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# Data report: temporal change in fossil ostracode assemblages in the Pliocene–Holocene strata of shelf IODP Site U1354 off the eastern coast of New Zealand[1]

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## Chapter contents



## Abstract

High-resolution analysis of fossil ostracode assemblages was performed in Pliocene to Holocene sections from Integrated Ocean Drilling Program Expedition 317 Site U1354 (water depth = 113 m), located on the continental shelf of the Canterbury Basin off New Zealand. In addition, samples from near the seafloor at Sites U1353 (water depth = 85 m), U1351 (122 m), and U1352 (344 m) were used to identify recent ostracode assemblages in the study area. At least 149 species and 60 genera of fossil ostracodes were identified from 142 core samples from Holes U1354B and U1354C, and many of them still inhabit the modern continental shelf around New Zealand and Australia.

## Introduction

Ostracodes from New Zealand and its surrounding seas have been investigated since the nineteenth century (e.g., Brady, 1866, 1880, 1898). Most of the research is systematic descriptions (Hornibrook, 1952; Swanson, 1969, 1980; Ayress, 1990, 1993, 1995; Ayress and Swanson, 1991; Milhau, 1993; Swanson and Ayress, 1999; Guise, 2001), assemblages and their distribution in the modern seas and bays (Swanson, 1979a, 1979b; Hayward, 1981, 1982; Ayress et al., 1997; Eager, 1999; Morley and Hayward, 2007, 2012), and paleoenvironments during the Miocene (Milhau, 1991) and the late Quaternary (Swanson and van der Lingen, 1997; Hayward et al., 2008). On the other hand, few fossil ostracode data for the Pliocene and early and middle Pleistocene have been reported in and around New Zealand.

Integrated Ocean Drilling Program (IODP) Expedition 317 cored at three shelf sites (U1351, U1353, and U1354) and one slope site (U1352) at water depths between 85 and 344 m (Fig. F1), aiming to understand the relationship between eustatic sea level changes and sequence stratigraphy. At Site U1354, 89% of the Pliocene–Holocene strata were recovered between 0 and 173.9 meters below seafloor (mbsf), and they contain numerous fossil ostracodes. Fossil shallow-marine ostracode assemblages are useful as paleodepth indicators because the habitat of each ostracode species is controlled by environmental factors such as pressure, temperature, and salinity relating to water depth. In this report, we describe temporal changes in dominant fossil ostracodes, the number of specimens per gram, species diversity, and equitability in

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Pliocene and Pleistocene sediment cores from Holes U1354B and U1354C.

# Materials and methods

Sediments from Holes U1354B (44°50.8367′S, 171°47.2069′E) and U1354C (44°50.8487′S, 171°47.2080′E), drilled on the outer shelf at a water depth of 113.4 m off the South Island of New Zealand, are mainly composed of silt, sandy mud, and muddy sand intercalated with thin fine- to medium-grained sands and/or shell hash beds. In this study, the section shallower than 375.0 mbsf was examined. Recovery of sediments between 0 and 173.9 mbsf was ~90%, but below this depth, recovery was poor. Sedimentation rates in the cores were calculated based on bio- and magnetostratigraphy as follows (**Expedition 317 Scientists**, 2011a): 21 cm/ky above 75 mbsf, 9.3 cm/ky between 75 and 128 mbsf, 4.5 cm/ky between 128 and 190 mbsf, and 40 cm/ky below 190 mbsf. Based on these sedimentation rates, the 144 samples with an average sedimentation rate of 30 cm/ky were taken from horizons above 375.0 mbsf. Of these, samples with sedimentation rates <22 cm/ky were examined between 0.3 and 165.7 mbsf. Furthermore, near-seafloor samples from Holes U1353B (44°46.1203′S, 171°40.4407′E; 0.9 mbsf), U1351A (44°53.0307′S, 171°50.4037′E; 0.3 mbsf), U1351B (44°53.0422′S, 171°50.4065′E; 0.9 mbsf), and U1352B (44°56.2558′S, 172°1.3630′E; 0.2 mbsf) were also examined to reveal recent ostracode assemblages in the study area. Samples collected using a 10 $cm^3$ cylinder (diameter = 2 cm) were freeze-dried and weighed (dry weight varied from 13.21 to 33.46 g) prior to wet sieving through a 63 µm sieve. The residues were dried, weighed, and divided into workable aliquots with a sample splitter until a fraction containing a minimum of 200 specimens was obtained. In samples where 200 ostracode specimens were not achieved, all ostracodes were counted. The resulting residue was then sieved through a 125 µm sieve, and all ostracodes retained on the sieve were picked. Both valve and carapace were counted as one specimen.

