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Altivasum Hedley, 1914 (Gastropoda: Turbinellidae) from South Western Australia

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ABSTRACT This paper seeks to correct the erroneous taxonomy associated with the current understanding of the *Altivasum flindersi* (Verco, 1914) complex based on type revision, morphological differences and geographic separation. Structurally, there are three distinct species that can be differentiated, *Altivasum flindersi* (Verco, 1914), *A. typicum* Hedley, 1916 and *A. profundum* sp. nov. Geographically, these species are not all sympatric, with *A. typicum* restricted to shallower waters, at depths around 20-180 m off the south Western Australian coast, whereas *A. profundum* is located at the edge of the South Western Australian continental shelf, and *A. flindersi* is found off the coast of the Great Australian Bight at similar depths to *A. typicum*. There is an overlap in distribution between *A. typicum* Hedley, 1916 and A. *flindersi* (Verco, 1914) on the western side of the Great Australian Bight where they are often associated with similar habitats.

KEY WORDS Turbinellidae, *Altivasum, A. flindersi A. typicum, A. profundum,* South Australia, Western Australia, taxonomy

INTRODUCTION

The subfamily Vasinae Adams and Adams, 1853, is a worldwide group of marine gastropods, belonging to the family Turbinellidae Swainson, 1835. Within this complex, the monotypic *Altivasum* Hedley, 1914 stands out as a unique large cold water species restricted to the southwestern Australian coast. Many of the marine molluscs that inhabit this region have undergone significant additions to the molluscan fauna (Volutidae: *Amoria weldensis* Bail & Limpus, 2001, *Amoria stricklandi* Bail & Limpus, 2016, *Amoria simoneae* Bail & Limpus, 2003; Cypraeidae: *Zoila raywalkeri* Lorenz, 2011). However, the *Altivasum* has not been examined in any significant detail since the revision of Abbott (1959). However, Abbott (1959) overlooked Hedley (1916) and this has led to long term taxonomic confusion on the status of the *Altivasum* complex (Hinton 1972). This paper argues that the type evidence indicates that *A. flindersi* Verco, 1914 can be divided into two distinct species based on the existing literature, *A. flindersi* Verco, 1914 and *A. typicum* Hedley, 1916. Furthermore, this paper describes one new species that historically has been included within the *A. flinderi* complex. All three *Altivasum* species have a distinctive morphological form, and have distinct ranges, with the range of the new species and *A. flindersi* Verco, 1914 partially overlapped by *A. typicum* Hedley, 1916.

ABBREVIATIONS

AMD: The collection of Aart M. Dekkers,

Purmerend, The Netherlands.
MNHN: Muséum National d'Histoire Naturelle, Paris, France.
NCB: Naturalis Biodiversity Center, Leiden, The Netherlands.
JES: The collection of Jason Earle-Sprague, Melbourne, Australia.
TMC: The collection of Trevor and Marguerite Young, Cannonvale, Australia.
UWC: The collection of Uwe Weinreich, Cairns, Australia.
VCC: The collection of Valda Cantemassa, Proserpine, Australia.
WAM: West Australian Museum, Perth, Australia.
H: Axial height of shell.
W: Width of shell measured at the shoulder.

SYSTEMATICS
Class Gastropoda
Subclass Caeneogastropoda
Order Neogastropoda
Superfamily Turbinelloidea Rafinesque, 1815
Family Turbinellidae Swainson, 1835
(synonym: Vasidae Adams & Adams, 1853)
Subfamily Vasinae Adams & Adams, 1853

Type genus. *Vasum* Röding, 1798.

Diagnosis. Shells in the subfamily are large, heavy, usually prominently sculptured and with two to six irregularly sized columellar plicae on the lower half of the inner parietal wall. The periostracum is thin to heavy. The operculum is horny and somewhat unguiculate in form.

Altivasum Hedley, 1914

Type species. *Latirus aurantiacus* Verco, 1895 (= *Altivasum flindersi* (Verco, 1914) (type by original designation).)

Synonymy.
Altivasum Hedley, 1914, p. 68.
= *Vasum* (*Altivasum*) Hedley – Wenz 1946, p. 1300. Abbott 1950, p. 213. Abbott 1959, p. 25. Wilson, 1994, p. 60.

