

## **A New Tubeworm of Possible Serpulid Affinity from the Permian of Sicily**

Authors: Sanfilippo, Rossana, Reitano, Agatino, Insacco, Gianni, and Rosso, Antonietta

Source: Acta Palaeontologica Polonica, 61(3) : 621-626

Published By: Institute of Paleobiology, Polish Academy of Sciences

URL: <https://doi.org/10.4202/app.00209.2015>

---

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/terms-of-use](http://www.bioone.org/terms-of-use).

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

---

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.



## A new tubeworm of possible serpulid affinity from the Permian of Sicily

ROSSANA SANFILIPPO, AGATINO REITANO, GIANNI INSACCO, and ANTONIETTA ROSSO

**A new tubeworm, *Palaeotubus sosisiensis* gen. et sp. nov., is described from the Permian Pietra di Salomone limestone (Sosio Valley, W Sicily). The new species is characterized by a thick tube ornamented with slightly flared peristomes and numerous longitudinal keels. The internal structure of the tube was obliterated during diagenesis, which prevents the tube unequivocal systematic attribution. Nevertheless, all preserved morphological characters strongly suggest that the new tube belongs to serpulids. When confirmed by further findings, the positive attribution of this new species to serpulids will imply that it represents the ancestor of the Serpulidae, and the earliest evidence of calcareous tubeworm polychaetes from the Palaeozoic.**

### Introduction

Calcareous tubeworms are common fossils throughout the Phanerozoic, but their systematics were addressed in detail only recently, when studies of the skeletal microstructure allowed to discern tentaculitids, cornulitids, trypanoporids, and other fossil tubeworms like spirorbids and serpulids (Vinn and Mutvei 2009). Serpulids (i.e., Serpulidae) are common and widely distributed in the fossil record, with about 46 genera and 350 species (ten Hove and Kupriyanova 2009) and are quite abundant in the modern seas, where they are widespread, also colonizing extreme environments (e.g., Di Geronimo et al. 1997; Kupriyanova et al. 2009, 2010, 2014; Sanfilippo 2009; Rosso et al. 2010, 2013; Sanfilippo et al. 2013, 2015; Vinn et al. 2013). The group is still virtually unknown from the Palaeozoic and the earliest records, related to the small *Filograna*-like forms, date back to the Middle Triassic (ca. 244 Ma) (see Ippolitov et al. 2014). Paleozoic records of presumed serpulids (e.g., Sandberger and Sandberger 1856; Dalvé 1948; Clausen and Álvaro 2002; Ziegler 2006) consist of erroneous interpretations of tube-like organism remains. Seemingly to all Palaeozoic spirorbids, later attributed to microconchids (Weedon 1994; Taylor and Vinn 2006), these problematic fossils, commonly reported as “*Serpula*” in early papers, proved to be trypanoporids, cornulitids, tentaculids, or hederelloids when their tube microstructures have been carefully analyzed (see Weedon 1991; Vinn and Taylor 2007; Taylor and Wilson 2008; Vinn 2013).

A new tubeworm, *Palaeotubus sosisiensis* gen. et sp. nov., found in the Permian Pietra di Salomone limestone (western Sicily), is here described. This new species is certainly attributable to a calcareous tubeworm, strongly recalling a serpulid

for its morphology. Unfortunately, the tube inner microstructure is not preserved owing to diagenetic recrystallisation. This lack of information coupled with the scarcity of presently available material, consisting of a single incomplete specimen, prevented an unequivocal taxonomic attribution. The new tubeworm has been cautiously considered as *incertae sedis* but its alleged affinities to serpulids have been highlighted.

*Institutional abbreviations.*—MSNC, Palaeontological Collections, Museo Civico di Storia Naturale di Comiso, Ragusa, Italy.

### Material and methods

The single specimen examined in the present paper comes from the Pietra di Salomone, one of the fossiliferous megablocks cropping out near Palazzo Adriano in the Sicani Mountains, western Sicily (Fig. 1A, B). These Permian limestone megablocks are included in debris flow and turbidite sediments deposited in a base-of-slope setting (Fig. 1C, D). Flügel et al. (1991) considered these blocks as mainly Wordian (Murghabian) in age. However, some reef-derived pebbles within them, are possibly Capitanian (Midian) or even Wuchiapingian (Dzhulfian) in age. The same age, and probably even a Changhsingian (Dorashamian) age, was suggested by Jenny-Deshusses et al. (2000) for the Pietra di Salomone megablock. Therefore, the studied specimen might be of Wordian to latest Permian age. Further information about geological setting and age is given in Flügel et al. (1991).