To reconstruct the faunal character of the section, we calculated the species diversity and equitability for samples containing more than 50 specimens. The species diversity is given by *H(S)* (Spellerberg and Fedor, 2003):

$$H(S) = -\Sigma p_i \ln p_i,$$

where $p_i$ is the proportion of specimens of *i*th species and *H(S)* is the species diversity.

The equitability (Eq.) of Buzas and Gibson (1969) is as follows:

$$\text{Eq.} = \exp^{H(S)}/S,$$

where *S* is the number of species.

# Results

At least 149 ostracode species belonging to 60 genera were identified from 142 samples from Holes U1354B and U1354C, although two samples collected from 147.1 and 147.6 mbsf contained no ostracodes (Table **T1**; Plates **P1, P2, P3**). The number of specimens per gram of dried sediment ranges between 0 and 143.7 (Fig. **F2**). High abundance values (>100 specimens) were identified from samples at 13.5, 66.4, 106.9, and 111.1 mbsf. Low abundance values (<1) were found in samples at 88.3, 101.9, 102.4, 133.0, 136.0, 146.1–152.1, 212.2, 279.3, 308.1, 317.4, and 375.0 mbsf. The species diversity in 113 samples containing more than 50 specimens ranges between 1.49 and 3.18. Relatively low values were found in samples at 52.9, 95.3, 106.9, 121.0, 121.5, 127.5, 130.5–136.0, 148.1, and 151.1 mbsf, and high values were found at 11.6, 13.5, 14.5, 18.6, 55.9, 58.3, and 88.3 mbsf. The equitability ranges between 0.6–0.9.

Temporal exchanges of dominant taxa were frequently found throughout the section (Fig. **F3**). There are 42 ostracode taxa that occupy >10% of the total abundance in each sample containing >50 specimens. Of these, the 18 taxa that occupied more than 20% are the following: *Actinocythereis tetrica*, *Argilloecia* spp., *Bradleya opima*, *Callistocythere* sp. 1, *Cytherois parallella*, *Cytheropteron sarsi*, *Cytheropteron wellingtoniense*, *Cytheropteron willetti* s.l., *Hermanites briggsi*, *Hemicytherura gravis*, *Kotoracythere formosa*, *Loxoconcha australis*, *Munseyella brevis*, *Munseyella* cf. *punctata*, *Munseyella* sp. 4, *Oculocytheropteron acutangulum*, *Oculocytheropteron* sp. 1, and *Pellucistoma coombsi*. Many of these inhabit the inner to outer shelf around New Zealand and Australia (e.g., Hornibrook, 1952; Swanson, 1979a, 1979b; Yassini and Jones, 1995; Swanson and Ayress, 1999; Webber et al., 2010), suggesting that dominant ostracode species on the Otago shelf have not changed since the late Pliocene. *Cytheropteron sarsi*, *Cytheropteron willetti* s.l., *Hemicytherura gravis*, *Munseyella brevis*, *Oculocytheropteron acutangulum*, and *Argilloecia* spp., which inhabit the middle to outer shelf, are abundant throughout the entire section (Fig. **F3**). Conversely, taxa living in the inner to middle shelf, such as *Kotoracythere formosa*, *Cytheropteron wellingtoniense*, and

*Hermanites briggsi,* and in the outer shelf, such as *Bradleya opima* and *Pellucistoma coombsi*, displayed relatively high abundances in several horizons. These horizontal patterns might be considered as paleodepth changes during the Pliocene–Holocene.

In the near-seafloor samples, 44 ostracode species belonging to 29 genera were identified in Hole U1353B, and 51 species belonging to 34 genera were identified in Holes U1351A and U1351B. The dominant taxa in all three samples are *Argilloecia* spp. (U1353B = 9.8%; U1351A = 11.5%; U1351B = 19.5%), *Hemicytherura gravis* (U1353B = 4.1%; U1351A = 9.7%; U1351B = 9.6%), and *Munseyella brevis* (U1353B = 9.5%; U1351A = 7.9%; U1351B = 3.9%). In the sample taken from near the seafloor in Hole U1352B on the continental slope, the dominant taxon is *Bairdoppilata* sp. 1 (22.6%), which is present in small amounts (<3%) in samples taken near the bottom of the shelf sites.

