

## A new species of *Phyllochaetopterus* (Annelida: Chaetopteridae) from deep-sea hydrothermal Ashadze-1 vent field, Mid-Atlantic Ridge: taxonomical description and partial COI DNA sequence

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**Abstract:** *Phyllochaetopterus polus*, a new species of the polychaete family Chaetopteridae is described. Specimens were collected at the Ashadze-1 vent field (Mid-Atlantic Ridge), from 4100–4200 m depth. *P. polus* is the first chaetopterid reported from the Atlantic hydrothermal vents. Three chaetopterid species have been recorded from deep-sea hydrothermal vents belonging to two genera, *Spiochaetopterus* and *Phyllochaetopterus*. *P. polus* sp. nov. is a medium-sized chaetopterid, characterized by 9 chaetigers in region A and 2 in region B; region C is usually incomplete in the specimens examined, but has at least 40–70 chaetigers. This polychaete has one pair of modified chaetae in chaetiger 4 with a pear-shaped obliquely truncated head, triangular uncini and a branched annulated tube. The species resembles *P. lauensis* Nishi & Rouse, 2007 in most characters but differs by the colour of the ventral shield and tube structure. Blast results of a 655 bp fragment of the mitochondrial DNA COI gene of this new species revealed *Phyllochaetopterids* as the closest available sequences in Genbank. A phylogenetic tree has been further built using all other COI chaetopterid polychaete sequences found in Genbank to infer phylogenetic position of the new species. It adds to the previous observations of close proximity of communities associated to whale falls and hydrothermal vents communities as the phylogenetically closest species is an undescribed *Phyllochaetopterus* found around whale fall in Monterey Bay (California).

**Résumé :** Une nouvelle espèce de *Phyllochaetopterus* (Annelida : Chaetopteridae) du site hydrothermal profond Ashadze-1, Ride médio-atlantique : description taxonomique et séquence partielle du gène mitochondrial COI. *Phyllochaetopterus polus*, une nouvelle espèce de la famille des Chaetopteridae, est décrite. Les spécimens ont été échantillonnés sur le champ hydrothermal Ashadze-1 entre 4100–4200 m de profondeur (ride médio-atlantique). C'est le premier Chaetopteridae provenant des sources hydrothermales profondes de l'Atlantique qui est décrit. Trois espèces de Chaetopteridae ont déjà été mentionnées au niveau des sources hydrothermales profondes; elles appartiennent à deux genres, *Spiochaetopterus* et *Phyllochaetopterus*. *P. polus* sp. nov. est un Chaetopteridae de taille moyenne, caractérisé par 9 segments dans la région A, et 2 dans la région B; la région C est généralement incomplète dans les spécimens observés mais peut contenir au moins 40 à 70 segments. Ce polychète a une paire de soies hautement modifiée au segment 4 avec une tête en forme de poire obliquement coupée, des uncini triangulaires et un tube annulé de couleur marron. Cette espèce ressemble à *P. lauensis* Nishi & Rouse, 2007 pour de nombreux caractères mais diffère de cette dernière par les couleurs de son plastron et de son

tube. Un fragment de 655 bp du gène mitochondrial COI a été utilisé avec d'autres séquences de polychète Chaetopteridae pour positionner phylogénétiquement la nouvelle espèce. Cela a permis d'appuyer les premières observations de proximité des communautés associées aux carcasses de baleines avec celles associées aux sources hydrothermales. En effet, l'espèce phylogénétiquement la plus proche est un *Phyllochaetopterus* non décrit localisé autour d'une carcasse de baleine dans la baie de Monterey (Californie).

**Keywords:** Polychaeta • Hydrothermal vent • Mid-Atlantic Ridge • Taxonomy • New species • COI

## Introduction

Chaetopteridae are tubicolous benthic polychaetes mostly inhabiting sediments and muddy sediments (Wilson, 2000). They have been recorded from the intertidal depths to the deep-sea hydrothermal vents, occurring either as solitary animals or in dense assemblages (Blake, 1996; Nishi et al., 2009; Nishi & Hsieh, 2009). This family of about 65 species was established by Audouin & Edwards in 1833 (Rouse & Pleijel, 2001). Chaetopterid body is divided into three regions: A (anterior), B (middle) and C (posterior-abdominal) and their chaetiger 4 has modified cutting chaetae (Wilson, 2000). Gitay (1969) reviewed the family composition and provided a key to the four genera: *Chaetopterus* Cuvier, 1830, *Mesochaetopterus* Potts, 1914, *Phyllochaetopterus* Grube, 1863 and *Spiochaetopterus* Sars, 1853. Bhaud (1977) and Bhaud et al. (1994 & 2006) clarified chaetopterid identification by using the structure of the tube, uncini and A4 modified chaetae. After discovery of additional new taxa, the family was revised by Nishi & Rouse (2007) who had used the number of A4 chaetae, number of region-A chaetigers and number of region-B chaetigers as main characters and divided *Phyllochaetopterus* into four species groups (A, B, C & D). However, chaetopterids often fragment during sampling resulting in doubtful taxonomic status of many species (Blake, 1996). Most recently, both Osborn et al. (2007) and Martin et al. (2008) carried out the first phylogenetic analysis of the Chaetopteridae using molecular data.

In non-reducing habitats, 22 *Phyllochaetopterus* species have been accepted as valid (Nishi & Hsieh, 2009). Nineteen of these species have been compared by Nishi & Rouse (2007). Five species occur in the Atlantic Ocean and adjacent areas: *P. socialis*, Claparède, 1868 from Atlantic and Mediterranean sea, *P. anglica* Potts, 1914 found in British waters and *P. fallax* Claparède, 1868 and *P. major* Claparède, 1868 collected from Italian waters, *P. bhaudi* Jirkov, 2001 has been collected in the Arctic.

