

A new species of scale-worm (Polychaeta: Polynoidae), *Lepidonotopodium jouinae* sp. nov., from the Azores Triple Junction on the Mid-Atlantic Ridge

Daniel DESBRUYÈRES¹ and Stéphane HOURDEZ²

¹ Ifremer, Centre de Brest, BP 70, 29280 Plouzané, France.

E-mail: ddesbruy@ifremer.fr

² Station Biologique, UPMC-CNRS-INSU, BP 74, 29682 Roscoff Cédex, France.

E-mail: hourdez@sb-roscoff.fr

Abstract: A new species of scale-worm, *Lepidonotopodium jouinae*, belonging to the sub-family Lepidonotopodinae (Polychaeta: Polynoidae) has been found in samples collected on deep-sea hydrothermal vent fields at the Azores Triple Junction on the Mid-Atlantic Ridge. It is the first species of Polynoidae described from the Mid-Atlantic Ridge hydrothermal vents. Other species of the same genus have been described from hydrothermal vents of the Pacific Ocean.

Résumé : Une nouvelle espèce de Polynoidae (Polychaeta), *Lepidonotopodium jouinae* sp. nov., du Point Triple des Açores, sur la Dorsale Médio-Atlantique. *L. jouinae* sp. nov., appartenant à la sous-famille des Lepidonotopodinae, a été trouvée dans des échantillons récoltés sur les sites hydrothermaux profonds du Point Triple des Açores sur la Dorsale Médio-Atlantique. C'est la première espèce de Polynoidae décrite provenant des sites actifs de la Dorsale Médio-Atlantique. D'autres espèces du même genre ont été décrites dans la faune des sources hydrothermales de l'Océan Pacifique.

Keywords: Annelida, Polychaeta, Polynoidae, deep-sea, hydrothermal vent, Mid-Atlantic Ridge.

Introduction

Since the discovery of deep-sea hydrothermal vent communities in 1977 (Lonsdale, 1979), about 40 species of Polynoidae have been described as living in these areas. Pettibone described the first hydrothermal vent species of Polynoidae in 1983, *Lepidonotopodium fimbriatum*, from the hydrothermal area off Western Mexico at 21°N and she erected a new subfamily, Lepidonotopodinae, for this unusual species. Five other Lepidonotopodinae, belonging to two genera, have then been described: *Lepidonotopodium*

williamsae and *L. riftense* Pettibone, 1984 from the Galápagos Rift, *L. piscesae* Pettibone, 1988 (Pettibone, 1990) from the Explorer Ridge, *L. minutum* Pettibone, 1989 from the Mariana Back Arc Basin, the branchiate *Thermopolynoe branchiata* Miura, 1994 from the Lau Back Arc and North Fiji Basins and finally *L. atalantae* Desbruyères & Hourdez, 2000 from 9°50' and 13°N on the East Pacific Rise. In 1985, the first hydrothermal vents on the Mid-Atlantic Ridge were discovered (Rona et al., 1986) in the TAG (Trans-Atlantic Geotraverse) area. Other vent sites have later been discovered: Lucky Strike, Snake Pit, Broken Spur, Fifteen Twenty, Menez Gwen, Rainbow (see Van Dover et al., 1996 and Desbruyères et al., in press). Although these latter report some species of Polynoidae, no taxonomic work on this family has been published to date.

Reçu le 16 février 2000; accepté après révision le 16 mai 2000.

Received 16 February 2000; accepted in revised form 16 May 2000.

Only the very abundant species *Amathys lutzi* Desbruyères & Laubier, 1996 (Ampharetidae) has been described.

In this paper we describe *Lepidonotopodium jouinae*, a new species of Lepidonotopodinae from the Azores Triple Junction area on the Mid-Atlantic Ridge, which has been found among *Bathymodiolus azoricus* Von Cosel, Comtet & Krylova, 1999, washings.