Diagnosis. The shell is large, globose and solid. The spire is elevated. The anterior canal is short. The shell has several to many elevated spiral rows with or without long, scale-like spines. The columella has three distinctive plicae. The umbilicus is wide and deep. The periostracum is thin and has a brownish yellow colouration. The operculum is horny and unguiculate, with a terminal nucleus.

Altivasum flindersi (Verco, 1914)
(Figures 1, 2A, 6A)

Type material. Verco (1895), p. 89, pl. 2 fig. 1 (Figure 2A), with the physical specimen believed to be in the South Australian Museum (Abbott 1959).

Type locality. Backstairs Passage, South Australia, at a depth of 20-30 m (Verco 1895, p. 90).

Synonymy.
Latirus aurantiacus Verco, 1895, p. 89, pl. 2, figs. 1, la and 1b.
= *Altivasum aurantiacum* Verco ex Hedley , 1914, p. 484.
Altivasum flindersi Verco, 1914, p. 69 (replacement name). Hinton 1972, p. 46, fig. 1a.

Original description. (from juvenile specimen) "Shell ovate-fusiform, very solid. Spire elevated, shorter than the aperture. Whorls six, without the nucleus which is wanting; rather convex, roundly angled just below the middle, and provided with eight or nine rounded well-marked nodules, about equal in width to the intervals, and costate in the lower half of the whorls. Spiral lira eight to ten, distinct, varying

in size, devious, about equal in width to the interstices, and crossed by longitudinal rather distant scabrous lines of growth. Suture distinctly marginate, sinuous, ascending between the costae, 'edge crinkled by imbricating growth lines. First and second whorls nearly destroyed by fine borings. Last whorl subventricose, shouldered at six lines from the suture, very slightly concave above, convex below, narrowing rapidly to its minimum at the middle point of the ventral surface; with nine very valid longitudinal costae, flatly rounded, rather wider than the interspaces, highest at the shoulder, which abruptly points them, very slightly marked above the shoulder, gradually narrowing and subsiding below, to disappear at the middle of the base. Well-marked spiral lira sub-equidistant (16 in the whorl), with an occasional spiral thread between the more distant (four in the whorl). Above the shoulder the lira, five in number, are narrowest; below it they gradually increase in size anteriorly, rounded, not quite as wide as the interstices. Whole surface roughened by close-set (two to the line) subvertical, imbricating, crinkled, incremental laminae. Suture rather widely margined, sinuous, generally ascending between the costae, conspicuously crinkled by longitudinal laminae. Umbilicus small, partly covered by the inner lip, which is somewhat reflected into it, left margin slightly corrugated by varix of the notch. Columella nearly straight in its lower half; three distinct equal plaits, slightly oblique, the lowest corresponding with the prolongation backwards of the varix of the apertural notch. Aperture obliquely ovate, an inconspicuous narrow ascending posterior sinus formed by the marginate suture. Canal about one-third of the whole aperture, open, wide, slightly deviated to the left, notched anteriorly, very slightly recurved. Outer lip acute, thin, a little everted, due to incipient formation of a costa, crenated by the spiral lira of the whorl, which also form sulcations within; internally of a deep salmon color at the margin, fading into the polished bluish white throat, and with somewhat darker red lines in the lirate depressions. Inner lip thin, a little spread over the columella, and partially occluding the umbilicus, of a glistening pearly-white color with a rusty tinge, especially between the plaits and near the upper part of the aperture. Ornament, a rusty salmon color most marked near the margin of the aperture, nearly hidden elsewhere by some green adventitious deposit. Operculum ovate, acute, nucleus at anterior apex. Length, 46 mm; greatest breadth, 27 mm; length of aperture, 27 mm; width, 10 mm; of spire, 19-20 mm. The shell most allied appears to be *L. concentricus*, Reeve. My shell is not so thick, the costae and lira are more numerous and not so valid; the last whorl is longer relatively to the spire" (Verco 1895, p. 89, pl. 2, fig. 1)