In deep-sea reducing habitats, only three species have been described, *Spiochaetopterus sagamiensis* Nishi et al.,

1999, from a cold-seep site in Sagami Bay, Central Japan, *Phyllochaetopterus lauensis* Nishi & Rouse, 2007, collected from the Lau Basin, western Pacific Ocean (22°31.94'S-176°43.10'W) and *Spiochaetopterus iheyasensis* Nishi, 2008, from the Iheya seamount in the East China Sea (27°32.50'N-126°58.50'E). A population of an undescribed chaetopterid has been recorded in very high densities near the Foundation Seamount Chain on the Pacific-Antarctic Ridge (37°30'S-110°30'W) by Stecher et al. (2002). Another *Spiochaetopterus* species collected at Mid-Atlantic Ridge in the vicinity of Rainbow and TAG hydrothermal vent fields (36°13'N-33°54'W and 26°08'N-44°49'W respectively) has not been described due to its poor condition of the specimen preservation (Desbruyères, 2006).

The SERPENTINE cruise explored Ashadze-1 vent field (12°58'N-44°52'W), the deepest (4100-4200 m depth) hydrothermal field known (Beltenev et al., 2003) and obtained the first faunal samples from this vent field. During this cruise, many massive chaetopterid mats consisting of an unknown *Phyllochaetopterus* species appeared to be one of the dominant species of this hydrothermal vent community (Fabri et al., in press). This new species is herein described using morphology, complemented with COI DNA partial sequence analysis.

## Materials and Methods

Samples were collected during the SERPENTINE cruise from February to April 2007 by the remotely operated vehicle 'Victor 6000' operated from the research vessel 'Pourquoi pas?'. Samples were taken using suction pump or arm grab at Ashadze-1 vent field (12°58'N-44°51'W, 4100-4200 m) in the 'Petite forêt' and 'Grande cheminée' sites. On board the ship, specimens were sorted and fixed in 4% buffered formalin for 24 hours and then transferred to 70°C ethanol. Some specimens were extracted from their tubes before preservation, whereas others were preserved in the tubes. One specimen extracted from the tube was

directly preserved into 70°C ethanol for molecular analysis.

In the laboratory, 5 specimens were critical point dried with carbon dioxide, sputtered with gold and examined using an FEI scanning electron microscope (SEM) Quanta 200. Measurements of the body width were taken at the ventral glandular shields, excluding chaetae. The holotype and 9 paratypes have been deposited at the Museum National d'Histoire Naturelle, Paris, France (MNHN) and 3 other paratypes at the Natural History Museum and Institute in Chiba, Japan (CBM).

DNA from tissue was extracted using the Biosprint 96 (Qiagen) according to the manufacturer's tissue protocol. Amplification of a 655 bp PCR product of COI mitochondrial DNA was done using primers originally designed by Folmer et al. (1994), and modified by Meyer (2003) and by primer-tailing method with M13 universal primers Dg COI (M13):

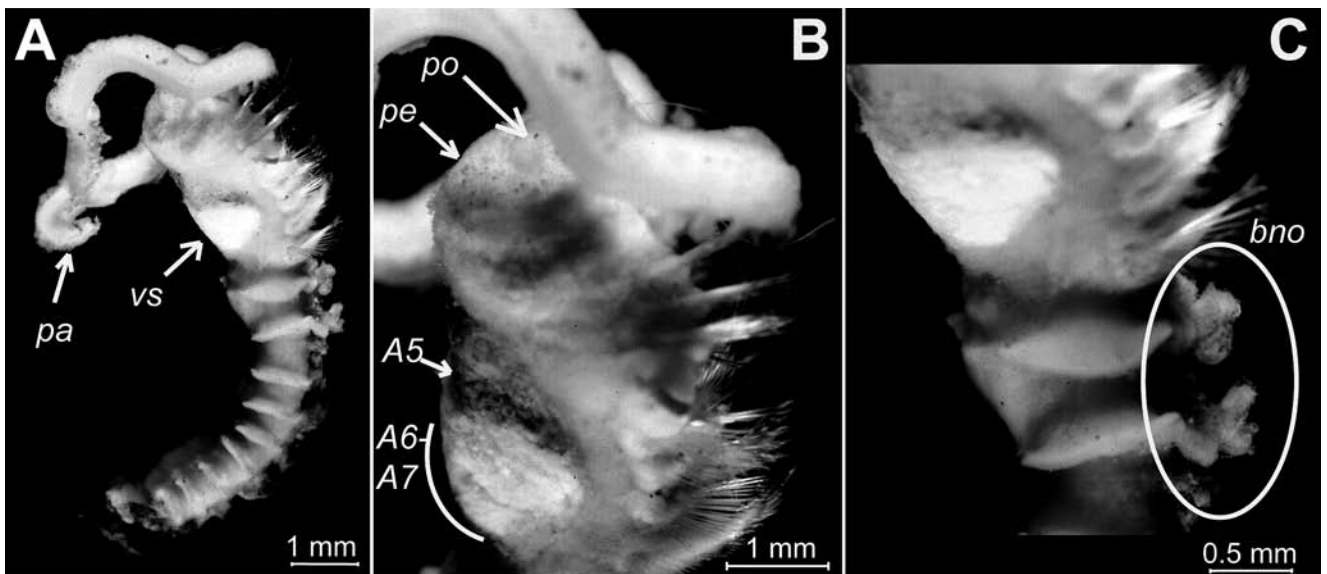
F : 5' CACGACGTTGTAAAACGACGGTCAA-CAAATCATAAAGAYATYGG 3';

R : 5' GGATAACAATTCACACAGGTAAACTTCA GGGTGACCAARAAYCA 3'

Polymerase Chain Reaction (PCR) was performed using Folmer et al. (1994) and Meyer (2003) protocols. PCR products were cleaned up with ExosapIT (USB). Sequencing reactions were purified with Sephadex-50 (GE Healthcare). The sequences were read on a 3730xl ABI DNA Analyzer (Applied Biosystems).

