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Makoiamya cotterallae, a new genus and species of bivalve (Ceratomyidae) from the latest Triassic of New Zealand and New Caledonia

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Abstract

The new genus and species *Makoiamya cotterallae* is erected for fossil bivalves previously informally identified as *Anodontophora* Alberti (= *Unionites* Wissmann) or a relative or *Ochotomya* Polubotko in the Late Triassic Murihiku Terrane of New Zealand and Téremba Terrane of New Caledonia (Norian and Rhaetian; Warepan and Otapirian local stages). Neither of these genera happily accommodates these shells and a new genus is considered necessary for them. *Makoiamya* fits most readily into the Ceratomyidae and members were burrowers in fine sand and silt, where they are generally preserved in life orientation.

Key words: New genus, *Makoiamya cotterallae,* Norian, Rhaetian, Warepan, Otapirian

Introduction

In recent years the North Pacific bivalve genus *Ochotomya* Polubotko, 1966, has figured in some publications dealing with Late Triassic faunas of New Zealand (Grant-Mackie 1981, 1985, 2009; MacFarlan 1998) and New Caledonia (Campbell *et al.* 1985; Wiley 1996). The same taxon had been recorded earlier (e.g., Campbell 1956, 1959; Campbell & McKellar 1956; Grant-Mackie 1959; Martin 1975) as *Anodontophora* Cossmann, 1897, a name now regarded as a junior synonym of *Unionites* Wissmann, 1841. The taxon is reported in these publications as occurring in Murihiku Terrane (New Zealand) (Mortimer 2007) or Téremba Terrane (New Caledonia) (Black 1997) strata of Warepan (Late Norian) and Otapirian (Rhaetian) ages (see Cooper 2004; Fig. 1), relatively commonly in the North Island but rare in the South Island of New Zealand and uncommon in New Caledonia.

More careful consideration of the morphology outlined below shows that neither of the genera *Ochotomya* nor *Unionites* comfortably accommodates these fossils. Furthermore, as more localities yield specimens, the value of the taxon as a possible biostratigraphic marker arises.

Systematics

The classification followed here is that of Bieler *et al.* (2010). Fossil localities in New Zealand (Figs 2–8) are all registered in the archival New Zealand Fossil Record File (FRED) of the Geosciences Society of New Zealand administered by GNS Science, in which sites are numbered serially within each sheet of the 1:50,000 NZMS 260 series (e.g., for R16/f8528, R16 is the map sheet number, and the locality is identified by a running number prefixed by 'f'). Collections held in New Zealand from localities in New Caledonia are numbered in a comparable way with the prefix NC/f and those from which the fossils described herein have been collected are shown in Figure 9. Collections are mostly housed in the store of the Geology section, School of Environment, University of Auckland, numbered serially with prefix AU, and individual bivalve specimens are numbered within the *Catalogue of Type and Figured Specimens* of the Geology section with the prefix L. Some collections are held by GNS Science, Lower Hutt, numbered and with the prefix GS, and others in the Geology Department, University of Otago, with prefix OU. Those collections containing the new taxon are listed in Appendix 1.

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References

Agassiz, L. (1842) *Etudes critiques sur les mollusques fossils. Monographie des Myes,* 4. H. Wolfrath, Neuchâtel, 287 pp.

Avias, J. (1953) Contribution à l'étude stratigraphique et paléontologique des formations antécretacées de la Nouvelle Calédonie centrale. *Sciences de la Terre,* 1–2*,* 1–276.

Bieler, R., Carter, J.G. & Coan, E.V. (2010) Classification of bivalve families. *Malacologia,* 52 (2), 113–172. http://dx.doi.org/10.4002/040.052.0201

Black, P.M. (1997) Permian-Jurassic "basement" terranes of the Norfolk Ridge system: Northland Peninsula (New Zealand) and New Caledonia. *Terrane Dynamics – 97: International Conference on Terrane Geology, Christchurch 10–14 February, 1997,* 19–21.

Bruguière, J.G., Lamarck, J.B., Bory de Saint-Vincent, G.M., Deshayes, G.P. & Müller, O.F. (1791–1827) *Tableau Encyclopédique et Méthodique des Trois Règnes de la Nature Contenant L'Helminthologie, ou les Vers Infusoires, les Vers Intestins, les Vers Mollusques, &c. 3 Vols*. H. Agasse, Paris, viii + 180 + 16 pp. + 488 [actually 493] pls. [Plates to Vers, Coquilles, Mollusques et Polypiers: viii + 1–83 p. [p. 84 blank], pls. 1–95 (1791); p. 85–132, pls. 96–189, 107a–c (1792); pls. 190–286 (1797)]

Campbell, H.J., Grant-Mackie, J.A. & Paris, J-P. (1985) Geology of the Moindou-Téremba area, New Caledonia. Stratigraphy and structure of the Téremba Group (Permian-Lower Triassic) and Baie de St-Vincent Group (Upper Triassic - Lower Jurassic). *Géologie de la France,* 1 (1985), 19–36.