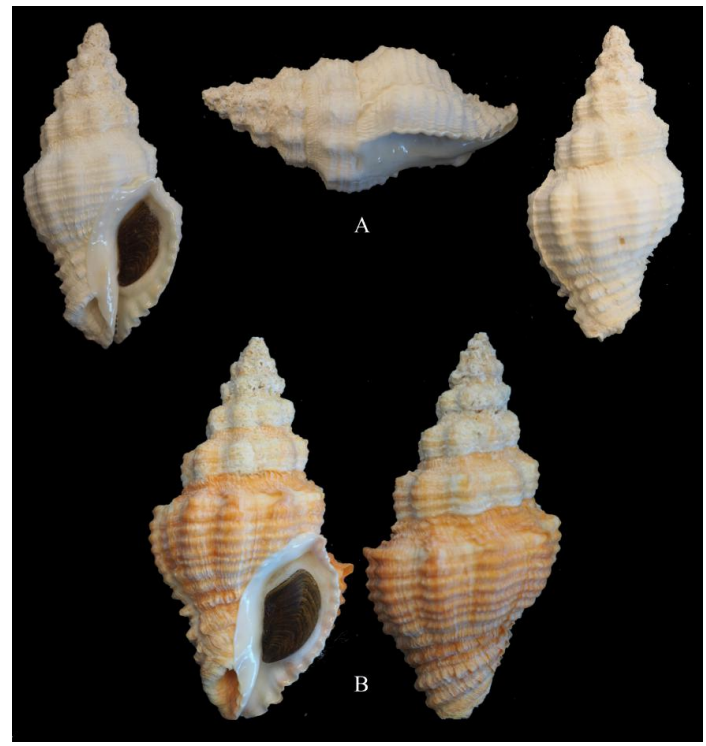

Figure 1. A = *A. flindersi* (Verco, 1914). Thorny Passage, South Australia. H 91.1 mm W 46.8 mm (AMD VAS0178). **B** = *A flindersi* (Verco, 1914). Port Lincoln, South Australia. Dived 10-20 meter in gravely sand gutters. H 110.3 mm W 57.2 mm (MNHN IM-2014-6965).

Supplementary diagnosis. The shell is of medium size and solid, typically below 130 mm in length. The shell is not spinose on the later whorls. The colour ranges from burnt orange to creamy orange to white. The shell has approximately eight whorls. The early teleoconch bears seven to nine blunt, axial nodules with four spiral lines crossing it and smaller riblets in between. The body whorl has eleven broad axial ribs gradually disappearing anteriorly. Above the shoulder, the axial ribs are crossed by three larger spirals with a smaller spiral in the interspaces. Occurring between the shoulder and the anterior are eleven or twelve strong spiral ribs with smaller ribs in the interspaces. The suture is wavy, bordered below by a scaly fimbriated broad thread. The shell is completely covered with axially aligned small scales, becoming stronger on the more dominant ribs near the anterior. Overall, the shell has a very rough appearance caused by the ribbing and the axially aligned scales. The aperture is ovate, bright white within, and glossy. There is a small shallow posterior canal. The labrum is slightly reflected. The columella bears two small, slightly slanting plicae, with a third plica towards the edge of the siphonal canal. The siphonal canal is narrow and not reflected upwards. The umbilicus is rather large, funnel-shaped and deep. The brown operculum is somewhat obovate, with a nucleus at the anterior point.

Habitat and distribution. Known from the Great Australian Bight, this species can be found within a typical depth range 10-30 m. However, crabbed examples are known down to 180 m. (Ray Walker, personal communication) Examples at hand (AMD) from Port Lincoln were collected in gravelly sand gutters at 10-20 m.

Material and records. Thorny Passage, South Australia, dived in 20-30 m, H 91.1 mm, W 46.8 mm, operculum 24.5 x 12.8 mm, (AMD VAS0178); Thorny Passage, South Australia, dived in 20-30 m, H 97.5 mm, W 51.0 mm, (AMD VAS0177); Port Lincoln, South Australia, dived in 10-20 m in gravelly sand gutters, H 110.3 mm, W 57.2 mm, (MNHM IM-2014-6965); Port Lincoln, South Australia, dived in 10-20 m in gravelly sand gutters, H 103.6 mm, W 56.1 mm, (AMD VAS0046); Off Port Lincoln, Eyre Peninsula, South Australia, Australia, upon sand/gravel substrate, amongst seaweeds and algae, 46 m, dived, 2000 (JES).

Remarks. The original description as *Latirus aurantiacus* Verco, 1895 was determined to be a junior homonym of *L. aurantiacus* Montfort, 1810, a Fascolariidae species. Verco (1914) corrected this by erecting *Altivasum flindersi* (Verco, 1914).