Material and methods

Type locality: Mid-Atlantic Ridge, 37°17'18"N, 32°16'29"W, 1690 meters depth ("Tour Eiffel" site on the Lucky Strike vent field). Animals found in *Bathymodiolus azoricus* washings.

Type material: Holotype (Muséum National d'Histoire Naturelle, MNHN Paris n° POLY 45) from 37°17'18"N, 32°16'29"W, 1690 m depth (Cruise DIVA2, *Nautilé* dive 920, Lucky Strike vent field, Eiffel Tower vent site). Paratypes (MNHN Paris POLY 45; National Museum of Natural History, Smithsonian Institution, Washington DC, USNM) from the Lucky Strike vent field [Cruise Diva 2, *Nautilé* dive 916 (11 specimens) from Bairro Alto vent site, cruise Marvel *Nautilé* dive 1193 (43 specimens) Eiffel Tower vent site].

Other 176 specimens of *Lepidonotopodium jouinae* sp. nov. have been found on the Lucky Strike vent field (sites "Tour Eiffel", "Nuno", "Sintra", "Isabel", "L'Aiguille", "Bairro Alto" and "PP24") and the Menez Gwen vent field (37°51'40"N, 31°31'10"N, site "Annabelle"). They have been collected during 26 dives during the cruises DIVA1 (1994), DIVA2 (1994), MARVEL (1997) and PICO (1998).

Specimens, fixed with 10% formalin in sea water and preserved in ethanol, were prepared for SEM. The specimens were critical point dried with carbon dioxide, sputtered with gold-palladium and examined with a Philips scanning electron microscope (XL30).

Description of *Lepidonotopodium jouinae* sp. nov.

The holotype is 8 mm long for 24 segments, and 5 mm wide including chaetae. The largest paratype has a length of 14 mm for 23 segments, the smallest has a length of 4.8 mm for 19 segments. The body is short, suboval in outline, flattened dorsoventrally, slightly tapered and rounded anteriorly and posteriorly. Specimens appear light brown after preservation. Notopodial chaetae are straw coloured, often covered by mineral deposits. Neuropodial chaetae are gold coloured.

The eleven pairs of elytra are located on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19 and 21 (Fig. 1a). They cover the dorsum and are attached eccentrically on prominent elytophores, with dorsal cirri on the posterior segments.

The elytra are opaque, oval to subreniform, imbricate, appearing smooth to the naked eye. Under the scanning electron microscope (Fig. 2a, c, d), the elytral surface in the non-overlapping area, appears covered with numerous globular (10 µm in diameter) or clavate (up to 27 µm long) micropapillae (Fig. 2c). The dorsal cirri on segments lacking elytra have cylindrical cirrophores, attached dorsoposteriorly on the notopodia (Figs 2b, 3b), and are slightly bulbous with tapering tips. They extend well beyond the tip of the neurochaetae. The dorsal tubercles on the elytophorous segments are large and inflated (Fig. 2b). The surface of both the elytophorous and cirrigerous segments have some bands or tufts of cilia (Fig. 2b). There are two transversal ciliated ridges per segment on the first 12 segments and only one per segment on the remaining posterior segments.

The prostomium is bilobed, the anterior lobes subtriangular, each with a small frontal filament; lateral antennae are absent (Fig. 1b, c). The median antenna is inserted in the anterior notch, having a short cylindrical ceratophore and a short subulate style. The palps are slightly subulate, about one and a half times the length of the prostomium. Eyes are lacking. The first or tentacular segment is not visible dorsally (Fig. 1b). The tentaculophores of the tentacular segment are lateral to the prostomium (Fig. 1c) and lack chaetae. The styles are smooth and tapered. The styles of the dorsal tentacular cirri are 1.5 times longer than that of the ventral ones and they are longer than the palps, while the ventral ones are subequal in length to the palps. The facial tubercle is lacking.