Campbell, J.D. (1956) The Otapirian Stage of the Triassic System of New Zealand. Pt II. *Transactions of the Royal Society of New Zealand,* 84, 45–50.

Campbell, J.D. (1959) The Warepan Stage (Triassic): definition and correlation. *New Zealand Journal of Geology & Geophysics,* 2*,* 198–207. http://dx.doi.org/10.1080/00288306.1959.10431323

Campbell, J.D. (1991) A Late Triassic spiriferacean brachiopod (Family Laballidae) from the Taringatura Hills, Southland, New Zealand. *New Zealand Journal of Geology & Geophysics,* 34, 359–363. http://dx.doi.org/10.1080/00288306.1991.9514474

Campbell, J.D. & McKellar, I.C. (1956) The Otapirian Stage of the Triassic System of New Zealand. Pt I. *Transactions of the Royal Society of New Zealand,* 83, 695–704.

Cave, M.P. (1982) Occurrence of *Zoophycos* in Oretian rocks of the Murihiku Supergroup, south Otago, New Zealand. *New Zealand Journal of Geology & Geophysics,* 25, 367–369. http://dx.doi.org/10.1080/00288306.1982.10421501

Cooper, R.A. (Ed.) (2004) The New Zealand Geological Time Scale. *Institute of Geological & Nuclear Sciences Monograph*, 22, 1–284.

Cossmann, A.E.M. (1897) *Revue critique de paléozoologie,, 1,* Cossmann, Paris, 186 pp.

Cox, L.R. (1969a) Family Pachycardiidae Cox, 1961. *In*: Cox, L.R. *et al.* (Eds.), *Part N [Bivalvia], Mollusca 6*, *Vols. 1 & 2*. pp. i–xxxvi + 1–952. *In*: Moore, R.C. (Ed.), Treatise on *Invertebrate Paleontology.* Geological Society of America and University of Kansas, Lawrence, p. N467–N468.

Cox, L.R. (1969b) Family Ceratomyidae Arkell, 1934. *In*: Cox, L.R. *et al.* (Eds.), *Part N [Bivalvia], Mollusca 6*, *Vols. 1 & 2*. pp. i–xxxvi + 1–952. *In:* Moore, R.C. (Ed.), *Treatise on Invertebrate Paleontology.* Geological Society of America and Univerasity of Kansas, Lawrence, pp. N838–N841.

Cox, S.H. (1878) Report on the geology of the Hokanui Ranges, Southland. *Reports of Geological Exploration 1877–78*, 284 pp.

Dana, J.D. (1847) Description of fossil shells of the collections of the exploring expedition under the command of Charles Wilkes, U.S.N., obtained in Australia from the lower layers of the Coal Formation in Illawarra, and from a deposit probably of nearly the same age at Harper's Hill, valley of the Hunter. *American Journal of Science and Arts,* ser. 2, 4*,* 151–160.

Dun, W.S. (1932) The lower marine forms of *Myonia,* with notes on a proposed new genus, *Pachymyonia. Records of the Australian Museum,* 18, 411–414. http://dx.doi.org/10.3853/j.0067-1975.18.1932.745

Fleming, C.A. (1987) New Zealand bivalves of the family Trigoniacea. *New Zealand Geological Survey Paleontological Bulletin,* 53*,* 104 pp.

Fordyce, R.E. (1976) *Zoophycos* from the Torlesse Supergroup, north Canterbury, New Zealand. *New Zealand Journal of Geology & Geophysics,* 19, 289–291. http://dx.doi.org/10.1080/00288306.1976.10423524

Grant-Mackie, J.A. (1959) Hokonui stratigraphy of the Awakino-Mahoenui area, south-west Auckland. *New Zealand Journal of Geology & Geophysics*, 2, 755–787. http://dx.doi.org/10.1080/00288306.1959.10422769

Grant-Mackie, J.A. (1960) On a new *Kalentera* (Pelecypoda: Cypricardiacea) from the Upper Triassic of New Zealand. *New Zealand Journal of Geology & Geophysics,* 3, 74–80. http://dx.doi.org/10.1080/00288306.1960.10423146