The “Sosio Limestone” is world-wide famous for its well preserved and very rich invertebrate fauna. Overall, more than 520 species have been described from the Sosio Limestone and more than 300 species from the Pietra di Salomone megablock (Fig. 2). This fauna comprises foraminifera, sponges, corals, bryozoans, brachiopods, gastropods, bivalves, ammonoid and nautiloid cephalopods, trilobites, ostracodes, and other crustaceans, as well as crinoids, blastoids, and fossils of uncertain taxonomic assignment (see Flügel et al. 1991; Jenny-Deshusses et al. 2000; Ernst 2000; Jones et al. 2015, and references therein). The specimen described herein was found in the white crinoid-rich limestone from the upper part of the Pietra di Salomone, by one of us (AR) in October 2014, during field works lead by the MSNC, within the Riserva Naturale Orientata Monti di Palazzo Adriano e Valle del Sosio. Associated faunas include the crinoids *Palermocrinus jaekeli* Gislen, 1924 and *Heterobrachiocrinus fabianii* Yakovlev, 1938, the gastropods *Bellerophon sosisiensis* Gemmellaro, 1889 and

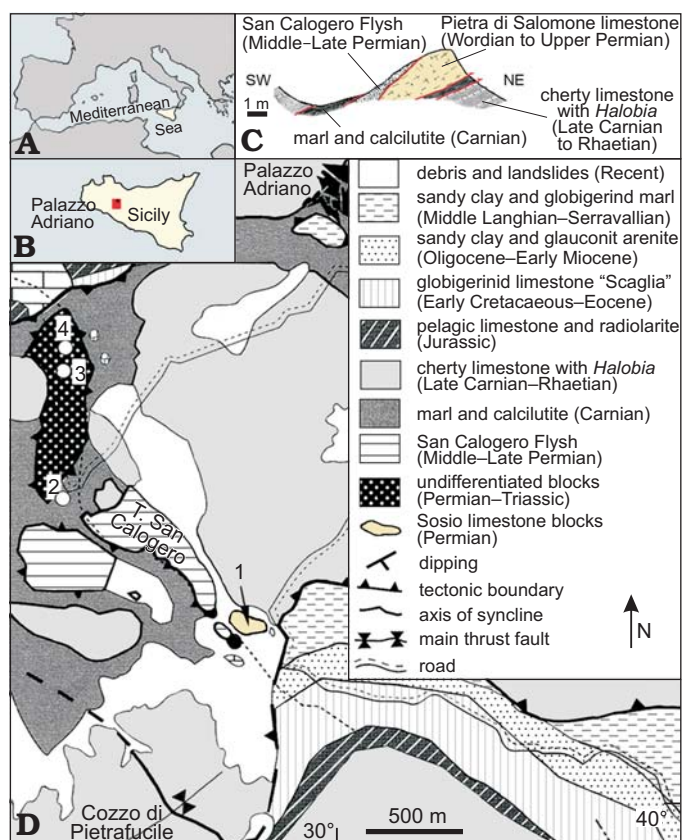


Fig. 1. Location of the study area in Mediterranean (A) and Sicily (B). Section across the Torrente San Calogero and the Pietra di Salomone block (C), modified from Flügel et al. 1984. Geological map of the Palazzo Adriano area (D), showing the location of the Pietra di Salomone block (modified from Di Stefano and Gullo 1997). 1, Pietra di Salomone limestone; 2, Rupe di Passo di Burro; 3, Petra dei Saracini; 4, Rupe di San Calogero.

*Plocostoma piazzii* (Gemmellaro, 1889), and the brachiopods *Coscinaria communis* (Gemmellaro, 1894) and *Martinia* sp.

The specimen was separated mechanically from the slightly cemented calcilutite containing cm-sized fossils and accurately cleaned to examine the whole external surface. Low magnification photos were acquired with a Zeiss Discovery V8A stereomicroscope equipped with an Axiovision acquisition system, in order to document general tube morphology. The specimen was also examined uncoated under a LMU Tescan Vega Scanning Electron Microscope in Low Vacuum modality, to investigate its micromorphology.

## Systematic palaeontology

### Class Polychaeta Grube, 1850

#### Family incertae sedis

#### Genus *Palaeotubus* nov.

*Etymology*: From Latin *palaeo*, ancient and *tubus*, tube; referring to the ancient age of the tubular fossil.

*Type species*: *Palaeotubus sosisiensis* gen. et sp. nov., monotypic; see below.

*Diagnosis*.—The same as for the monotypic type species.

#### *Palaeotubus sosisiensis* sp. nov.

Figs. 3, 4.

*Etymology*: Named after the type locality, in the Sosio Valley area.