The second or buccal segment bears the first pair of large elytophores, and biramous parapodia (Fig. 1b, c). The two ventral or buccal cirri are attached basally on prominent cirrophores lateral to the ventral mouth; they are similar in shape to the tentacular cirri and are longer than the following ventral cirri. The mouth is enclosed in upper, lateral and posterior lips between segments 1 and 2. Six pairs of unequal pear-shaped papillae and two median papillae encircle the opening of the extended pharynx. The two median papillae are shorter than the six other pairs (Fig. 1d). The two pairs of dorsal and ventral hooked jaws are minutely serrated with numerous teeth (Fig. 1e).

The biramous parapodia have shorter notopodia located on the anterodorsal sides of the longer neuropodia (Fig. 3a-d). The notopodium is subconical, with acicular lobe, and is enclosed by a flaring bract, more developed posteriorly due to the presence of the aciculum. The neuropodium is deeply cleft in the upper and lower part, with a long conical prechaetal acicular lobe and a shorter rounded postchaetal lobe. Tufts of bacteria-like filaments are located on the margin of neuropodia and notopodia, and on the chaetae (Fig. 3a-d). The notochaetae are numerous, forming thick

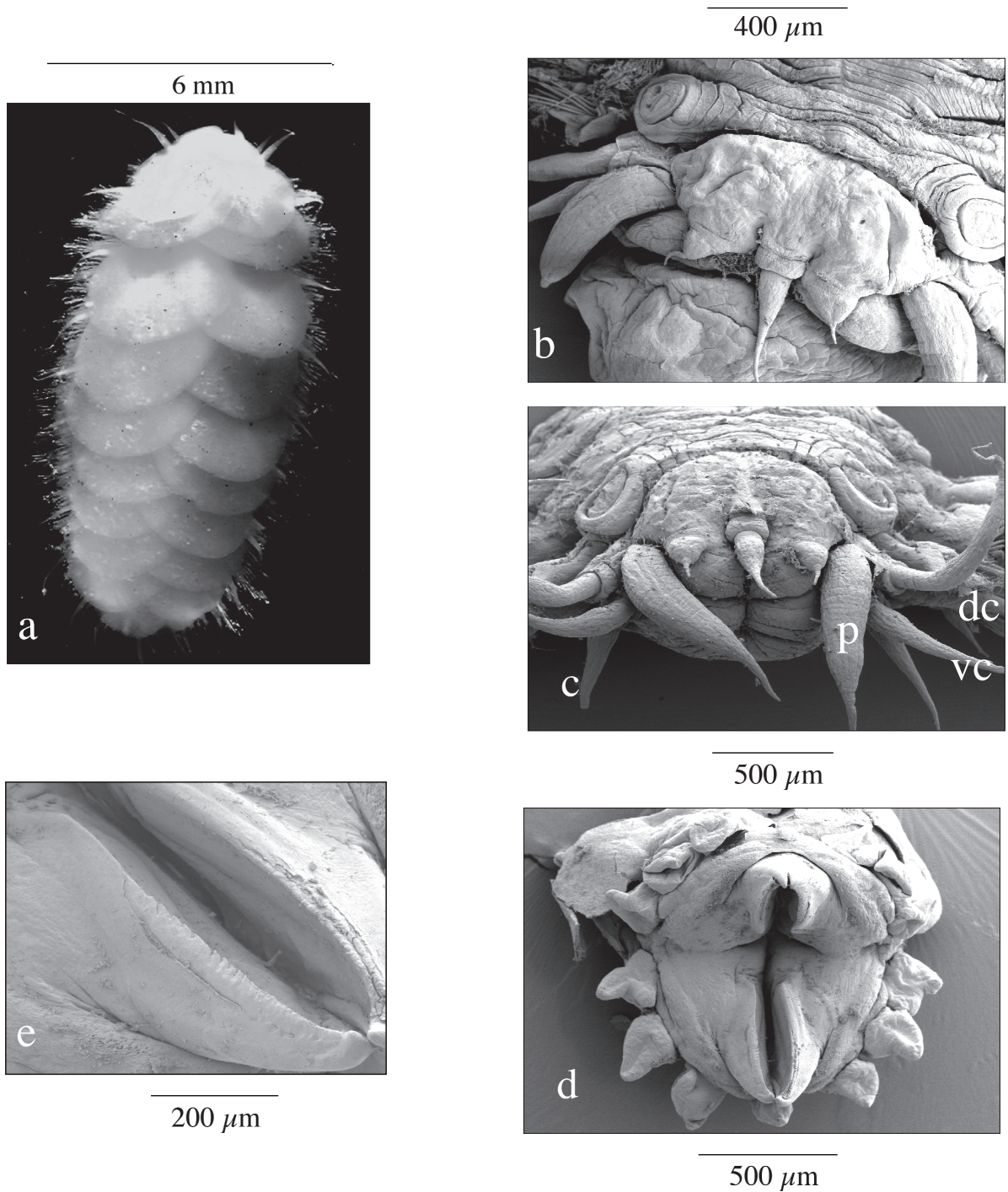


Figure 1. *Lepidonotopodium jouinae* sp. nov. **a.** light and **b-e.** SEM views. **a.** Formalin preserved specimen in dorsal view. **b.** Dorsal view of the prostomium (pharynx everted) and first segments. **c.** Fronto-dorsal view of the prostomium with palps and buccal cirri. (*p*) palps, (*vc*) ventral buccal cirrus, (*dc*) dorsal buccal cirrus. **d.** Frontal view of the everted pharynx with the two pairs of jaws and six pairs of buccal papillae plus one mediodorsal and one medioventral papillae. **e.** Detail of the ventral pair of jaws.

Figure 1. *Lepidonotopodium jouinae* sp. nov. **a.** vue en microscopie optique et **b-e.** vues en microscopie électronique à balayage (MEB). **a.** Habitus d'un spécimen fixé au formol en vue dorsale. **b.** Vue dorsale du prostomium et des premiers segments. **c.** Vue fronto-dorsale du prostomium avec ses palpes et cirres buccaux. (*p*) palpes, (*vc*) cirre buccal ventral, (*dc*) cirre buccal dorsal. **d.** Vue frontale du pharynx dévaginé montrant les deux paires de mâchoires et les six paires de papilles buccales plus une papille médioventrale et une médiodorsale. **e.** Détail de la paire de mâchoires ventrale.