The COI sequence obtained for *P. polus* sp. nov. has been submitted to Genbank and assigned the accession number GQ891958. Sixteen other chaetopterid COI sequences available on Genbank were downloaded: 3 sequences of *Phyllochaetopterus*, *P. sp. 1* (DQ209248), *P. sp. 3* (DQ209249), *P. socialis* Claparède, 1868 (DQ209247); 3 sequences of *Mesochaetopterus*, *M. rogeri* (AM503098), *M. xerecus* (AM503097), *M. taylora* (DQ209251.1); 10 sequences of *Chaetopterus*, *C. varioopedatus* (AM503094.1), *C. varioopedatus* (AM503095.1), *C. varioopedatus* (AM503096.1), *C. pugaporcinus* PB2 (DQ209256), *C. pugaporcinus* (DQ209257), *C. sarsi* (DQ209254), *C. sp.1* (DQ209252.1), *C. sp.* (DQ087501.1), *C. cf. luteus* (DQ209253) and *C. sp.2* (DQ209255) (Osborn et al., 2007; Martin et al., 2008). No *Spiochaetopterus* COI sequences were found in Genbank.

Sequences were aligned with Geneious 4.6.4 (Drummond et al., 2009) using Muscle algorithm (Edgar, 2004). The phylogenetic position of the new species was inferred by aligning the COI sequence of *Phyllochaetopterus polus* sp. nov. with other chaetopterid sequences available on GenBank. A species of *Prionospio* was used as an outgroup taxon (Genbank accession number DQ209266). The Akaike Information Criterion (AIC) implemented in MODELTEST v.3.7 (Posada & Grandall, 1998) was used to determine the evolutionary model that best fits the data set. Maximum Likelihood analysis (ML)



**Figure 1.** *Phyllochaetopterus polus* sp. nov. Binocular images. **A.** Entire specimen, latero-ventral view;  $p_a$ : palps,  $vs$ : ventral shield. **B.** Detail of prostomium and A part;  $p_o$ : prostomium,  $p_e$ : peristomium, A5: chaetiger A5, A6-A7: chaetigers A6 and A7. **C.** Detail of part B;  $bn_o$ : bilobed notopodia.

**Figure 1.** *Phyllochaetopterus polus* sp. nov. Images numériques. **A.** Spécimen entier, vue latéro-ventrale ;  $p_a$  : palpes,  $vs$  : plastron ventral. **B.** Détail du prostomium et de la partie A ;  $p_o$  : prostomium,  $p_e$  : peristomium, A5 : chaetiger A5, A6-A7 : chaetigers A6 et A7. **C.** Détail de la partie B ;  $bn_o$  : notopode bilobé.

was conducted with PhyML (Guindon & Gascuel, 2003). A bootstrap analysis with 1000 replicates was conducted also using PhyML.

## Systematics

### Family Chaetopteridae Audouin & Milne-Edwards, 1833

Genus *Phyllochaetopterus* Grube, 1863

*Phyllochaetopterus polus* sp. nov.

(Figs 1-4)

#### Material examined

Type locality: Mid-Atlantic Ridge, Ashadze-1 vent field, 12°58'N-44°51'W, 4100-4200 m water depth. Specimens found in mats in sediment surface.

Type material: Holotype (MNHN POLY TYPE 1509) incomplete with fragment of its tube, 12°58.352'N-44°51.780'W, 4085 m, 11 March 2007 (ROV 'Victor 6000', dive 311, suction sample 1). Paratypes: 12°58.352'N-44°51.780'W, 4085 m, 11 March 2007 (ROV 'Victor 6000', dive 311, suction sample 1), 1 specimen (CBM-ZW 1020); 12°58.352'N-44° 51.778'W, 4087 m, 11 March 2007 (ROV 'Victor 6000', dive 312, suction sample 1), 9 incomplete specimens with fragments of tubes (MNHN POLY TYPE 1510), 1(CBM-ZW 1021); 12°58.352'N-44°51.777'W, 4086 m, 13 March 2007 ('Victor 6000', dive 312, suction sample 3), 1 specimen (CBM-ZW 1022).

#### Description

Holotype and all paratypes incomplete, lacking end of posterior C-abdominal region. Length of holotype 10 mm excluding palps, 3.5 mm long and 2.5 mm wide in A-region (at ventral shield without chaeta), 1 mm long and 2 mm wide in B-region and 5.5 mm long in C-incomplete region of 7 chaetiger; paired grooved palps about 1.5 times longer than entire A-region (Fig. 1A). Paratypes 8-35 mm excluding palps, 4-7 mm long and 2-4 mm wide in A-region (at ventral shield without chaeta), 1-2 mm long and 2-2.5 mm wide in B-region and 4-35 mm long in C-incomplete-region (4 to 60 chaetigers); palps incomplete.