*Holotype*: A unique incomplete unattached tube (MSNC 4499) broken at both ends.

*Type locality*: Sosio Valley, western Sicily (Italy).

*Type horizon*: Pietra di Salomone limestone, Wordian to Upper Permian.

*Diagnosis*.—Tube free, relatively thick and solid, circular in cross-section. Longitudinal keels smooth. Peristomes circular and slightly flared.

*Description*.—The holotype is 17 mm long and slightly bending, due to a change in growth direction in correspondence of a feeble peristome. The specimen consists of a tube fragment rather massive and solid, not increasing in diameter, circular in cross-section, 3.8 mm in diameter at its distal end (Fig. 3A, B). Lumen 2.7 mm wide (Figs. 3C, 4D). Sculpture consisting of 12 continuous, straight, robust, and smooth longitudinal keels, in equal distances of about 900  $\mu$ m from each other (Fig. 4B, C). Two low prominent transverse rings representing peristomes, one of which slightly flared indicating the growth direction and the pristine position of the tube opening (Figs. 3A, B, 4A, B). A change in growth direction is evident in correspondence of a slight peristome, increasing the bent aspect of the tube (Fig. 3A, B). Feeble transverse growth lines revealed by careful observation, best visible in the interspaces between keels. They are ca. 0.2 mm spaced, their faint concavity facing distally (Fig. 4B, C). Tube outline regularly undulated in cross section, for the alternation of shallow rounded depressions and angular peaks, these latter corresponding to the transverse keels' profiles (Fig. 4D, E). Tube wall ca. 0.5 mm thick, the structure presumably obliterated by diagenetic recrystallisation, but with an inner part formed by prevailing small and relatively loose crystals (Fig. 4F), grading to an outer part mostly with larger and more densely patched crystals (Fig. 4G).

*Remarks*.—The studied tube of *P. sosisiensis* gen. et sp. nov. only superficially resembles those of other common Palaeozoic organisms with the only character in common being the tubular calcareous skeleton. Among these fossils are the sabellid *Glomerula* Nielsen, 1931 and other tubeworms such as tentaculitids, cornulitids, and trypanoporids in the past affiliated with annelids and more recently transferred to lophophorates (see Vinn and Mutvei 2009).

In the absence of the internal structure and initial cemented tube portion, comparisons will be attempted exclusively on the basis of morphological characters of the erect part. Tubes of *Glomerula* differ from the studied one in lacking longitudinal keels, and in having irregular wall thickness and lumen diameter (see Vinn et al. 2008a). Further differences are the typical glomerate coiling and the minute size of the tube showed by the older (i.e., Palaeozoic) representatives of *Glomerula* (Nielsen 1931; Ippolitov et al. 2014).

Some tentaculitids, cornulitids, and trypanoporids tubular shells, only roughly similar to *P. sosisiensis* gen. et sp. nov. in their general morphologies, sizes and in having growth lines,



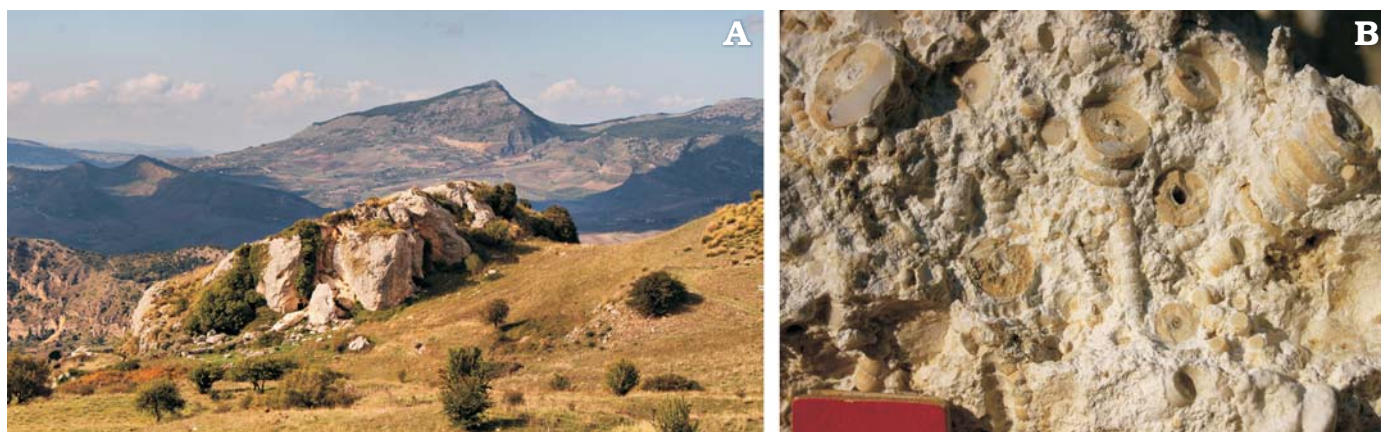


Fig. 2. **A.** The general appearance of the Pietra di Salomone megablock viewed from the East. **B.** Detail of the rock at mesoscale. Scale bar 30 mm.

differ from it in having: (i) smooth or ornamented surfaces with mostly transverse features, such as annulations or ribs, (ii) internal septa, and (iii) pseudopunctae and microscopic pores in the tube wall.