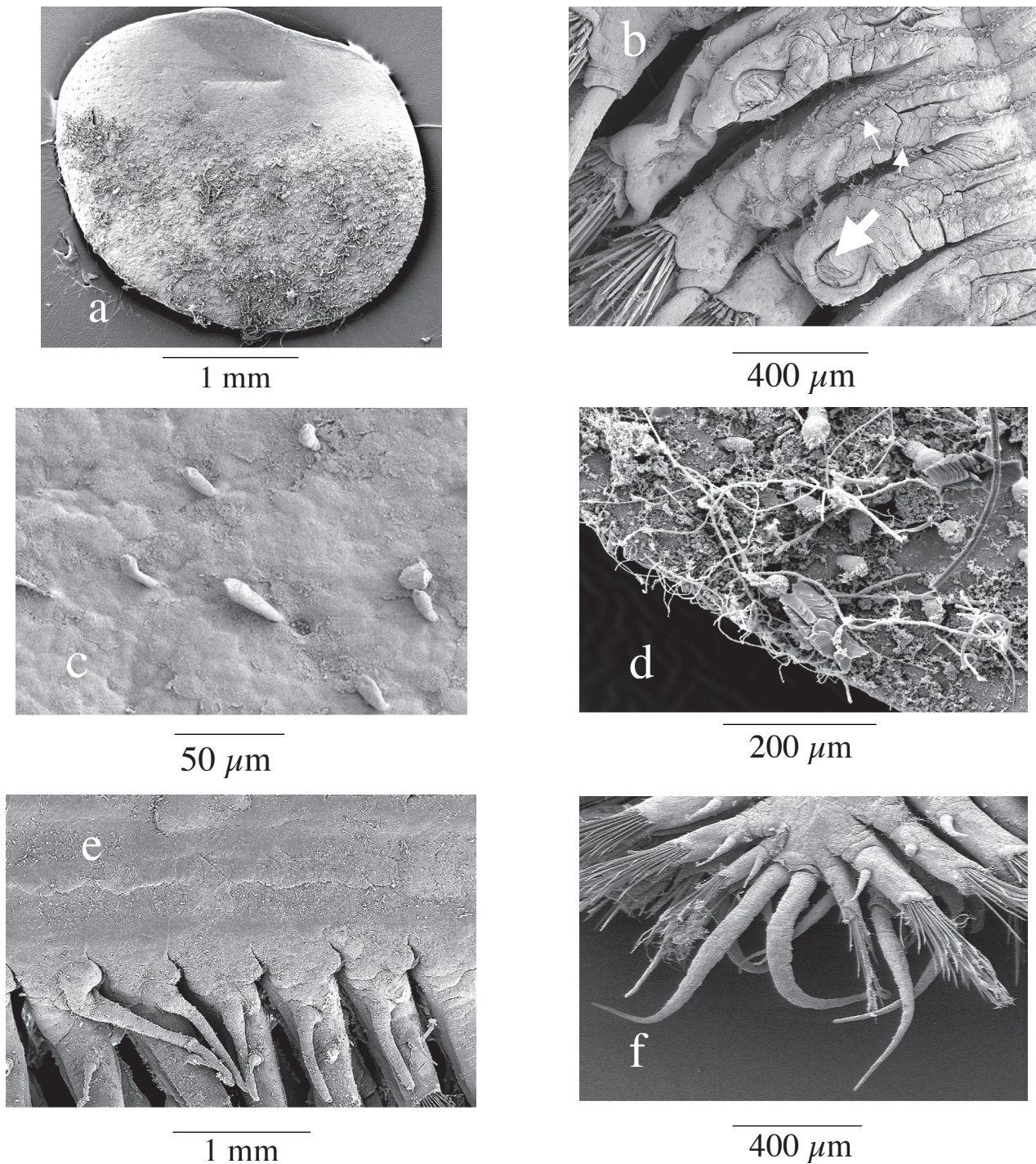


Figure 2. *Lepidonotopodium jouinae* sp. nov. SEM views. **a.** Elytron removed from segment 9. **b.** Dorsal view of segments 9-11 showing the inflated dorsal tubercles (*large arrow*) on an elytriferous segment and bands of cilia (*small arrows*). **c.** View of the elytral surface in a clean area showing micropapillae. **d.** View of the elytral surface in an area covered by filamentous and mineral material. **e.** Ventral view of segments 11-15 of a specimen with elongated ventral papillae. **f.** Ventral view of posterior segments and the pygidium with two anal cirri.

Figure 2. *Lepidonotopodium jouinae* sp. nov. Vues en MEB. **a.** Elytre prélevée sur le segment 9. **b.** Vue dorsale des segments 9-11 montrant les tubercules dorsaux (*grosse flèche*) sur un segment elytrifère et les bandes de cils (*petites flèches*). **c.** Vue de la surface de l'élytre dans une zone propre, montrant les micropapilles. **d.** Vue de la surface de l'élytre dans une zone couverte de matériel filamenteux et minéral. **e.** Vue ventrale des segments 11-15 d'un spécimen possédant des papilles ventrales allongées. **f.** Vue ventrale des segments postérieurs et du pygidium avec ses deux cirres anaux.