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**Figure F1. A.** Location of the Canterbury Basin and geological setting around New Zealand. **B.** Expedition 317 core sites. The location of Ocean Drilling Program Site 1119 is also indicated.

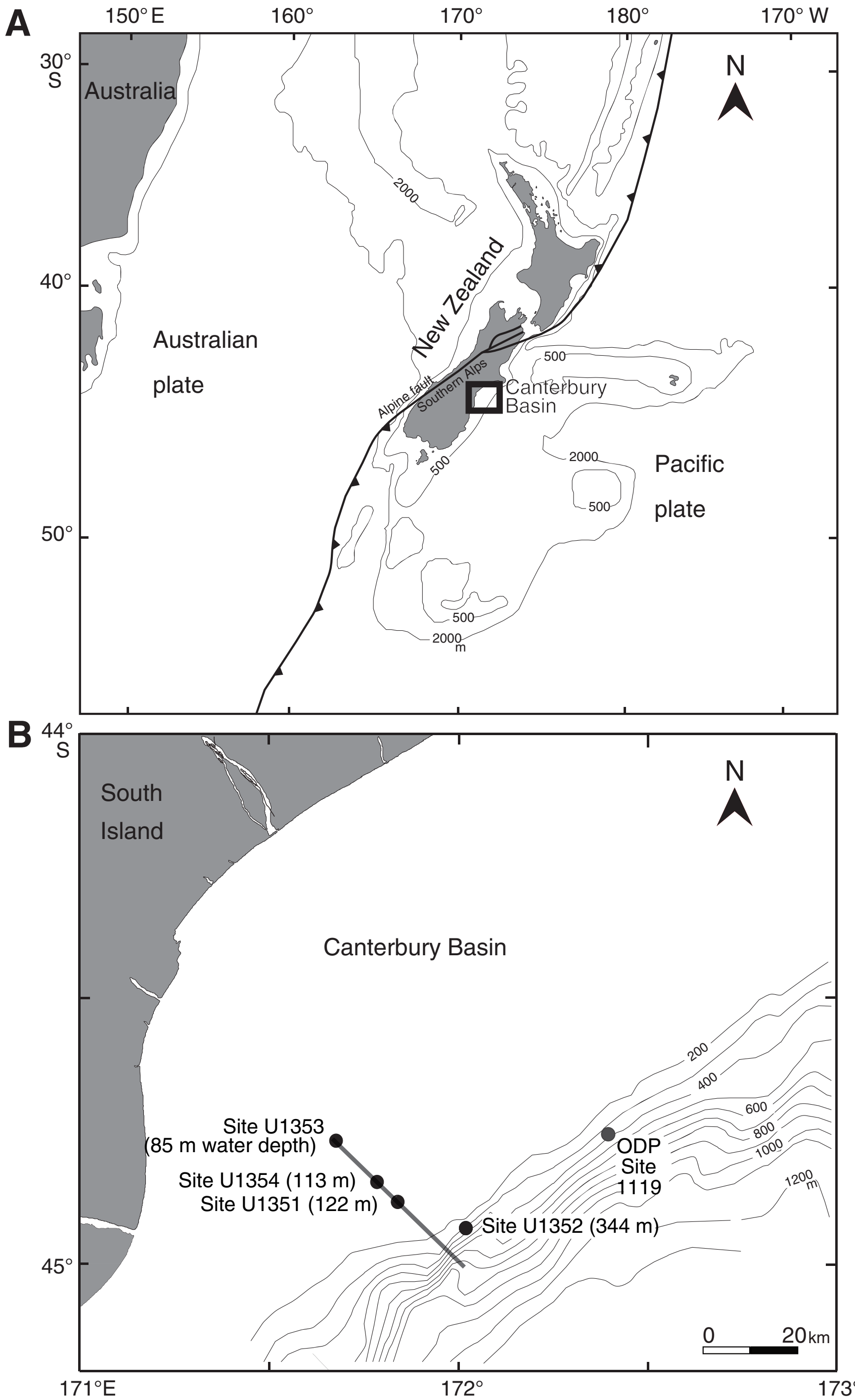

**Figure F2.** Lithologic summary and temporal changes in the number of ostracode specimens/g, species diversity, and equitability of fossil ostracodes, Holes U1354B and U1354C. Columnar sections were modified after the "Expedition 317 summary" chapter and the "Site U1354" chapter (Expedition 317 Scientists 2011a, 2011b).