In contrast, the skeleton of *P. sosisensis* gen. et sp. nov. shows the greatest morphologic affinities with tubes constructed by polychaete serpulids. Characters supporting an attribution to serpulids are: (i) the tube size, consistent with that of medium-to-large sized serpulids, (ii) the ornamentation, including longitudinal keels and peristomes, which are diagnostic in the serpulids palaeontological systematics, and (iii) the micromorphology of the outer surface of the tube, made up of growth lines that fit well with those known for serpulids. These characters, and in particular the tube size and its ornamentation, have been considered as important features for the identification of fossil serpulid genera (e.g., Ippolitov et al. 2014).

Based on these morphological characters, differences/affinities with some particularly similar serpulid genera are discussed. A few serpulid genera share characters observed on *P. sosisensis* gen. et sp. nov. although not contemporaneously co-occurring. Tubes circular in cross-section and bearing longitudinal keels are present in *Serpula* Linnaeus, 1758, *Vermiliopsis* Saint-Joseph, 1894, *Semivermilia* ten Hove, 1975, *Metavermilia* Bush, 1905, and *Pyrgopolon* de Montfort, 1808. In particular, the genus *Serpula* has some species with tubes reaching 5 mm in diameter but showing no more than 5–7 longitudinal keels (Zibrowius 1968; ten Hove and Kuprianova 2009; Sanfilippo et al. 2013). Tubes of *Pyrgopolon* and *Vermiliopsis* have a comparable thickness, but differ from the described specimen as they rapidly increase in diameter and show a maximum of 7–9 keels (Jäger 2005, 2011; ten Hove and Kuprianova 2009), except for a single Recent species of *Pyrgopolon* which has up to 12 longitudinal ridges (ten Hove 1973). Superficially similar tubes with circular keeled distal ends can be present in the genus *Semivermilia*, as in the case of *S. crenata* (Costa, 1861). However, tubes are sensibly smaller and thinner than that of *P. sosisensis* gen. et sp. nov., with a maximum of 7 longitudinal keels (Zibrowius 1968; Bianchi 1981). Some species of the genus *Metavermilia* are similar to *P. sosisensis* gen. et sp. nov. for size, wall thickness and number

of longitudinal keels. In particular, the Pleistocene to Recent *M. multicristata* (Philippi, 1844), has 5–7 keels distributed all around the tube end, although they are thinner and denticulate (Zibrowius 1971; D'Onghia et al. 2015). Thus, the number of longitudinal keels appears as one of the most relevant features in *P. sosisensis* gen. et sp. nov., as the great majority of Recent and fossil serpulid species possesses no more than 7 keels.

Besides general morphology and ornamentation, the inner structure of the tube wall recently revealed to be of diagnostic importance for the assignment of tubeworms to taxonomic groups (e.g., Weedon 1991; Vinn and Taylor 2007; Taylor and Wilson 2008; Vinn and Mutvei 2009; Vinn et al. 2008a–c; Vinn 2013). Nevertheless, as the inner structure is not well preserved in the studied tube, and its appearance only weakly points to a probable serpulid-like two-layer organization, the