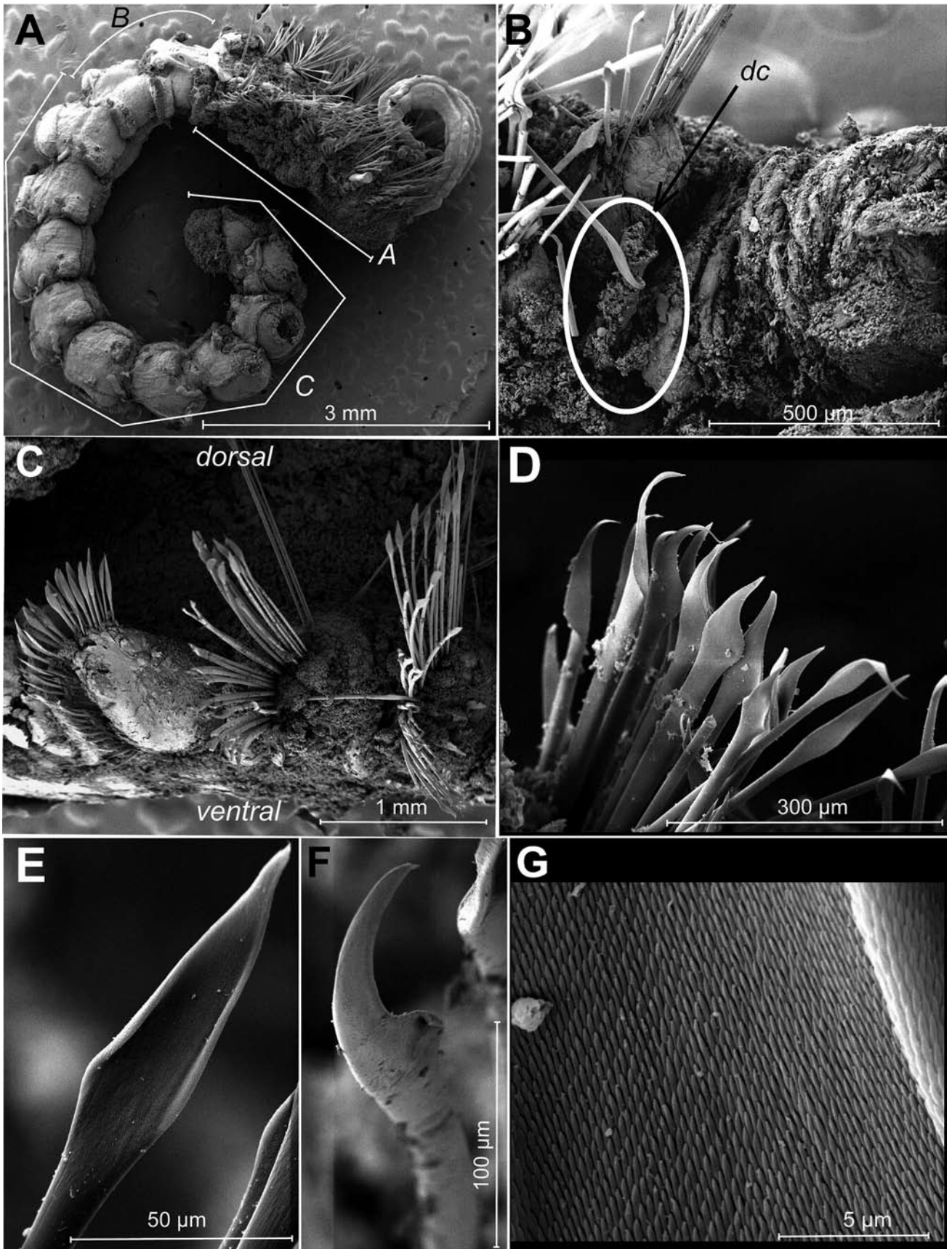
Body slender, divided into typical three regions: A, B and C (Fig. 2A). A long dorsal faecal groove extending from base of palps along the three body regions. Colour variable throughout body: preserved specimens yellow except in A5-A7 plastron region where A5 with a light brown lateral line, A6-A7 with white lines (Fig. 1B); chaetiger from A-region with tips orange due to iron oxide deposits. Holotype with 18 chaetigers (9A + 2B + 7C), paratypes with 15 to 71 chaetigers (9A + 2B + 4-60C), all specimens were incomplete in C-region.