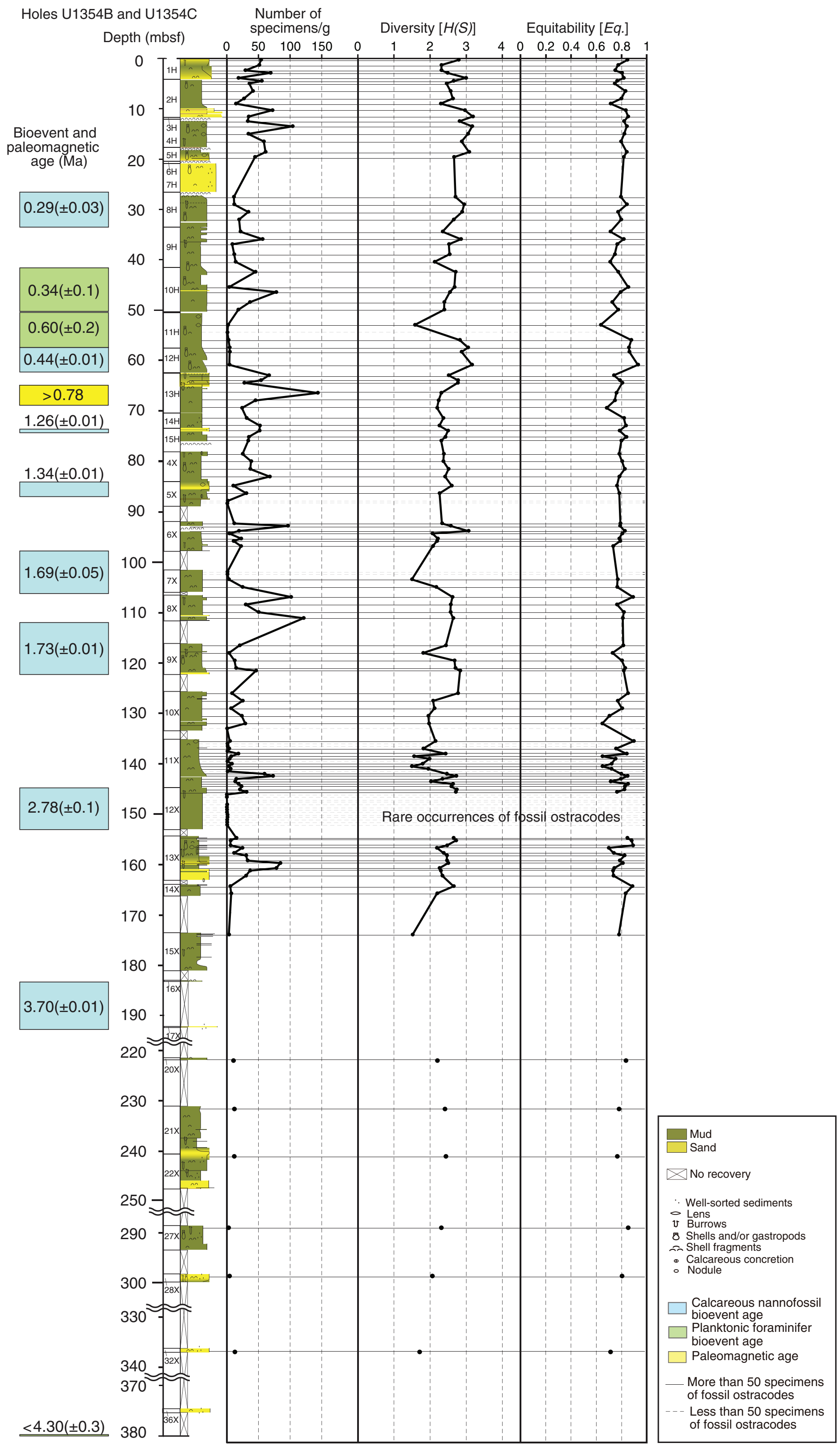

**Figure F3.** Temporal changes in the relative abundance of dominant fossil ostracode taxa, Holes U1354B and U1354C.

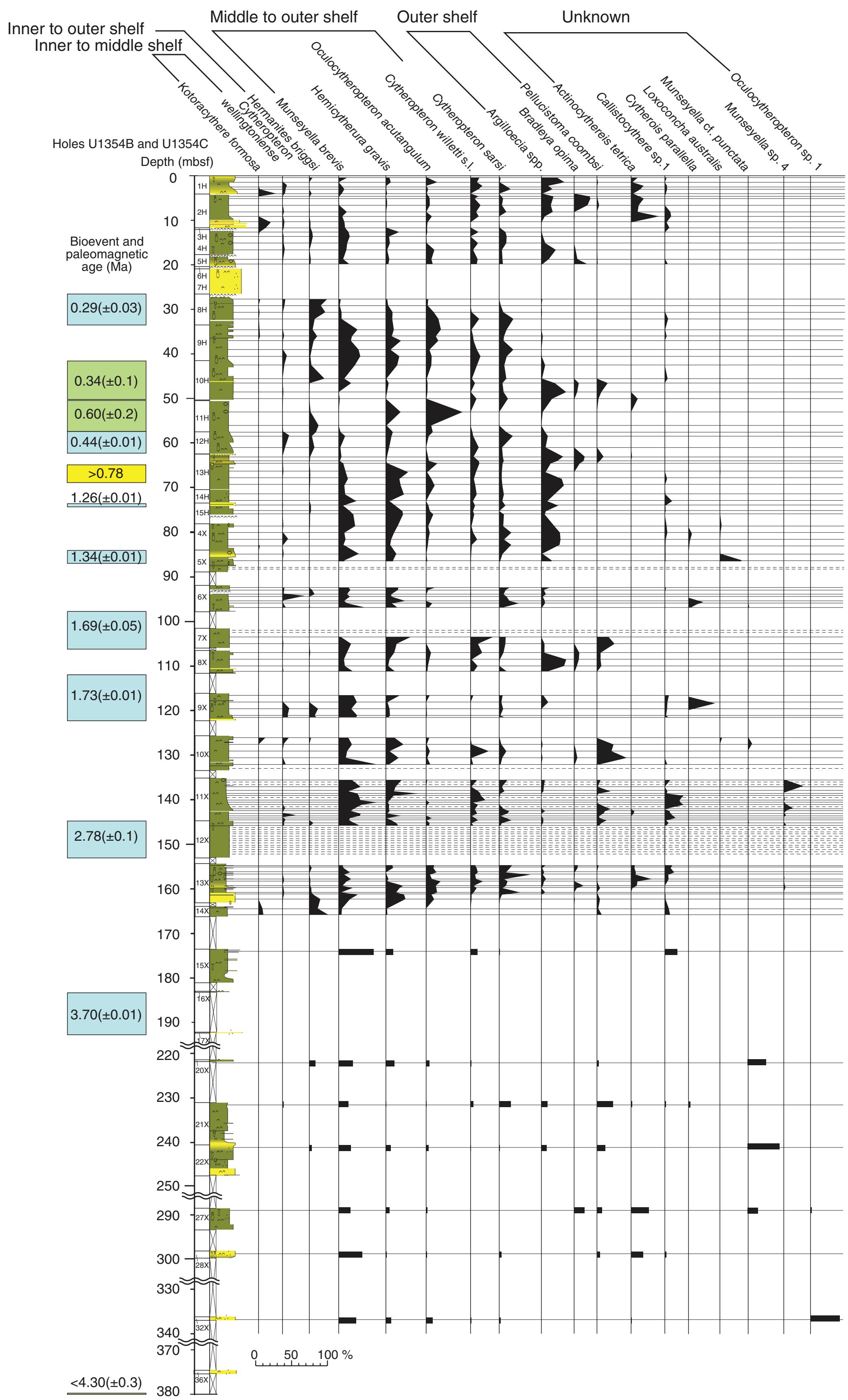

**Table T1.** Fossil ostracode occurrences in the Pliocene–Holocene strata of shelf IODP Site U1354 off the eastern coast of New Zealand. This table is available in an **oversized format.**