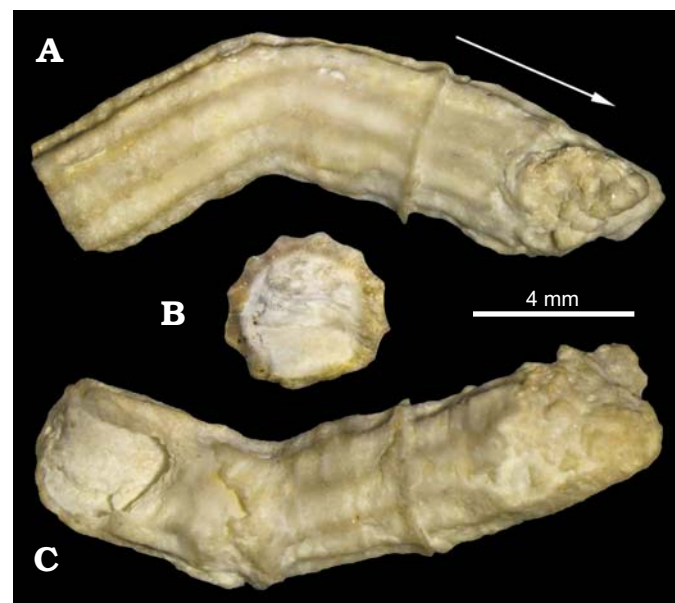


Fig. 3. The alleged serpulid *Palaeotubus sosisensis* gen. et sp. nov., holotype (MSNC 4499) from Pietra di Salomone limestone, Palazzo Adriano (Sicani Mountains, W Sicily); Wordian to upper Permian. The specimen was accurately cleaned from the rock but the white limestone is still visible infilling the tube lumen. Two opposite side views (A, C), growth direction arrowed, cross section (B).