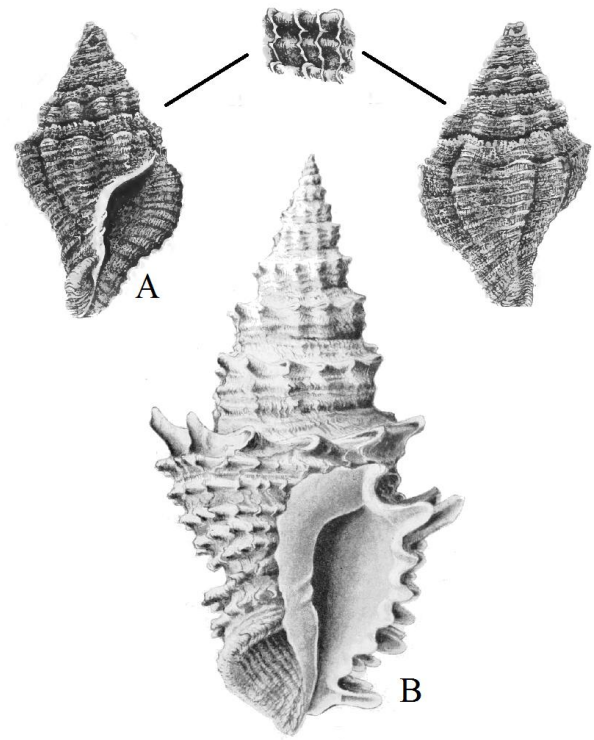

Figure 2. The images of the types of *Altivasum*: **A** = *Latirus aurantiacus* Verco, 1895 (Verco, 1895, pl. 2, figs. 1, la and 1b); **B** = *A. typicum* Hedley, 1916 (Hedley 1914, pl. 9, fig. 2).

Altivasum flindersi (Verco, 1914) has also been confused with the much larger and coarser spined *A. typicum* Hedley, 1916. *Altivasum flindersi* rarely attains a length greater than 110 mm, and shares a variable colouration with *A. typicum* ranging from bright reddish to creamy orange to white, which is in contrast to the similarly sized *A. profundum* sp. nov., which is known only in white. *Altivasum flindersi* differs further from *A. profundum* by the higher number of spiral ribs and a smaller single interspace rib. Furthermore, *A. flindersi* differs in having a straight siphonal canal unlike the slightly dorso-reflected canal of *A. profundum*.

Altivasum typicum Hedley, 1916
(Figures 2B, 4, 6B)

Type material. Hedley (1916), p. 69 pl. 9, fig. 2 (Figure 2B).

Type locality. Great Australian Bight between Longitude 126º and 129º, 220 m (crabbed).

Synonymy.
Altivasum typicum Hedley, 1916, p. 207.
Altivasum aurantiacum Verco – Hedley 1914, p. 69, pl. 9, fig. 2.
Altivasum flindersi Verco – Hinton 1972, p. 46, fig. 1. Wilson and Gillet 1971, p. 112, pl. 7 fig. 3. Wells and Bryce 1986, p. 114, fig. 436.
Vasum flindersi Verco – Wilson 1994, p. 60, pl. 8, figs. 12a and b.

Original description. "Shell large for its size rather light and thin, ovate-acuminate, broadly and deeply perforate. Colour uniform salmon red. Whorls eleven, graduate, slowly increasing, angles at the suture, contracted at the base then produced to the canal. Apex mucronate, of two smooth whorls. Epidermis thin, membranous and easily shredded. Sculpture: low broad radial ribs ascend the spire obliquely at the rate of about a dozen to a whorl, but vanish on the last. There are eight spiral cords, the four lower are wider spaced than those above, of which two ascend the spire. Each cord carries distant high vaulted scales, sometimes projecting as long spines, those on the shoulder and the base being most developed, set at the rate of twelve to fifteen to a whorl. Besides, there is an unarmed spiral beneath the suture and another margining the umbilicus. Perforation broad and deep, expanding finally and penetrating as a spiral tube to the earlier whorls, its surface is spirally grooved and transversely scaled. Aperture elliptical, outer lip fimbriated by incipient scales, inner lip spread above on the preceding whorl for s short space, then projecting free for the rest of its course. Above, the aperture is slightly channeled, below it passes into a short narrow and recurved canal. Deep within the aperture, and low on the columella, appear three strong well-spaced plaits, of which the lowest nearly overlies the umbilical margin of the former whorl. Length, 130; breadth 65 mm" (Hedley, 1914, pp. 69 and 70).