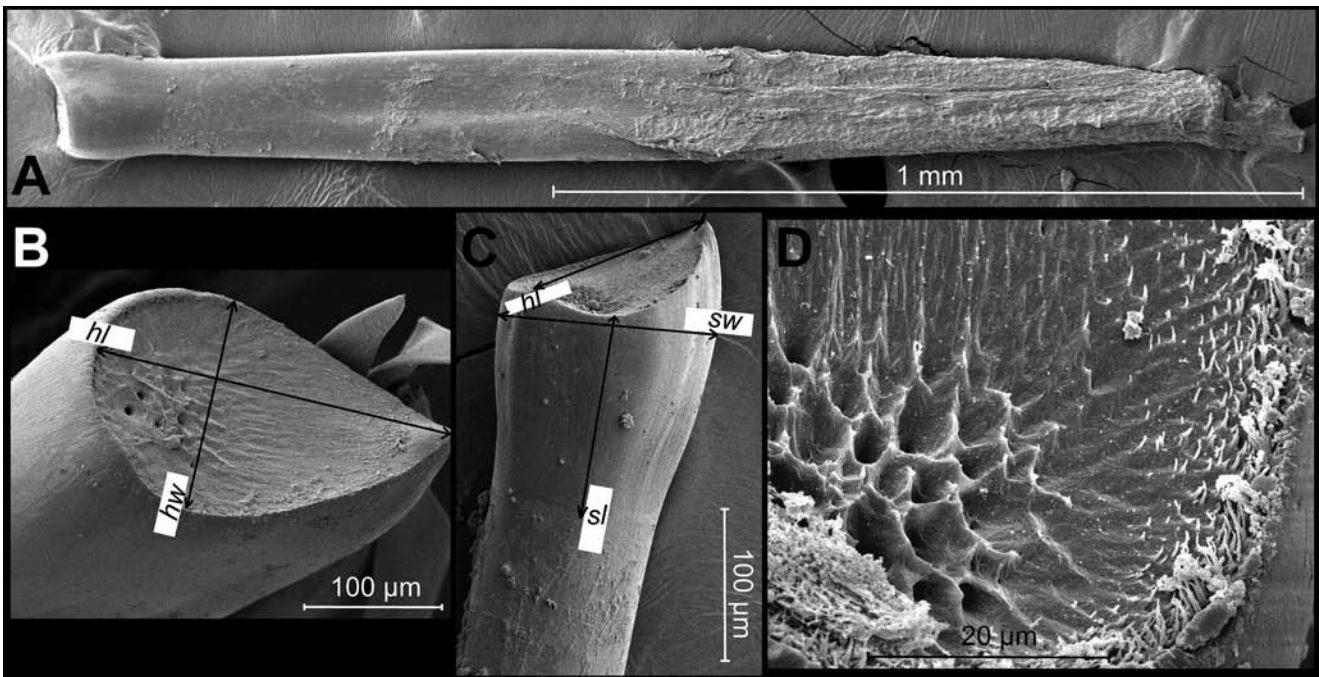
Anterior region (A). Holotype and paratypes with 9 chaetigers (A1 to A9). Head poorly defined (Fig. 1B). Prostomium small, ovoid; eyes absent. Peristomium ventrally and laterally surrounding prostomium, with pair of long dorsally-grooved palps arising from latero-posterior borders, length of palps longer than A-region (about 1.5 times A-region length) (Figs 1A & 2A). Chaetiger 1 with of one pair of small dorsal cirri (Nishi & Rouse, 2007) (Fig. 2B). Region A dorsally flattened and ventrally convex (Figs 1A & 2A). Ventral part composed of a glandular shield (ventral shield) (Fig. 1A). Parapodia uniramous with a single row of 20 to 40 long capillary lanceolate chaetae (Fig. 2C). Tip ending from oar-like, sickle-like to spoon-like structure, ventrally to dorsally (Fig. 2C-F); all tips with fine serrated structures (Fig. 2G). A4 chaetiger with one single large, heavy modified (cutting) chaeta on each side (Fig. 3A-C), each embedded in parapodia; colour light brown on trunk and brownish on head. Head slightly wider than shaft, obliquely truncated, pear-shaped, with a small spine on edges (Fig. 3A & D). Lateral and ventral grooves absent. Measurements on two A4 chaetae with total length 1.5 mm (Fig. 3A), shaft 124 µm long and 136 µm wide (width measured just under head), head 114-130 µm long and 75 µm width (Fig. 3B-D).

Middle region (B). Holotype and paratypes with 2 chaetigers (B1 and B2) (Figs 1A & 2A), flattened, plate-like ventrally and dorsally. Region B1 mm long with chaetigers about same size as those in region A; B1 and B2 early same length. Parapodia of B1 and B2 biramous (Fig. 4A). Notopodia foliaceous, bilobed with inner part Y-shaped (dichotomously branched) and outer part unilobed (Fig. 4A); neuropodia of 2 unilobed with one row of over-

**Figure 2.** *Phyllochaetopterus polus* sp. nov. SEM images. **A.** Entire specimen, lateral view, parts A, B & C are presented. **B.** Latero-dorsal view of chaetiger A1; dc: dorsal cirri. **C.** Latero-dorsal view of A part showing the row of chaetae. **D.** Long capillary lanceolate chaetae of A part. **E.** Spoon-like chaetae tip. **F.** Sickle-like chaetae tip. **G.** Detail of serrated structure on chaeta.

**Figure 2.** *Phyllochaetopterus polus* sp. nov. Images MEB. **A.** Spécimen entier, vue latérale, les parties A, B et C sont présentées. **B.** Vue latéro-dorsale du chaetiger A1 ; dc : cirre tentaculaire en A1. **C.** Vue latéro-dorsale de la partie A présentant la ligne de soie. **D.** Longues soies capillaires lancéolées de la partie A. **E.** Soie avec pointe en forme de cuillère. **F.** Soie avec pointe en forme de faucille. **G.** Détail des structures dentelées d'une soie.





**Figure 3.** *Phyllochaetopterus polus* sp. nov. SEM images. **A.** Entire A4 modified chaeta. **B.** Pear-shaped head of A4 modified chaeta in latero-frontal view; hl: head length, hw: head width. **C.** Pear-shaped head of A4 modified chaeta in lateral view; hl: head length, sw: shaft width, sl: shaft length. **D.** Head of A4 modified chaeta enlarged in a frontal view: small spines on edges; sp: spine.

**Figure 3.** *Phyllochaetopterus polus* sp. nov. Images MEB. **A.** Soie A4 modifiée, entière. **B.** Tête en forme de poire de la soie modifiée A4, vue latéro-frontale; hl : longueur de la tête, hw : largeur de la tête. **C.** Tête en forme de poire de la soie modifiée A4, vue latérale; hl : longueur de la tête, sl : longueur du tronc, sw : largeur du tronc. **D.** Tête de la soie modifiée A4 grossie, vue frontale : présence de petites épines sur les bords; sp: épine.

lapping uncini. Uncinal plate with more than 150 uncini (Figs 2A & 4A).

**Posterior region (C).** Holotype and all paratypes with C-region incomplete (Figs 1A & 2A). Holotype with 7 chaetigers and paratypes with 4 to 60 chaetigers. Chaetigers longer than A- and B-region chaetigers. Notopodia poorly developed with a small elongated tip and a single chaeta (Fig. 4B). Neuropodia all bilobed (Fig. 4B); dorsal lobe with fewer uncini in one row (about 10) than ventral lobe with one row of overlapping uncini (over 100) (Fig. 4B & C). Uncini mostly triangular with 22 minute teeth (Fig. 4D).

**Tube.** Tube branched, slender, nearly straight and strongly annulated in most specimens. Tube wall thin, consisting of several inner layers of parchment-like material and an outer layer embedded with iron oxide deposit (Fig. 5A & B). Tubes buried into the sediment (Fig. 5C). Tube ending unknown. Colour brown.

