marionae</i>	x	x	x	x	x		110m
<i>Tawera spissa</i>							B-1H to B-10H
<i>Zygochlamys delicatula</i>	x		x	x	x		540m
Bivalve pieces indet.				x			C-3H
Barnacle plate indet.						x	
Brachiopod indet.	x	x	x	x			
Bryozoans	x		xx		x		
Echinoderm spines	x	x		x			
Serpulid worm tubes	x	x	x				

REFERENCES

- Carter, R.M. and Beu, A.G. 1999. Mollusks *in* Carter, R.M. et al. Chapter 3, Site 1119: Drift accretion on Canterbury Slope. Proceedings of the Ocean Drilling Program, Initial Reports 181, p.18.
- Carter, R.M., Gammon, P.R. and Millwood, L. 2004. Glacial-interglacial (MIS1-10) migrations of the Subtropical Front across ODP Site 1119, Canterbury Bight, Southwest Pacific Ocean. *Marine Geology* 205: 29-58.
- Carter, R.M. 2005. A New Zealand climatic template back to c.3.9 Ma: ODP 1119, Canterbury Bight, Southwest Pacific Ocean, and its relationship to onland successions. *Journal of the Royal Society of New Zealand* 35: 9-42.
- Powell, A.W.B. 1979. *New Zealand Mollusca*. Collins, 500 p.