Supplementary diagnosis. The solid shell is large, typically ranging in height from 130-190 mm, with rare examples achieving 230 mm in length. The shell is strongly spinose on the later whorls. The colour ranges from orange to pure white. The shell has approximately twelve whorls, the early teleoconch bearing nine to eleven blunt, axial nodules. The later teleoconch developing short anteriorly open knob-like spines which morph gradually into long, slightly recurved, anteriorly open, tubular spines of about 20 mm. The protoconch of one slightly swollen nuclear whorl is round and smooth. Spiral sculpture on post-nuclear whorls consist of five to six raised threads, the most centred one being nodulated. The suture is wavy, indented and bordered directly below by a raised fimbriated thread. Shoulder of the last whorl bears the largest spines, and below this

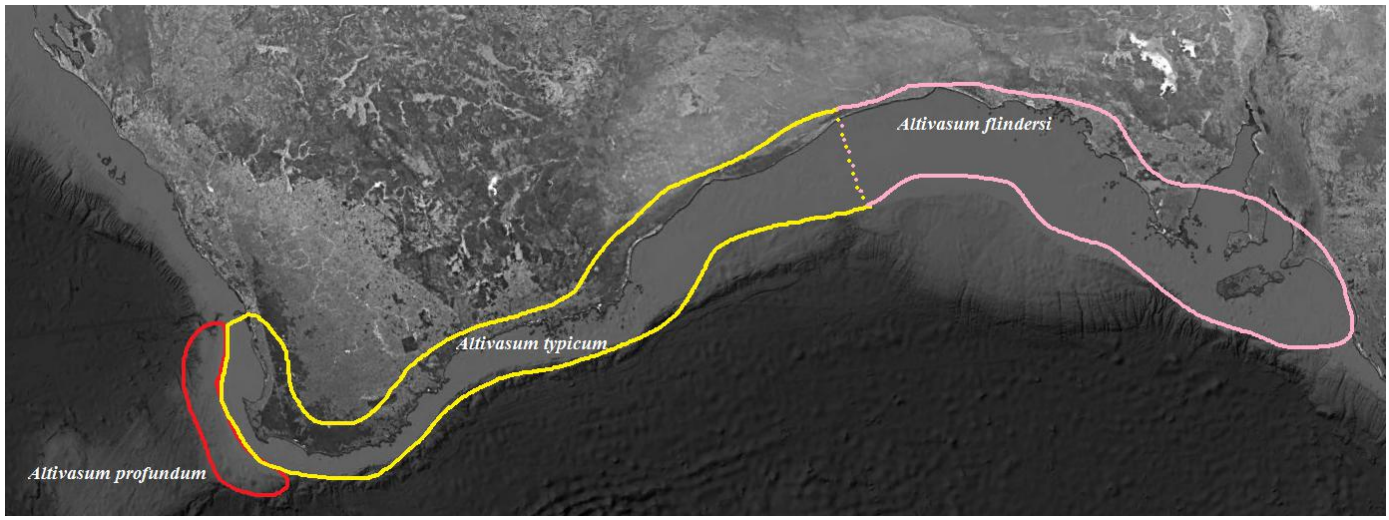

Figure 3. The apparent distribution of *Altivasum* species in southwestern Australia.

row are seven to eight crowded spiral rows of smaller spines. The aperture is ovate and bright white within. The siphonal canal is narrow. The umbilicus is rather large, funnel-shaped and very deep. The periostracum is thin, translucent-brown and coriaceous.

Habitat and distribution. This species is known from southeastern Australia, ranging from Geraldton to the eastern Great Australian Bight and typically in depths of 10-180 m (Figure 3).

Material and records. Fremantle, Western Australia (Wilson 1994); Jurien Bay, Western Australia, L 167.0 mm (Wilson 1994); Off Augusta, Western Australia, Australia, upon coarse sand/rubble/detritus substrate, 40-80 m, craypot, 1989 (JES); Geraldton, 180 m crabbed, 1992 (VCC); Esperance, Western Australia, crabbed, H 222.0 mm (UWC); Unlocalised Great Australian Bight, deep water lobster pots, H 135.0 mm W 75.0 mm (AMD VAS0181); Unlocalised Great Australian Bight, 180 m (VCC); Cape Leeuwin, south-west Australia, crabbed from lobster pots in very deep water, 2015, H 103.0 mm W 52.0 mm (juvenile, AMD VAS0160).