#### Etymology

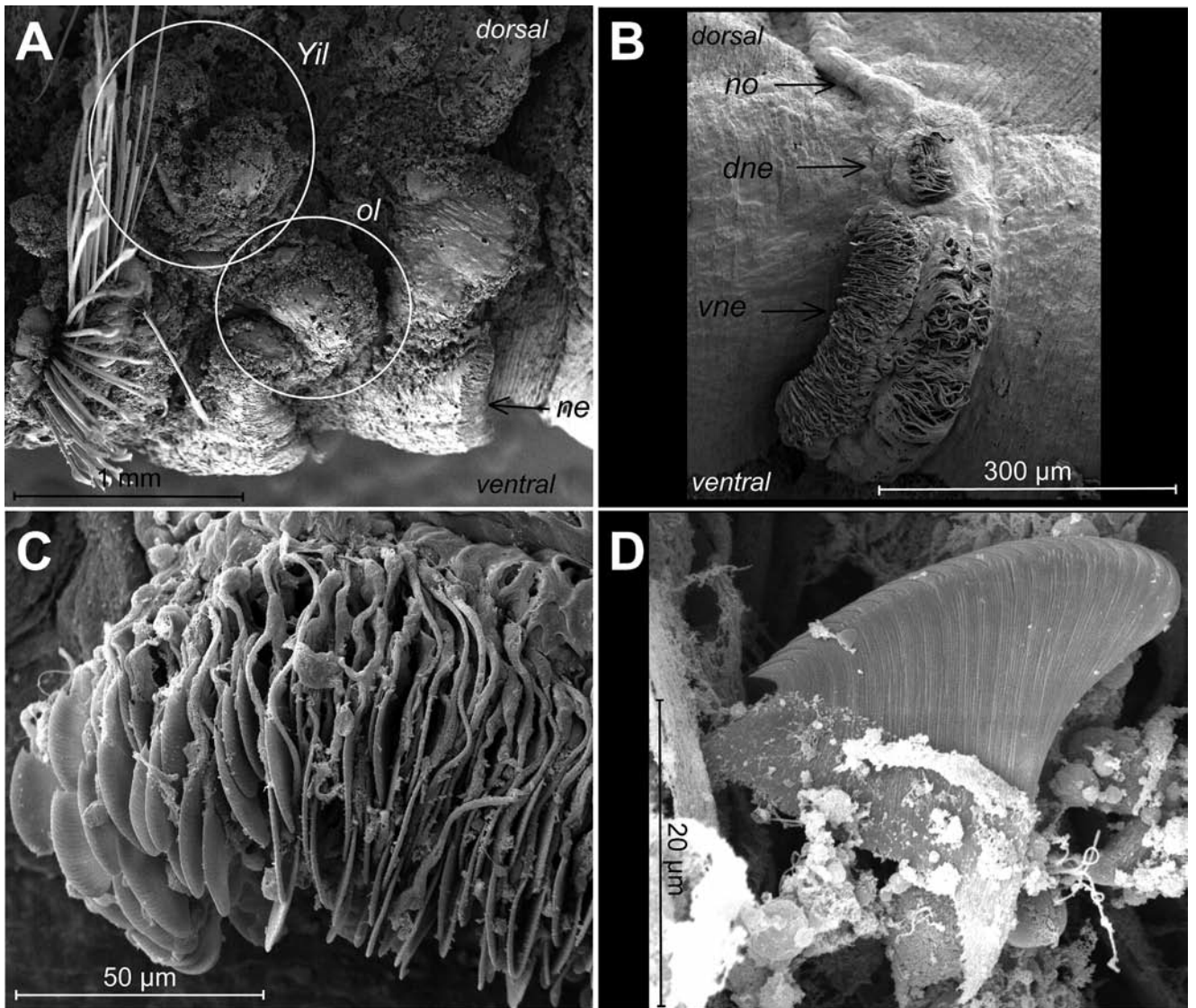
The new species is named *polus*, referring to the high number of specimens found into the Ashadze-1 deep-sea

hydrothermal vent field (Greek root: 'poly'). It is actually the main species of this community with the anemone *Maractis rimicarivora* (Fabri et al., in press)

#### Remarks

The genus *Phyllochaetopterus* has been split into four groups by Nishi & Rouse (2007) based on the number of chaetigers in A-region and B-region and the number of modified A4-chaeta. *P. polus* sp. nov. belongs to the '*Phyllochaetopterus* group A' characterized by 1-3 cutting modified chaetae in A4 chaetiger, 9-11 chaetigers in A-region and 2 chaetigers in B-region.

According to Nishi & Rouse (2007), group-A includes 5 *Phyllochaetopterus* species: *P. lauensis* Nishi & Rouse, 2007 (hydrothermal vents, Lau Basin, W. Pacific); *P. claparedii* McIntosh, 1885 (off Japan); *P. limicolus* Hartman, 1960 (off California); *P. gracilis* Grube, 1863 (Adriatic Sea); and *P. monroi* Hartman, 1967 (Southern Ocean). *P. lauensis* differs from *P. polus* sp. nov. by the ventral shield colour and the tube structure; the former *P. lauensis* has one light brown line belt posterior to the white section on A8 to A9 and no branched tube whereas *P. polus* sp. nov. lacks such a posterior light brown portion or belt