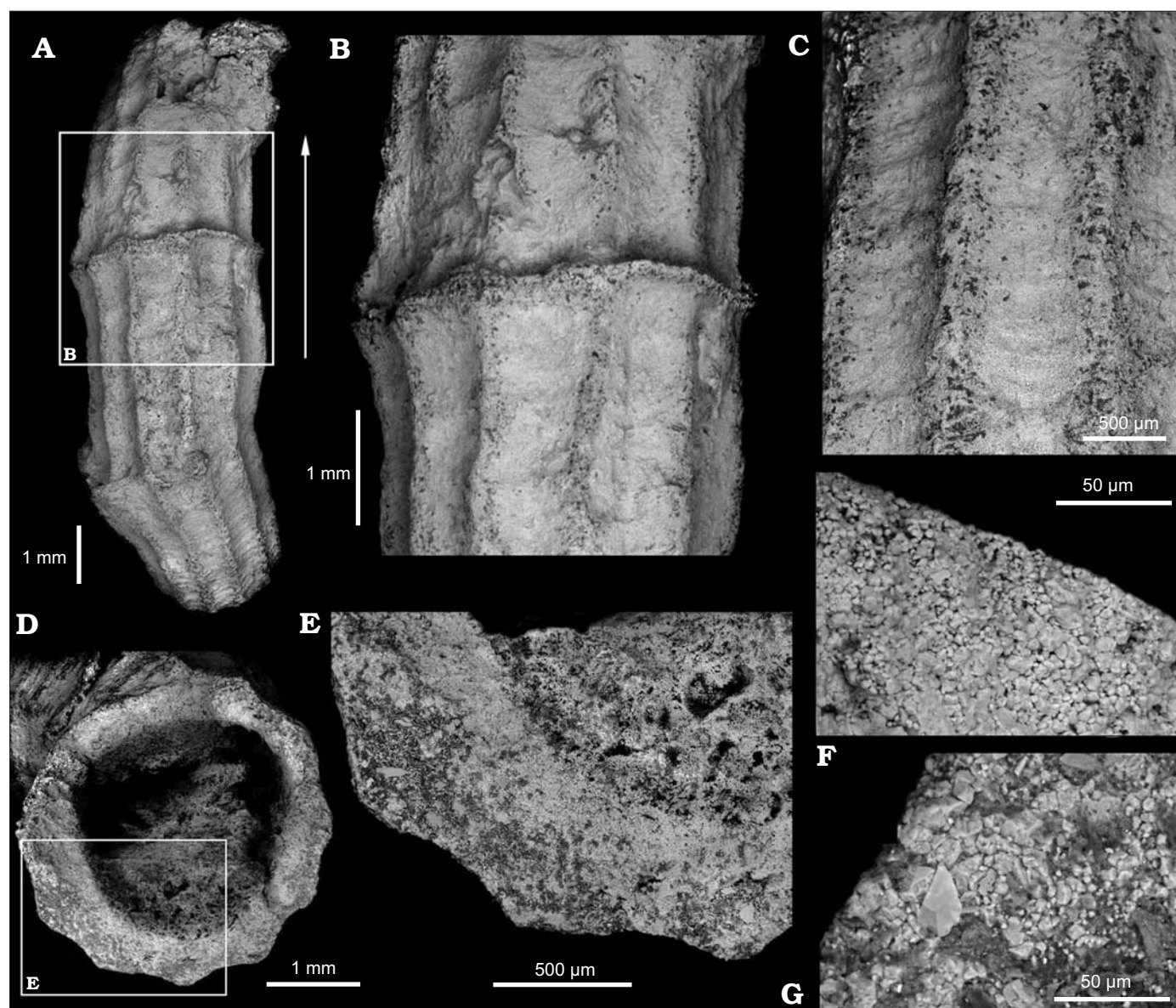


Fig. 4. SEM images of the alleged serpulid *Palaeotubus sosisensis* gen. et sp. nov., holotype (MSNC 4499) from Pietra di Salomone limestone, Palazzo Adriano (Sicani Mountains, W Sicily); Wordian to upper Permian. **A.** General view showing the entirely keeled tube (arrowed the growth direction, inferred from the slightly flaring peristomes). **B.** Close up of a peristome and longitudinal keels. **C.** Detail of keels and growth lines. **D.** Cross section of the tube. **E.** Tube wall. **F.** Detail of the tube wall showing prevalently small and loosely patched crystals on its inner part. **G.** Detail of the tube wall showing prevalently large and densely patched crystals on its outer part.

attribution of *P. sosisensis* gen. et sp. nov. to one of these systematic groups can neither be excluded nor substantiated.

It is similarly impossible to use a further unequivocal diagnostic character to discriminate between Palaeozoic tube-dwelling lophophorates, which share initial portions with small, sometimes spherical, embryonic shell chambers (e.g., Vinn and Mutvei 2009; Vinn and Zatoń 2012), from serpulids which show initial portions consisting of opened tiny tubes (e.g., Sanfilippo 1998: pl. 2: 2). Thus, the lack of both characters prevents the nature of the studied tube to be ascertained reliably.

*Palaeotubus sosisensis* gen. et sp. nov. presumably thrived in a shallow-marine environment, corresponding to the outer edge of a carbonate platform. The robust and massive tube of

the new species would represent an adaptive response to exposed and waved shallow-reef environment.

*Stratigraphic and palaeogeographic range.*—Type locality and horizon only.

## Concluding remarks

Serpulids are polychaetes confidently documented since the Middle Triassic (Vinn et al. 2008a, c; Ippolitov et al. 2014) with characteristic very simple forms from China (Stiller 2000). In contrast, records of Palaeozoic tubeworms formerly sometimes considered as belonging/related to serpulids, are now currently attributed to different groups, as is the case of some minute



typically glomerate coiled tubes, first related to the sabellid genus *Glomerula* (Ippolitov et al. 2014), also on the basis of their inner structure (Vinn et al. 2008a). Moreover, as suggested by Ippolitov et al. (2014), the status of the formally described Palaeozoic species *Serpula testatrix* Etheridge, 1892 is questionable, because its tubes are small and peculiarly coiled as in *Glomerula*. Further Palaeozoic (Permian) records of presumed serpulids are those reported as “*Vermilia*” *obscura* King, 1850 and *Serpula pusilla* Geinitz, 1848. Their old descriptions and figures did not provide morphological details, and Ippolitov et al. (2014: 140) commented that “their potentially serpulid nature was yet to be re-investigated”.

In this context, if the serpulid origin for *P. sosisensis* gen. et sp. nov. was confirmed by future findings, it would be the earliest representative within the family. The existence of this species would document an ancestral serpulid characterized by a solid, thick and multi-keeled tube, predating currently known first appearance of serpulids represented by *Filograna*-like forms with small and tiny tubes. In that case the new serpulid would push the origins of the entire group back to the Permian.

**Acknowledgements.**—The authors thank the Dipartimento Azienda Foreste Demaniali of Sicily for permission to collect Permian material from the outcrop; Filippo Spadola, Francesco Cavallaro, and Mario Dipasquale (cooperators of MSNC); Rosario Occhipinti and Lorenzo Zurla (Associazione Onlus Ulixes, Ragusa, Italy) for sampling help; Alfio Viola (University of Catania, Italy) for assistance with the SEM acquisition of images; Ruggero Sciuto (University of Oxford, UK) for bibliographic help. Special thanks are due to Olev Vinn (University of Tartu, Estonia), Manfred Jäger (Holcim Süddeutschland, Dotternhausen, Germany), Alexei Ippolitov (Geological Institute of Russian Academy of Sciences, Moscow, Russia), Elena K. Kupriyanova (Australian Museum Research Institute, Sydney, Australia) and an anonymous reviewer for providing suggestions that improved the manuscript. This paper was financially supported by University of Catania grants to RS and AR (Catania Palaeontological Research Group: contribution n. 408).