Grant-Mackie, J.A. (1978) Systematics of New Zealand *Monotis* (Upper Triassic Bivalvia): subgenus *Maorimonotis. Journal of the Royal Society of New Zealand,* 8, 293–322.
http://dx.doi.org/10.1080/03036758.1978.10429383
Grant-Mackie, J.A. (1981) New Zealand Warepan (Upper Triassic) sequences: Murihiku Supergroup of the North Island. *Journal of the Royal Society of New Zealand,* 11, 231–256.
http://dx.doi.org/10.1080/03036758.1981.10421839
Grant-Mackie, J.A. (1985) The Warepan Stage of the Upper Triassic: redefinition and subdivision. *New Zealand Journal of Geology & Geophysics,* 28, 701–724.
http://dx.doi.org/10.1080/00288306.1985.10422542
Grant-Mackie, J.A. (2009) Jurassic Mollusca. *In*: Gordon, D.P. (Ed.), *The New Zealand inventory of biodiversity. Vol. 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia*. Canterbury University Press, Christchurch, pp. 172–174, 223–224.
Grant-Mackie, J.A. & Lowry, DC. (1964) Upper Triassic rocks of Kiritehere, southwest Auckland, New Zealand. Pt 1: Submarine slumping of Norian Strata. *Sedimentology,* 3, 296–317.
Hector, J. (1879) On the fossil Brachiopoda of New Zealand (abstract). *Transactions of the New Zealand Institute,* 11, 537–539.
Loriol, C.L.P. de (1868) Monographie paléontologique et géologique de l'étage Portlandien de l'Yonne. *Bulletin de la Société des Sciences Historiques et Naturelles de l'Yonne,* 21, 437–696.
MacFarlan, D.A.B. (1992) Triassic and Jurassic Rhynchonellacea (Brachiopoda) from New Zealand and New Caledonia. *Royal Society of New Zealand Bulletin,* 31, 1–310 pp.
MacFarlan, D.A.B. (1998) Mesozoic stratigraphy of the Marokopa area, southwest Auckland. *New Zealand Journal of Geology & Geophysics,* 41, 297–310.
http://dx.doi.org/10.1080/00288306.1998.9514812
Martin, K.R. (1975) Upper Triassic to Middle Jurassic stratigraphy of southwest Kawhia, New Zealand. *New Zealand Journal of Geology & Geophysics,* 18, 909–938.
http://dx.doi.org/10.1080/00288306.1975.10423534
Marwick, J. (1926) Myalinidae from the Jurassic of New Zealand. *Transactions of the New Zealand Institute,* 56, 304–306.
Marwick, J. (1953) Divisions and faunas of the Hokonui System (Triassic and Jurassic). *New Zealand Geological Survey, Paleontological Bulletin,* 21, 141 pp.
Massalingo, A. (1855) *Zoophycos*, *novum genus plantarum fossilium*. Antonelli, Venice, 52 pp.
Mitchell, T.L. (1838) *Three expeditions into the interior of eastern Australia, with descriptions of the recently explored region of Australia Felix, and of the present colony of New South Wales. Vol. 2*. I. & W. Boone, London, 405 pp.
Moore, C. (1861) On the zones of the lower Lias and the *Avicula contorta* zone. *Quarterly Journal of the Geological Society of London,* 17, 483–516.
http://dx.doi.org/10.1144/gsl.jgs.1861.017.01-02.39
Mortimer, N. (2007) New Zealand's geological foundations. *Gondwana Research,* 7, 261–272.
http://dx.doi.org/10.1016/s1342-937x(05)70324-5
Olivero, D. (1996) *Zoophycos* distribution and sequence stratigraphy. Examples from the Jurassic and Cretaceous deposits of southeastern France. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 123, 273–287.
http://dx.doi.org/10.1016/0031-0182(95)00120-4
Olivero, D. (2003) Early Jurassic to Late Cretaceous evolution of *Zoophycos* in the French Subalpine Basin (southeastern France). *Palaeogeography, Palaeoclimatology, Palaeoecology,* 192, 59–78.
http://dx.doi.org/10.1016/s0031-0182(02)00679-x
Polubotko, I.V. (1966) The genus *Ochotomya* (Bivalvia) from the Upper Triassic of the Soviet northeast. *Paleontologicheskiy Zhurnal*, 1966 (3), 13–21. [in Russian]
Quenstedt, F.A. von. (1858) *Der Jura.* H. Laupp'sche Buchhandlung, Tübingen, 842 pp.
Roemer, F.A. (1836*) Die Versteinerungen des norddeutschen Oolithen-Gebirges,Vol. 2.* Hahn'sche Hofbuchhandlungen, Hannover, 2, 75–218.
Runnegar, B. (1965) The bivalves *Megadesmus* Sowerby and *Astartila* Dana from the Permian of eastern Australia. *Geological Society of Australia,* 12, 227–252.
http://dx.doi.org/10.1080/00167616508728594
Sandberger, F. (1864) Beobachtungen im mittleren Jura des badischen Oberlandes. *Würzburger Naturwissenschaftliche Zeitschrift*, 5, 1–22.
Sowerby, J. de C. (1826) *Mineral conchology of Great Britain,* 6 (87–93), 1–86.
Sternberg, K.M. Graf von. (1833) *Versuch einer geognostich-botanischen Darstellung der Flora der Vorwelt.* vol. 6 (of 8), Fr. Fleischer, Leipzig, Prague, 89 pp.
Stevens, G.R. (1980) *New Zealand adrift.* A.H. & A.W. Reed, Wellington, Sydney, London, 442 pp.
Tokuyama, A. (1957) On the Late Triassic rhynchonellids of Japan. *Japanese Journal of Geology and Geography,* 28, 121–137.
Trechmann, C.T. (1918) The Trias of New Zealand. *Quarterly Journal of the Geological Society,* 73, 165–246.
http://dx.doi.org/10.1144/gsl.jgs.1917.073.01-04.10
Waterhouse, J.B. (1969) The Permian bivalve genera *Myonia, Megadesmus, Vacunella* and their allies, and their occurrences in New Zealand. *New Zealand Geological Survey, Paleontological Bulletin,* 41, 1–141.