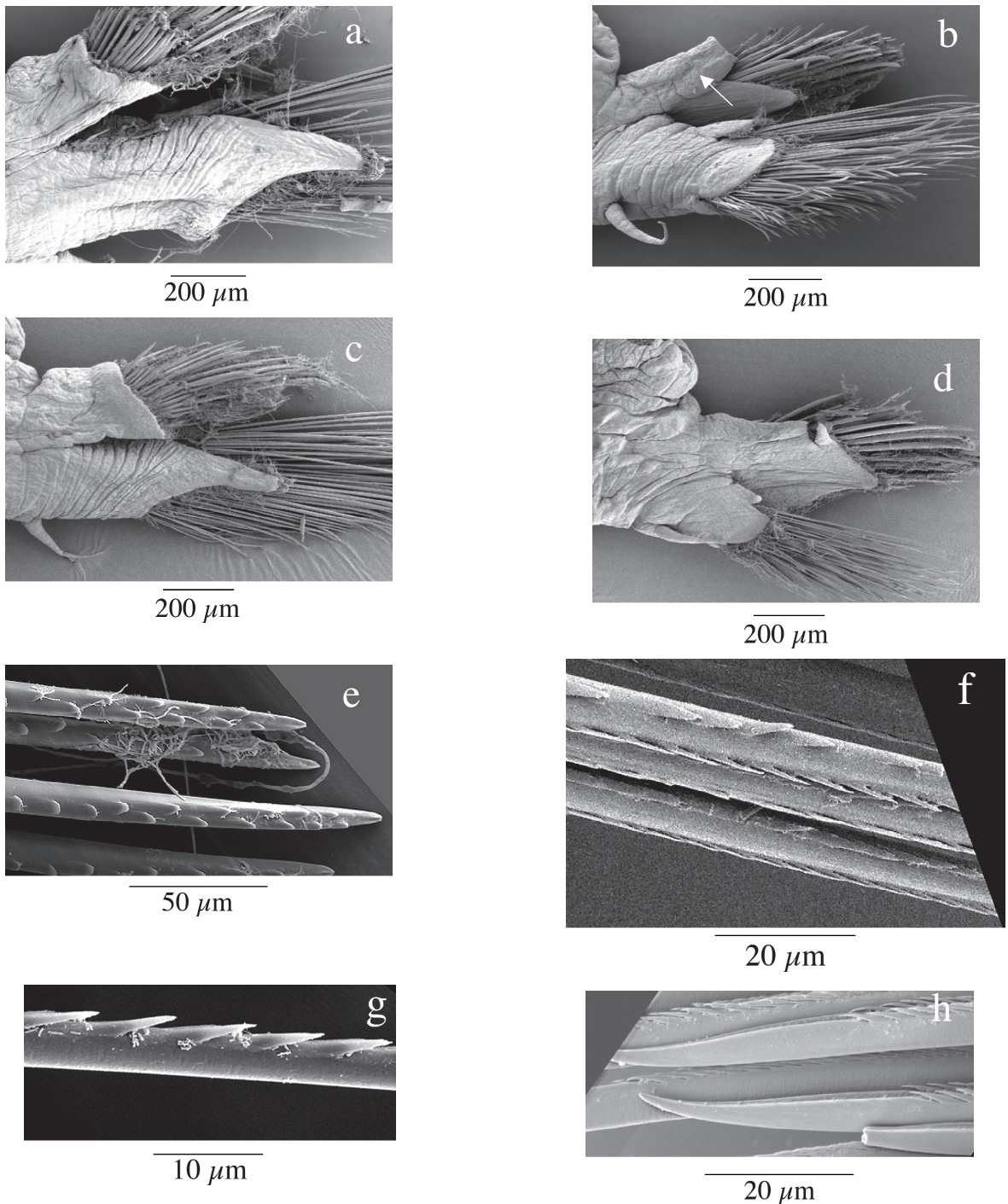


Figure 3. *Lepidonotopodium jouinae* sp. nov. SEM views. **a.** Anterior view of a cirriferous parapodium (segment 8). **b.** Posterior view of a cirriferous parapodium (segment 8). The *arrow* indicates the cirrophore. **c.** Anterior view of an elytriferous parapodium (segment 9). **d.** Posterior view of an elytriferous parapodium (segment 9). **e.** Notochaetae. **f.** Ventral neurochaetae. **g.** Dorsal neurochaeta. **h.** Tips of ventral neurochaetae.