## References

- Bianchi, C.N. 1981. Policheti Serpuloidei. Guide per il riconoscimento delle specie animali delle acque lagunari e costiere italiane AQ/1/96. *Consiglio nazionale delle Ricerche, Genova* 5: 1–187.
- Clausen, S. and Alvaro, J.J. 2002. Encrusting strategies in a Cambrian nonreefal epibenthic community. *Bulletin de la Société Géologique de France* 173: 553–559.
- Dalvé, E. 1948. *The Fossil Fauna of the Ordovician in the Cincinnati Region: Cincinnati*. 56 pp. Ohio University Museum, Athens.
- Di Geronimo, I., Allegri, L., Improta, S., La Perna, R., Rosso, A., and Sanfilippo, R. 1997. Spatial and temporal aspects of benthic thanatocoenoses in a Mediterranean infralittoral cave. *Rivista Italiana di Paleontologia e Stratigrafia* (special volume) 103: 15–28.
- Di Stefano, P. and Gullo, M. 1997. Permian deposits of Sicily. A review. *Geodiversitas* 19: 193–202.
- D’Onghia, G., Capezzuto, F., Cardone, F., Carlucci, R., Carluccio, A., Chimienti, G., Corriero, G., Longo, C., Maiorano, P., Mastrototaro, F., Panetta, P., Rosso, A., Sanfilippo, R., Sion, L., and Tursi, A. 2015. Macro- and megafauna recorded in the submarine Bari Canyon (southern Adriatic, Mediterranean Sea) using different tools. *Mediterranean Marine Science* 16: 180–196.
- Ernst, A.K. 2000. Permian Bryozoans of the NW-Tethys. *Facies* 43: 79–102.
- Flügel, E., Di Stefano, P., and Senowbari-Daryan, B. 1991. Microfacies and depositional structure of allochthonous carbonate base-of-slope deposits: The Late Permian Pietra di Salomone megablock, Sosio Valley (western Sicily). *Facies* 25: 147–186.
- Flügel, E., Flügel-Kahler, E., Martin, J.M., and Martin-Algarra, A. 1984. Middle Triassic Reefs from Southern Spain. *Facies* 11: 173–218.
- ten Hove, H.A. 1973. Serpulinae (Polychaeta) from the Caribbean: II—the genus *Sclerostyla*. *Studies on the Fauna of Curaçao and other Caribbean Islands* 43: 1–21.
- ten Hove, H.A. and Kupriyanova, E.K. 2009. Taxonomy of Serpulidae: the state of affairs. *Zootaxa* 2036: 1–126.
- Ippolitov, A.P., Vinn, O., Kupriyanova, E.K., and Jäger, M. 2014. Written in stone: history of serpulid polychaetes through time. *Memoirs of Museum Victoria* 71: 123–159.
- Jäger, M. 2005. Serpulidae und Spirorbidae (Polychaeta sedentaria) aus Campan und Maastricht von Norddeutschland, den Niederlanden, Belgien und angrenzenden Gebieten. *Geologisches Jahrbuch A* 157: 121–249.
- Jäger, M. 2011. Sabellidae, Serpulidae and Spirorbinae (Polychaeta sedentaria) from the Barremian (Lower Cretaceous) of the Serre de Bleyton (Drôme, SE France). *Annalen des Naturhistorischen Museums in Wien, Serie A* 113: 675–733.
- Jenny-Deshusses, C., Marrini, R., and Zaninetti, L. 2000. Découverte du foraminifère *Colaniella* Likharev dans le Permien supérieur de la vallée du Sosio (Sicile). *Comptes Rendus de l’Académie des Sciences* 330: 799–804.
- Jones, W.T., Feldmann, R.M., Schweitzer, C.E., Reitano, A., and Insacco, G. 2015. New pygocephalomorph (Peracarida) from the Permian of the Sosio Valley (Sicily, Italy). *Journal of Crustacean Biology* 35: 627–632.
- Kupriyanova, E.K., ten Hove, H.A., Sket, B., Trontelj, P., Zakšek, V., and Rouse, G.W. 2009. Evolution of a unique freshwater cave dwelling serpulid polychaete *Marifugia cavatica* Absolon and Hrabě, 1930. *Systematics and Biodiversity* 7: 389–401.
- Kupriyanova, E.K., Nishi, E., Kawato, M., and Fujiwara, Y. 2010. New records of Serpulidae (Annelida, Polychaeta) from hydrothermal vents of North Fiji, Pacific Ocean. *Zootaxa* 2389: 57–68.
- Kupriyanova, E.K., Vinn, O., Taylor, P.D., Schopf, J.W., Kudryavtsev, A., and Bailey-Brock, J. 2014. Serpulids living deep: calcareous tubeworms beyond the abyss. *Deep-Sea Research Part I* 90: 91–104.
- Nielsen, K.B. 1931. Serpulidae from the Senonian and Danian deposits of Denmark. *Meddelelser fra Dansk geologisk Forening* 8: 71–113.
- Rosso, A., Sanfilippo, R., Taddei Ruggieri, E., and Di Martino, E. 2013. Faunas and ecological groups of Serpuloidea, Bryozoa and Brachiopoda from submarine caves in Sicily (Mediterranean Sea). *Bollettino della Società Paleontologica Italiana* 52: 167–176.
- Rosso, A., Vertino, A., Di Geronimo, I., Sanfilippo, R., Sciuto, F., Di Geronimo, R., Violanti, D., Corselli, C., Taviani, M., Mastrototaro, F., and Tursi, A. 2010. Hard and soft-bottom thanatofacies from the Santa Maria di Leuca deep-water coral province, Mediterranean. *Deep Sea Research II. Topical Studies in Oceanography* 57: 360–379.
- Sandberger, G. and Sandberger, F. 1856. *Die Versteinerungen des rheinischen Schichtensystems im Nassau*. 564 pp. Kreidel & Niedner, Wiesbaden.
- Sanfilippo, R. 1998. Tube morphology and structure of the bathyal mediterranean serpulid *Hyalopomatus variorugosus* Ben-Eliahu and Fiege, 1996 (Annelida, Polychaeta). *Rivista Italiana di Paleontologia e Stratigrafia* 104: 131–138.
- Sanfilippo, R. 2009. New species of *Hyalopomatus* Marenzeller, 1878 (Annelida, Polychaeta, Serpulidae) from Recent Mediterranean deep-water coral mounds and comments on some congeners. *Zoosystema* 31: 147–161.
- Sanfilippo, R., Rosso, A., Guido, A., Mastandrea, A., Russo, F., Ryding, R., and Taddei Ruggieri, E. 2015. Metazooan/microbial biostalactites from modern submarine caves in the Mediterranean Sea. *Marine Ecology* 36: 1277–1293.
- Sanfilippo, R., Vertino, A., Rosso, A., Beuck, L., Freiwald, A., and Taviani, M. 2013. *Serpula* aggregates and their role in deep-sea coral communities in the southern Adriatic Sea. *Facies* 59: 663–677.