Remarks. Hedley (1916) erected *A. typicum* to replace *Latirus aurantiacus* Verco, 1895, which is described based on a single juvenile specimen of *A. flindersi*. Hedley (1916) provided a full description that clearly articulates a new

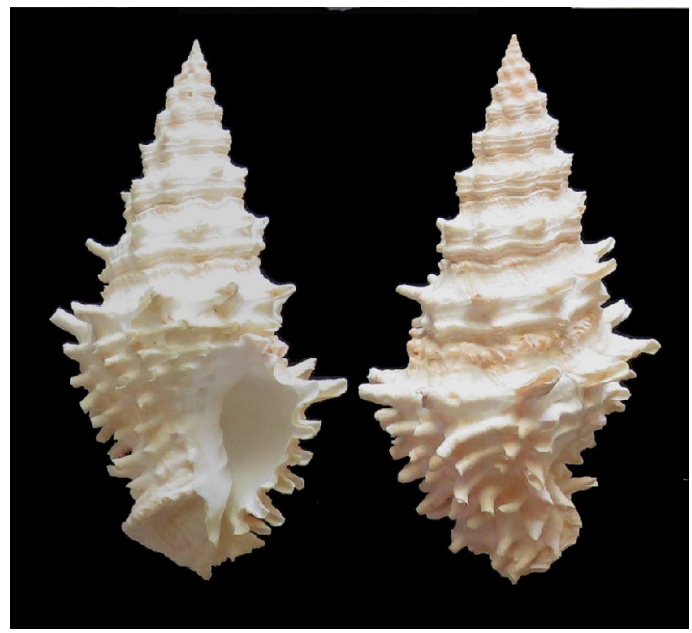

Figure 4. *Altivasum typicum* Hedley, 1916, Esperance, Western Australia, crabbed, H 222.0 mm (UWC).

species. Both *Altivasum flindersi* and *A. typicum* have been found together in 30-40 m along the south coast of Australia at Bald Island between

Albany and Esperance. The late Peter Clarkson found both species at Esperance and he thought these different forms represented a case of sexual dimorphism (Ray Walker, personal communication). However, anatomical studies have established that this is not the case and that they are two distinctive species that share a partial range overlap (Ray Walker, personal communication).

Altivasum profundum Dekkers and Maxwell, 2018, new species
(Figures 5, 6C)

Type material. Holotype: Off Augusta, West Australia, ROV – collected at 162 m, H 77.0 mm, W 38.5 mm. see Figure 3. (WAM No. 72381.)

Paratypes:

Paratype 1, H 81.4 mm, W 42.6 mm (WAM No. 72382) Windy Harbour, between 130-150 m;
Paratype 2, H 69.8 mm, W 38. mm (VCC);
Paratype 3, H 70.3 mm, W 37.7 mm (MNHN – IM-2014-6963);
Paratype 4, H 73.5 mm, W 38.5 mm (MNHN – IM-2014-6964);
Paratype 5, H 77.7 mm, W 41.7 mm (NCB no. RMNH.MOL.340751);
Paratype 6, H 52.0 mm, W 27.2 mm (NCB no. RMNH.MOL.340752);
Paratype 7, H 122.5 mm, W 62.0 mm (AMD VAS0129);
Paratype 8, H 112.6 mm, W 58.7 mm (AMD VAS0141);
Paratype 9, H 63.4 mm, W 34.2 mm (AMD VAS0182);
Paratype 10, H 65.3 mm, W 36.9 mm (AMD VAS0183);
Paratype 11, H 68.9 mm, W 36.4 mm (AMD VAS0184);
Paratype 12, H 69.4 mm, W 35.5 mm (AMD VAS0185);
Paratype 13, H 60.4 mm, W 33.7 mm (AMD VAS0186);
Paratype 14, H 64.9 mm, W 34.4 mm (AMD VAS-187);
Paratype 15, H 75.7 mm, W 39.4 mm (AMD VAS0142).

All paratypes from off Windy Harbour, were ROV collected between 130-150 m, crabbed, with exception of paratype 7 from off Augusta ROV collected from 165 m. Paratype 3 was live collected and the operculum is preserved. Paratypes 11-15 have damaged outer lips most likely due to crab attacks. The smaller ones are likely not adult.

Type locality. Off the east coast of Augusta, Western Australia in 180 m of water.

Figure 5. *Altivasum profundum* Dekkers and Maxwell, 2018, new species, off Augusta, West Australia, ROV-collected at 162 m, H. 77.0 mm, W. 38.5 mm, Holotype.