Wiley, M.L. (1996) *Mesozoic stratigraphy of Creek Aymes-Moindou, west coast, New Caledonia.* Unpublished M.Sc. thesis, University of Auckland Library, 106 pp.

Wissmann, H.L. (1841) Taxonomic names. *In*: Beiträge zur Geognosie und Petrefacten-Kunde des Südöstlichen Tirols vorzüglich der Schichten von St-Cassian. *Beiträge zur Petrefacten-Kunde,* 4, 1–152.

Zittel, K. (1864) Fossile Mollusken und Echinodermen aus Neu-Seeland nebst Beitragen von Herren Bergrath Franz Ritter v. Hauer und Professor Eduard Suess. *In*: Hochstetter, F. von; Hömes, M. & Hauer, F. Ritter von. Paläontologie von Neu-Seeland. *Beiträge zur Kenntnis der fossilien Flora und Fauna der Provinzen Auckland und Nelson. Novara-Expedition, Geologischer Theil*, 1 (2), 15–68.

Appendix 1

Localities from which *Makoiamya cotterallae* are recorded, listed north-to-south and west-to-east for New Zealand and in numerical order of fossil record numbers within each stage for New Caledonia. Collectors include DMcF = D.A.B. McFarlan; FH = F. Hasibuan; HJC = H.J. Campbell; JDC = J.D. Campbell; LRSB = L.R.S. Braithwaite. Artic. = articulated; bch = beach; Bo = Otapirian Stage; Bw = Warepan Stage; ck = creek; *E = Entomonotis; M = Maorimonotis*; *P = Pacimonotis;* sst = sandstone; stm = stream; strat = by stratigraphy; ? = age or identification of *Makoiamya* from this locality uncertain; *ca* = approximately equivalent to.

New Zealand, Warepan Stage

E45/f9904	JDC2090	E45/490459	Main tributary, NW branch Taylors Stm	?Bw		JDC, B. Paterson 18/6/65
R15/f8001	AU1541	R15/612408 to R15/613409	Boulders near Arawi Point, W of mouth of Ngutupuku Ck	Bw	Arawi Shellbed	AP Mason, `1942
R15/f8953	AU1456 AU12711	R15/619409	Arawi coastal cliff 40 m W of Ngutupuku Ck. mouth 2-6 m above beach level,	Bw (with M. maniopotoi)	Arawi Shellbed	JAG-M 1964; JAGM, P. Schäfer 3/91
R15/f8957	AU12704	R15/61974141	Te Arawi, SW Kawhia	Bw (with E. richmondiana)	Arawi Shellbed	JAGM, P Schäfer 3/91
R16/f8528	AU429, AU929, AU1427, AU1864, AU6405, AU11041	R16/592184	Coast 80 m W of S end of Kiritehere Bch., at high tide level; immed above "unconformity"	Bw (with *M. calvata*)	Arawi Shellbed	H. Ferrar & J. Marwick 25/3/36; D. Lowry, 1961, JAG-M 7/59, 24/10/70, 4/75, 9/86
R16/f8724	AU1428, AU1431, AU1870	R16/591184	Coast 90 m W of S end of Kiritehere Bch., at high tide level	Bw (with *M. calvata*)	Arawi Shellbed	JAG-M 1959
R16/f8723	AU1429, AU1865, AU11940 AU12062, AU12295	R16/592184	Kiritehere Coast, 2-3m above *Mon*otis beds	Topmost Bw	Ngutunui	JAG-M 24/10/70, 1960, 21/4/90, 12/11/90; JAGM et al 1/86, 12/88.
R16/f8747	AU1862	R16/973366	Coast, 296 m W of S end of Kiritehere Bch	Topmost Bw (or basal Bo).	Ngutunui	JAGM 1/61
R18/f6777	AU329	R18/562799	Awakino Valley Rd	Bw (with. *E. richmond.*)	Arawi Shellbed	JAGM 10/55