**Plate P1.** Scanning electron micrographs of fossil ostracodes, Holes U1354B and U1354C. Scale bars = 200 µm. RV = right valve, LV = left valve. All specimens are adult unless otherwise indicated. **1.** *Cytherella kerryswansoni*, RV (Sample 317-U1354C-11X-7, 89–91 cm). **2.** *Cytherella* sp. 1, RV (Sample 317-U1354B-5H-1, 89–91 cm). **3.** *Argilloecia* sp. 1, RV (Sample 317-U1354B-10H-5, 89–91 cm). **4.** *Pellucistoma coombsi*, LV (Sample 317-U1354B-10H-4, 39–41 cm). **5.** *Cytheropteron sarsi*, RV (Sample 317-U1354B-8H-4, 90–92 cm). **6, 7.** *Cytheropteron wellingtoniense* (Sample 317-U1354C-4X-3, 39–41 cm; (6) LV; (7) RV. **8.** *Cytheropteron wellmani*, RV (Sample 317-U1354B-1H-1, 134–136 cm). **9–12.** *Cytheropteron willetti* s.l.; (9) LV (Sample 317-U1354B-9H-4, 89–91 cm); (10) RV (Sample 317-U1354C-11X-2, 139–141 cm); (11) LV (Sample 317-U1354C-10X-3, 39–41 cm); **12.** RV (Sample 317-U1354C-4X-3, 39–41 cm). **13.** *Hemicytherura aucklandica*, juvenile, RV (Sample 317-U1354B-11H-5, 89–91 cm). **14.** *Hemicytherura gravis*, RV (Sample 317-U1354B-4H-1, 139–141 cm). **15.** *Hemicytherura radiata*, RV (Sample 317-U1354C-20X-1, 40–42 cm).