Figure 3. *Lepidonotopodium jouinae* sp. nov. Vues en MEB. **a.** Vue antérieure d'un parapode cirrophore (segment 8). **b.** Vue postérieure d'un parapode cirrophore (segment 8). La *flèche* indique le cirrophore. **c.** Vue antérieure d'un parapode élytrifère (segment 9). **d.** Vue postérieure d'un parapode élytrifère (segment 9). **e.** Soies notopodiales. **f.** Soie neuropodiale ventrale. **g.** Soie neuropodiale dorsale. **h.** Extrémités de soies neuropodiales ventrales.

radiating bundles. They are stouter than the neurochaetae (Fig. 3a-d). The superior notochaetae are shorter than those from the middle of the notopodium. The notochaetae have two rows of alternating teeth, appearing as scales, partially peeled off the body on the chaetae (Fig. 3e). The tips of the notochaetae are blunt. The neurochaetae are numerous, forming fan-shaped bundles (Fig. 3a-d). The dorsal ones have one row of spines and straight tips (Fig. 3g). The ventral neurochaetae have two rows of numerous spines along one side, with bare slightly hooked tips (Fig. 3f, h). The ventral cirri are very short, tapered, attached on the base of the neuropodia (Fig. 3a-d).

On about one half of the specimens, there are five pairs of large elongated papillae at the base of the neuropodia of segments 11 to 15 (Fig. 2e). In some of these specimens, sperm can be seen through the wall of the papillae. Any kind of segmental or nephridial papillae are absent on other segments. The elongated papillae are attached ventrally on the neuropodia and are similar in size, extending to the base of the neurochaetae. The three first pairs are attached basally whereas the two posteriormost pairs are attached more distally (Fig. 2e).

The pygidium is not visible dorsally (Fig. 2f). There is one pair of ventral anal cirri, as long as the dorsal cirri of the preceding segments.

Etymology. The species with the epithet *jouinae* is named in the honor of Dr. Claude Jouin-Toulmond for her kindness and enthusiasm at communicating her passion of Zoology. She was our teacher for our first contacts with Biology and Taxonomy at the "Université Pierre-et-Marie-Curie in Paris, France" and is still working with us on hydrothermal vent annelids.

Discussion

Lepidonotopodium was erected by Pettibone (1983) for *L. fimbriatum* from hydrothermal rift-area off western Mexico at 21°N. It is the type species of the subfamily Lepidonotopodinae, polynoids without lateral antennae, with a bilobed prostomium and with well developed notopodial bracts. They have 11 pairs of elytra, located on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19 and 21. Since this first description, five other species of *Lepidonotopodium* have been described (*L. riftense*, *L. williamsae*, *L. minutum*, *L. piscesae* and *L. atalantae*). Miura (1994) erected a second genus, *Thermopolynoe*, in this subfamily, with the species *T. branchiata*. This genus differs from *Lepidonotopodium* in having arborescent branchiae.

Lepidonotopodium jouinae is a small species of *Lepidonotopodium* as are *L. riftense*, *L. minutum* and *L. atalantae*. *L. jouinae* resembles *L. piscesae* in having five pairs of elongate ventral papillae but differs in the location

of these papillae on the neuropodia. In *L. piscesae*, the papillae are all inserted at the base of the neuropodia where they are attached to the body whereas in *L. jouinae*, the two last pairs are inserted more distally on the neuropodia. In addition, *L. jouinae* has 24 segments and *L. piscesae* has 28 segments. About 250 specimens have been observed, most of which were sexually mature (presence of sperm in the elongated papillae). We are therefore confident that the adults do not have more than 24 segments, this number being very stable as in other hydrothermal vent polynoid species. The prostomium has triangular cephalic peaks in *L. riftense*, *L. minutum*, *L. atalantae* and *L. jouinae* whereas *L. fimbriatum*, *L. piscesae* and particularly *L. williamsae* have more prominent cylindrical lobes. The jaws are also distinctive: they have numerous small teeth in *L. jouinae* as in *L. riftense* and *L. atalantae*. Other species have either smooth teeth (*L. minutum*) or a small number of big teeth as in *L. fimbriatum*, *L. williamsae* and *L. piscesae* (see Tables 1-3 in Desbruyères and Hourdez, 2000). The papillae on the proboscis of *L. jouinae* are different in position and shape from the other species.