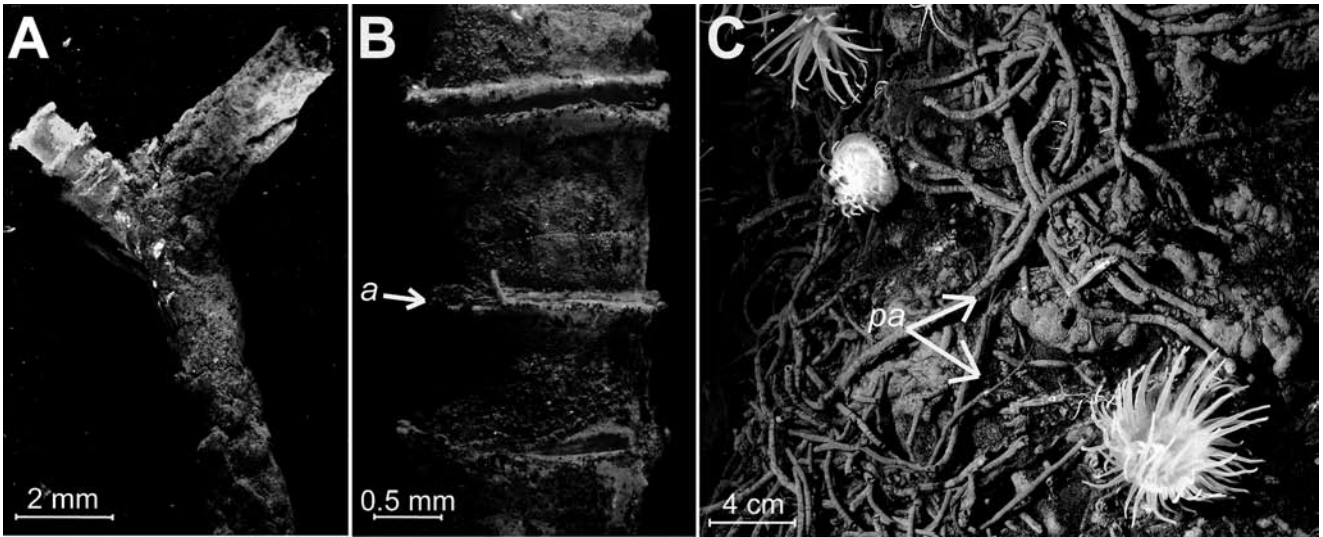


**Figure 4.** *Phyllochaetopterus polus* sp. nov. SEM images. **A.** A9, B1 & B2 in a latero-dorsal view illustrating foliaceous and bilobed notopodia. Yil: Y-shaped inner lobe, ol: outer lobe, n<sub>e</sub>: neuropodia. **B.** C part in a latero-dorsal view, notopodia with a single chaeta and bilobed neuropodia with uncini; n<sub>o</sub>: notopodia, dn<sub>e</sub>: dorsal neuropodia, vn<sub>e</sub>: ventral neuropodia. **C.** Enlarged picture of uncinal row. **D.** Detail of an uncinus.

**Figure 4.** *Phyllochaetopterus polus* sp. nov. Images MEB. **A.** A9, B1 et B2 dans une vue latéro-dorsale illustrant les notopodes foliacés et bilobés ; yn<sub>o</sub> : notopode en forme de Y, on<sub>o</sub> : partie extérieure du notopode, n<sub>e</sub> : neuropode. **B.** Partie C en vue latéro-dorsale, notopode avec une seule soie et les neuropodes bilobés avec les uncini; n<sub>o</sub> : notopode, dn<sub>e</sub> : neuropode dorsal, vn<sub>e</sub> : neuropode ventral. **C.** Photo grossie de la ligne d'uncini. **D.** Détail d'un uncinus.

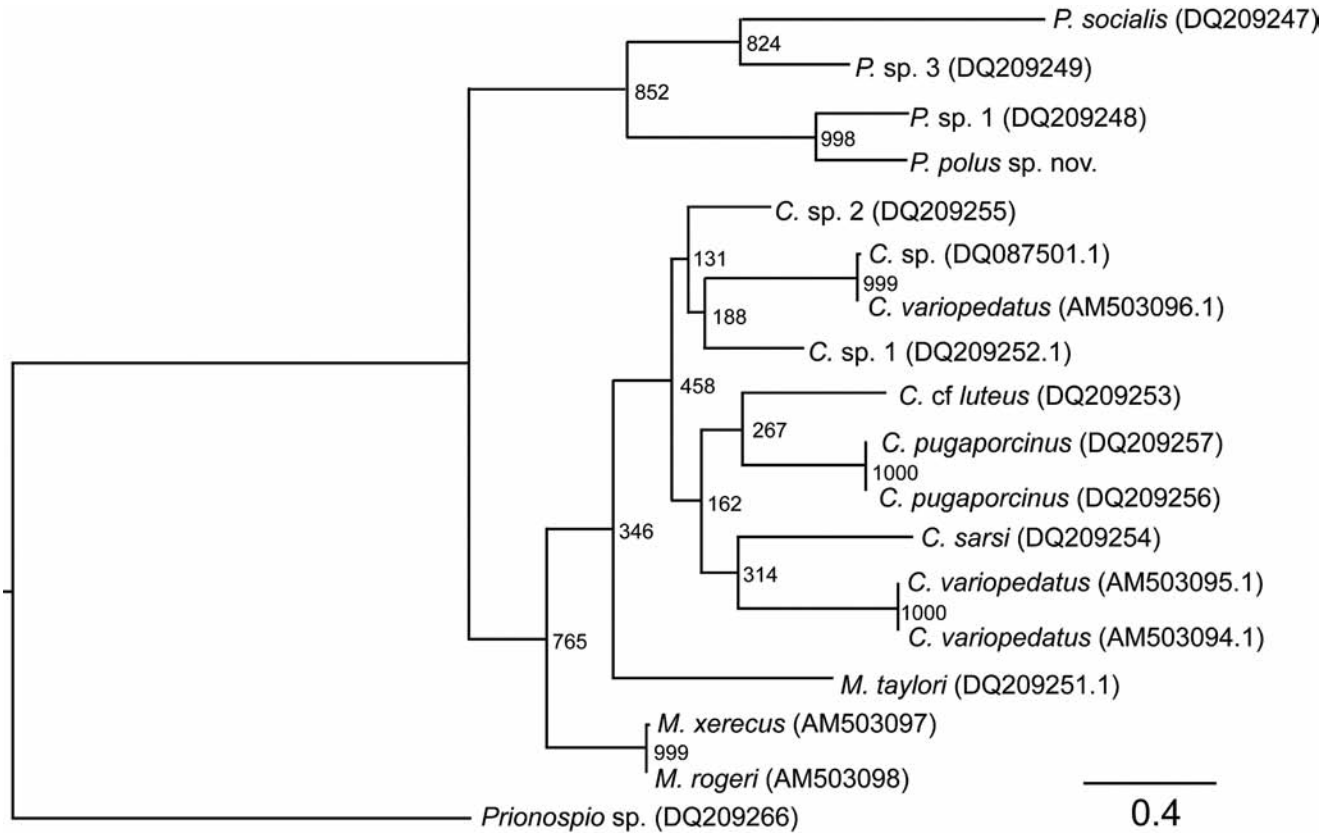
and has branched tube. *P. polus* sp. nov. differs from *P. claparedii* by the number of notopodial chaetae, the former has a single chaeta per notopodial lobe in region-C, and the latter has a row of some chaetae. *P. polus* sp. nov. has apparent coloration on the A5-A7 ventral shield of region-A, but in *P. limnicolus* has shows alternation of chalky white band or pale (anterior 2 segments), brown band (3<sup>rd</sup> to 4<sup>th</sup> segments), chalky white patch (6<sup>th</sup> to 8<sup>th</sup> segments) and