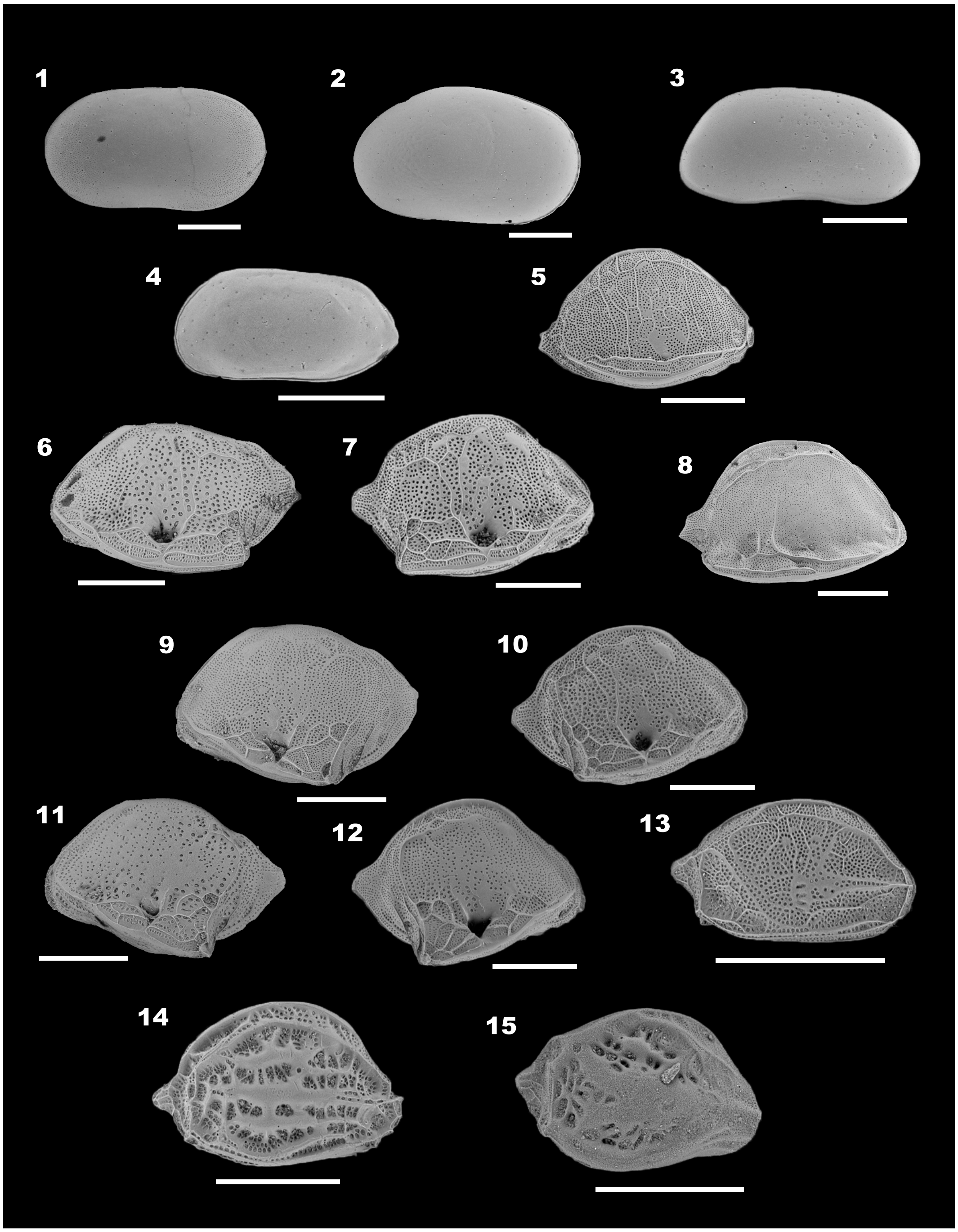

**Plate P2.** Scanning electron micrographs of fossil ostracodes, Holes U1354B and U1354C. Scale bars = 200 µm. RV = right valve, LV = left valve. All specimens are adult. **1.** *Oculocytheropteron acutangulum*, RV (Sample 317-U1354B-4H-3, 139–141 cm). **2.** *Oculocytheropteron confusum*, RV (Sample 317-U1354B-2H-5, 39–41 cm). **3.** *Oculocytheropteron* sp. 1, RV (Sample 317-U1354C-32X-1, 39–41 cm). **4.** *Oculocytheropteron* sp. 2, RV (Sample 317-U1354C-20X-1, 40–42 cm). **5, 6.** Sample 317-U1354B-2H-6, 41–43 cm, LV; (5) *Semicytherura* cf. *arteria*; (6) *Semicytherura* cf. *costellata*. **7.** *Hermanites briggsi*, LV (Sample 317-U1354B-4H-1, 39–41 cm). **8.** *Krithe swansoni*, LV (Sample 317-U1354B-1H-1, 134–136 cm). **9.** *Bisulcocythere novaezealandiae*, RV (Sample 317-U1354C-13X-2, 88–90 cm). **10.** *Callistocythere obtusa*, RV (Sample 317-U1354B-4H-1, 139–141 cm). **11.** *Callistocythere* sp. 1, RV (Sample 317-U1354B-2H-3, 89–91 cm). **12.** *Loxoconcha australis*, RV (Sample 317-U1354C-5X-2, 39–41 cm). **13.** *Phlyctocythere caudata*, LV (Sample 317-U1354B-2H-1, 39–41 cm). **14.** *Cytherois parallella*, LV (Sample 317-U1354C-6X-3, 39–41 cm). **15.** *Nodoconcha* aff. *minuta*, LV (Sample 317-U1354B-4H-2, 138–140 cm).