Acknowledgements

We thank Anne-Marie Alayse (co-chief scientist of DIVA 2 and MARVEL with DD), Yves Fouquet, chief scientist of DIVA 1 for providing samples. The Cruises DIVA 1 & 2, MARVEL and Pico on the MAR were supported by IFREMER. We thank Philippe Crassous for his help for SEM views. We acknowledge the support of the European Commission's Marine Science and Technology Program (MAST III) under contract MAS3-CT9560040.

References

- Desbruyères D. & Hourdez S. 2000. A new species of scale-worm (Polychaeta: Polynoidae), *Lepidonotopodium atalantae* sp. nov., from the East Pacific Rise at 13°N and 9°50'N. *Cahiers de Biologie Marine*, **41** (1): 47-54.
- Desbruyères D., Biscoito M., Caprais J.-C., Colaço A., Comtet T., Crassous P., Fouquet, Y., Khripounoff A., Le Bris N., Olu K., Riso R., Sarradin P.-M., Segonzac M. & Vangriesheim A. (in press). Variations in deep-sea hydrothermal vent communities on the Mid-Atlantic Ridge when approaching the Azores Plateau. *Deep-Sea Research*
- Desbruyères D. & Laubier L. 1996. A new genus and species of ampharetid polychaete from deep-sea hydrothermal vent community in the Azores Triple Junction area. *Proceedings of the Biological Society of Washington*, **109**: 248-255.
- Lonsdale P.F. (1979). A deep-sea hydrothermal site on a strike-slip fault. *Nature*, **281**: 531-534.
- Miura T. 1994. Two new scale-worms (Polynoidae: Polychaeta) from the Lau back-arc and North Fiji basins, South Pacific Ocean. *Proceedings of the Biological Society of Washington*, **107** (3): 532-543.

- Pettibone M. H. 1983.** A new scale worm (Polychaeta : Polynoidae) from the hydrothermal rift-area off western Mexico at 21°N. *Proceedings of the Biological Society of Washington*, **96** (3): 392-399.
- Pettibone M. H. 1984.** Two new species of *Lepidonotopodium* (Polychaeta: Polynoidae: Lepidonotopodinae) from hydrothermal vents off the Galapagos and East Pacific Rise at 21°N. *Proceedings of the Biological Society of Washington*, **97** (4): 849-863.
- Pettibone M. H. 1988.** New species and new records of scaled polychaetes (Polychaeta: Polynoidae) from hydrothermal vents of the Northeast Pacific Explorer and Juan de Fuca Ridges. *Proceedings of the Biological Society of Washington*, **101** (1): 192-208.
- Pettibone M. H. 1989.** New species of scale-worms (Polychaeta: Polynoidae) from the hydrothermal rift-area of the Mariana back-arc basin in the western central Pacific. *Proceedings of the Biological Society of Washington*, **102** (1): 137-153.
- Pettibone M. H. 1990.** New species and new records of scaled polychaetes (Polychaeta: Polynoidae) from the Axial Seamount caldera of the Juan de Fuca Ridge in the Northeast Pacific and the East Pacific Ocean off Northern California. *Proceedings of the Biological Society of Washington*, **103** (4): 825-838.
- Rona P. A., Klinkhammer G., Nelsen T. A., Trefry J. H. & Elderfield H. 1986.** Black smokers, massive sulphides and vent biota at the Mid-Atlantic Ridge. *Nature*, **321**: 33-37.
- Van Dover C. L., Desbruyères D., Segonzac M., Comtet T., Saldanha L., Fiala-Médioni A. & Langmuir C. 1996.** Biology of the Lucky Strike hydrothermal field. *Deep-Sea Research*, **43**: 1509-1529.