Description. The shell is medium sized and solid, up to 130 mm, not spinose on the later whorls and pure white in colour. The shell has approximately eight whorls. The early whorls bear seven to nine blunt, axial nodules with two spiral lines crossing them. On the body whorl,

the axial nodules extend to at least half the whorl, with six or seven spiral lines crossing them. The suture of the teleoconch is wavy, and is not bordered below by a fimbriated thread. The anterior part of body whorl bearing wide spaced coarse spiral lines.

The fimbriated thread appearing on the last part of the body whorl where some small scales may also occur. The aperture is ovate, bright white within and glossy. There is a small shallow posterior canal. The labrum is slightly reflected. The columella bears three small, spiral and slightly slanting plicae. The siphonal canal is narrow and slightly reflected dorsally. The umbilicus is moderately large, funnel-shaped and deep. The brown operculum is obovate with the nucleus at the anterior point.

Habitat and distribution. *Altivasum profundum* is a deep water species which is known only from the continental shelf at a depth of 130-200 m in southwestern Western Australia (Figure 3). There is no record of *A. profundum* from outside that depth range (Ray Walker pers. com.)

Remarks. *Altivasum profundum* has been historically conjoined with the much larger and coarsely sculptured *A. typicum*. However, the new species seldom attains a length greater than 110 mm, this is in contrast to *A. typicum* in which adults achieve lengths over 130 mm. Morphologically the new species differs from *A. typicum* in the lack of spines on the lower body whorl, and also lacks the scaly, fimbriated thread just under the suture found in that species. The new species is always white, while other species of *Altivasum* have varying colour morphs.

The new species is found consistently around the outside edge of the continental shelf, and therefore, *A. profundum* demonstrates a clear depth based distinction to *A. typicum,* which is typically found in shallower waters from 20-140 m. Rare examples are known from deeper waters to 180 m (Ray Walker, personal communication). Almost all type material has been ROV collected and these records indicate that there are no morphological intergrades between the two species (Ray Walker, personal communication).

Etymology. The Latin name *profundum* is the second declension nominative meaning abyss or depth. This name was chosen to indicate the habit preference and highlight the difference between the new species and the shallower water dwelling *Altivasum* species.

Discussion. The morphological differences that enable recognition of each *Altivasum* species are in the descriptions, with most important aspects for the differentiation given in a comparative table (Table 1, Figure 6). The restricted geographic range of *A. profundum* nov. sp. to southern Western Australia is also a helpful characteristic that enables differentiation from the similarly sized *A. flindersi* which is restricted to the eastern Great Australian Bight. Thus far the larger iconic *A. typicum*, currently misclassified as *A. flindersi*, has been illustrated the most in literature and is likely the commonest encountered species in private collections, though all three species are scarce.

Altivasum profundum maybe the remnant of the last interglacial maxima population that did not migrate with rising sea levels over the flooded sea terrace (Yokoyama, *et al.* 2001). This is not case for *A. flindersi* and *A. typicum,* both of which colonized the flooded landmass. Furthermore, we predict a fourth species may exist in the deep water to the south of the Great Australian Bight, where a similar plateau exists at depths similar to that which contains *A. profundum.*

Characteristic	*A. profundum*	*A. flindersi*	*A. typicum*
Size	< 130mm	< 130 mm	> 130mm
Subsutural cord	With fimbriations	Smooth	With fimbriations
Colour	Always white	Burnt orange to white	Orange, yellow, white
Spire	7-9 blunt axial nodules with 2 spiral lines crossing them	Axial nodules with 4 spiral lines crossing it and smaller riblets in between	9-11 blunt axial nodules, the later whorls developing short anteriorly open knob like spines that morph gradually into anteriorly open tubular spines of about 20 mm
Suture	Wavy, but not bordered by a fimbriated thread [only on the very last part of the body whorl]	Wavy, bordered below by a scaly fimbriated broad thread	Wavy, indented, bordered below by a raised fimbriated thread which becomes scaly
Dorsal mid-body whorl	Axial nodules extend to at least half the whorl, with 6-7 spiral lines crossing them	Axially aligned scales	Spinose, the largest spines on the shoulder
Anterior dorsal body whorl	Wide spaced coarse spiral lines	Scales get stronger	Strongly spinose on 6-7 spiral rows

Table 1. Comparative table of structural characteristics of *Altivasum* Hedley, 1914.