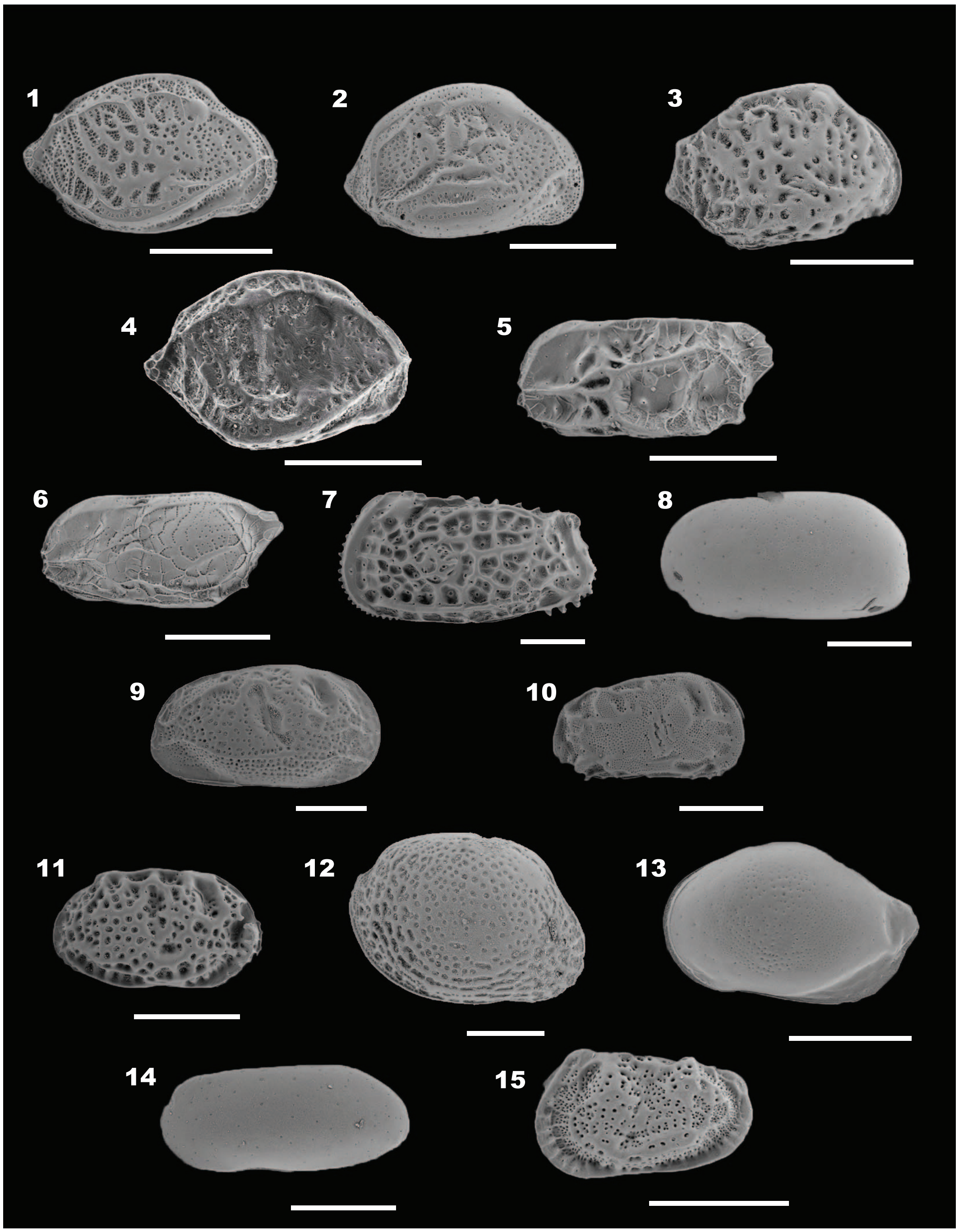

**Plate P3.** Scanning electron micrographs of fossil ostracodes, Holes U1354B and U1354C. Scale bars = 200 µm. RV = right valve, LV = left valve. All specimens are adult unless otherwise indicated. **1.** *Paradoxostoma* sp., juvenile, LV (Sample 317-U1354C-4X-3, 39–41 cm). **2, 12.** Sample 317-U1354B-2H-5, 39–41 cm; (2) *Kotoracythere formosa*, RV; (12) *Quadracythere truncula,* LV. **3.** *Munseyella brevis*, LV (Sample 317-U1354B-4H-2, 138–140 cm). **4.** *Munseyella* cf. *punctata*, LV (Sample 317-U1354C-22X-1, 29–31 cm). **5.** *Munseyella* sp. 1, LV (Sample 317-U1354B-2H-6, 41–43 cm). **6.** *Munseyella* sp. 3, LV (Sample 317-U1354C-28X-1, 39–41 cm). **7.** *Munseyella* sp. 4, LV (Sample 317-U1354C-11X-5, 89–91 cm). **8–10.** Sample 317-U1354B-4H-1, 139–141 cm, LV; (8) *Swansonites aequa*; (9) *Swansonites intermedia*; (10) *Swansonites tumida*. **11.** *Bradleya opima*, RV (Sample 317-U1354B-2H-1, 39–41 cm). **13, 14.** Sample 317-U1354B-1H-2, 139–141 cm, RV; (13) *Actinocythereis tetrica*; (14) *Clinocythereis australis*. **15.** *Trachyleberis lytteltonensis*, RV (Sample 317-U1354B-2H-4, 39–41 cm).