greenish or dark grayish green belt (last segments) (Hartman, 1960). *P. gracilis* has 10 or 11 region-A chaetigers and *P. polus* sp. nov. has 9 region-A chaetigers. *P. monroi* differs from *P. polus* sp. nov. by the number of uncinal teeth and the notopodial chaetae in region-C: the former has over 50 teeth per uncinus and three to four chaetae per lobe, the latter has less than 22 teeth per uncinus and a single chaetae per lobe.



**Figure 5.** *Phyllochaetopterus polus* sp. nov. **A.** Branched tube. **B.** Annulated tube; a: annulation. **C.** Mats of *P. polus* sp. nov. found at Ashadze-1 (Mid-Atlantic Ridge); copyright Ifremer, Serpentine cruise (2007).

**Figure 5.** *Phyllochaetopterus polus* sp. nov. **A.** Tube avec des branches. **B.** Tube annelé ; a : annulation. **C.** Tapis de *P. polus* sp. nov. trouvés à Ashadze-1 (ride médio-atlantique) ; copyright Ifremer, campagne Serpentine (2007).





Although Nishi & Rouse (2007) placed *P. major* Claparède, 1868 in the uncertain group (?A group), *P. polus* sp. nov. is similar to *P. major* (belongs group A). *P. polus* sp. nov. differs from *P. major* by the middle region notopodia; *P. polus* sp. nov. has a bilobed, Y-shaped notopodia in the first and second chaetigers and *P. major* has a bilobed, Y-shaped notopodia in the first chaetiger and a triangular, not bilobed notopodia in the second chaetiger.

#### *Distribution and habitat*

*Phyllochaetopterus polus* sp. nov. is only known from dense mat surfaces often encountered at the active Ashadze-1 vent field, 4100-4200 m deep (Fabri et al., in press).

#### *Molecular analysis*

A 655 bp COI sequence was obtained for *P. polus* sp. nov. This sequence was submitted to Genbank and assigned accession number GQ891958. Blast results revealed *Phyllochaetopterids* as the closest known sequences in Genbank. The comparison with 16 other congeneric taxa and with the outgroup *Prionospio*, resulted in a 557 bp length alignment, with 259 variable sites. The result of ML analysis (Fig. 6), confirm the position of our new species *P. polus* sp. nov. in the genus *Phyllochaetopterus*, as they form a monophyletic group compared to the *Mesochaetopterus* and *Chaetopterus*, and to the *Prionospio* used as outgroup. A 16.3% divergence was observed between *P. polus* sp. nov. and the closest sequence, belonging to *P. sp. 1* (accession number DQ209248); this support the status of new species. It is interesting to mention that this closest congeneric taxon available so far in GenBank, the *P. sp.1* sequence from Pacific (Monterey Bay, CA), is a large undescribed *Phyllochaetopterus* found around a whale fall in Monterey Bay, California (Rouse & Brady, unpubl. data in Osborn et al., 2007). This clustering of the new species described here with the other *Phyllochaetopterus* spp. supports the observations mostly reported on bivalves, of close proximity between communities associated with whale bones and hydrothermal vent communities. This observation led to

suggest the role of whale bones as stepping stones for colonization of hydrothermal vent habitats (Smith & Baco, 2003).

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**Figure 6.** *Phyllochaetopterus polus* sp. nov. Maximum Likelihood phylogenetic tree with *P. polus* sp. nov. among other chaetopterids taxa available on GenBank. The tree was rooted with *Prionospio* sp. under the Akaike Information Criterion mutation model implemented in Modeltest, and the support values based on 1000 bootstrap replicates were reported.

**Figure 6.** *Phyllochaetopterus polus* sp. nov. Arbre phylogénétique réalisé en utilisant un modèle de maximum de ressemblance avec *P. polus* sp. nov. parmi les autres taxons de Chaetopteridae déposés dans la base de données GenBank. L'arbre a été enraciné avec *Prionospio* sp. selon le modèle d'information du critère de mutation d'Akaike exécuté sous Modeltest ; les résultats des 1000 bootstraps ont été reportés sur les nœuds.

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