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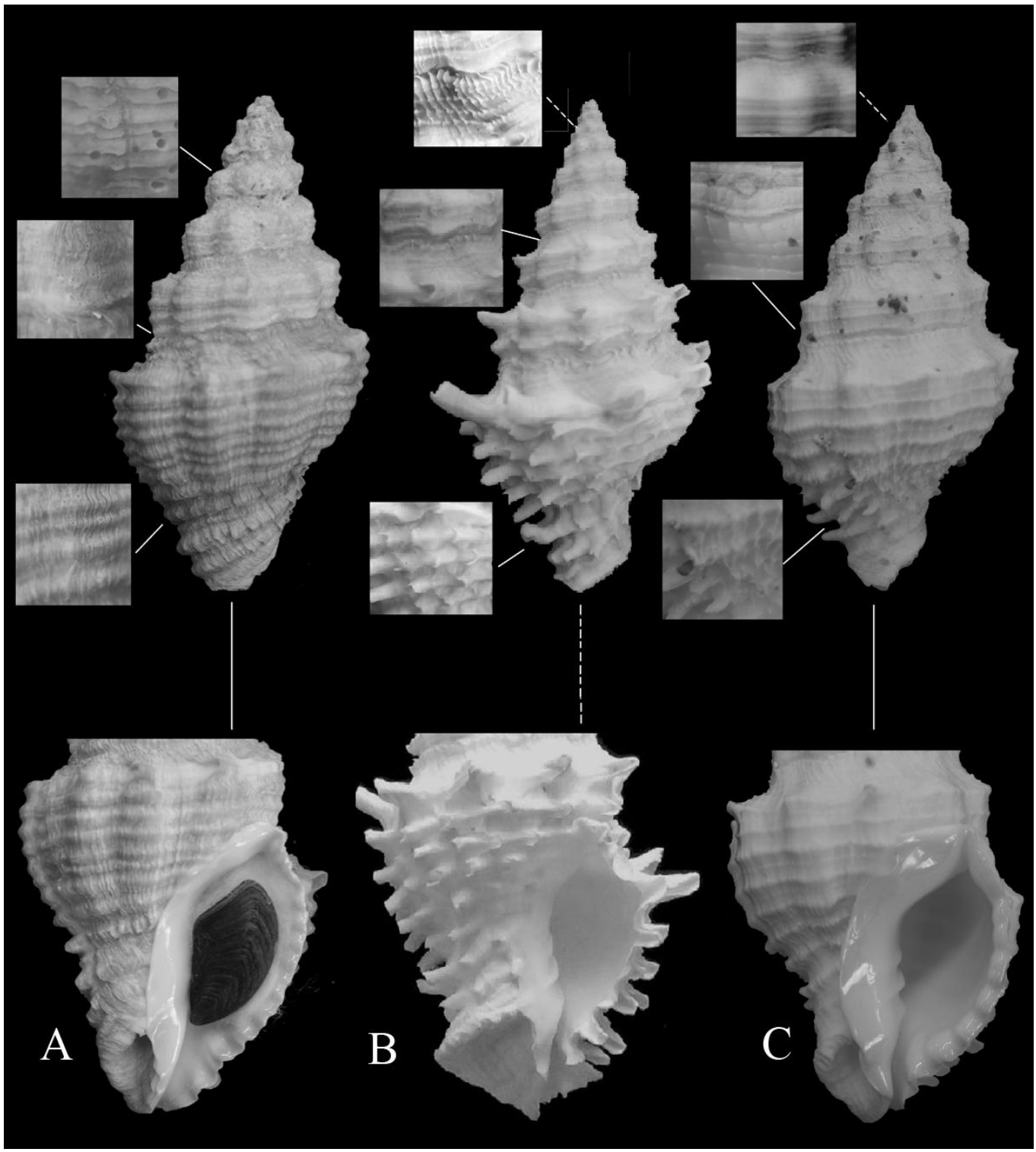

Figure 6. Comparative images of *Altivasum* taxa showing changes in shell morphology as the shell develops: **A** = *A. flindersi* Thorny Passage, South Australia, dived in 20-30 m (MNHN IM-2014-6965); **B** = *A. typicum* Thorny Passage, South Australia, dived in 20-30 m, Esperance, western Australia, dived 30 m, among rocks and sand: (UWC); **C** = *Altivasum profundum* nov.sp. Windy Harbour ROV collected at 136 m. Paratype AMD VAS0141.