- Stiller, F. 2000. Polychaeta (Annelida) from the Upper Anisian (Middle Triassic) of Qingyan, south-western China. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen* 217: 245–266.
- Taylor, P.D. and Vinn, O. 2006. Convergent morphology in small spiral worm tubes (“*Spirorbis*”) and its palaeoenvironmental implications. *Journal of the Geological Society, London* 163: 225–228.
- Taylor, P.D. and Wilson, M. 2008. Morphology and affinities of hedereloid “bryozoans”. *Virginia Museum of Natural History, Special Publication* 15: 301–309.
- Vinn, O. 2013. Cornulitid tubeworms from the Ordovician of eastern Baltic. *Carnets de Géologie, Brest* (CG2013\_L03): 131–138.
- Vinn, O. and Mutvei, H. 2009. Calcareous tubeworms of the Phanerozoic. *Estonian Journal of Earth Sciences* 58: 286–296.
- Vinn, O. and Taylor, P.D. 2007. Microconchid tubeworms from the Jurassic of England and France. *Acta Paleontologica Polonica* 52: 391–399.
- Vinn, O. and Zatoń, M. 2012. Phenetic phylogenetics of tentaculitoids extinct problematic calcareous tube-forming organisms. *Geologiska Föreningen i Stockholm Förhandlingar* 134: 145–156.
- Vinn, O., ten Hove, H.A., and Mutvei, H. 2008a. On the tube ultrastructure and origin of calcification in sabellids (Annelida Polychaeta). *Palaeontology* 51: 295–301.
- Vinn, O., ten Hove, H.A., Mutvei, H., and Kirsimäe, K. 2008b. Ultrastructure and mineral composition of serpulid tubes (Polychaeta, Annelida). *Zoological Journal of the Linnean Society, London* 154: 633–650.
- Vinn, O., Jäger, M., and Kirsimäe, K. 2008c. Microscopic evidence of serpulid affinities of the problematic fossil tube “*Serpula*” *etalensis* from the Lower Jurassic of Germany. *Lethaia* 41: 417–421.
- Vinn O., Kupriyanova E.K., and Kiel S. 2013. Serpulids (Annelida, Polychaeta) at Cretaceous to modern hydrocarbon seeps: Ecological and evolutionary patterns. *Palaeogeography, Palaeoclimatology, Palaeoecology* 390: 35–41.
- Weedon, M.J. 1991. Microstructure and affinity of the enigmatic Devonian tubular fossil Trypanopora. *Lethaia* 24: 227–234.
- Weedon, M.J. 1994. Tube microstructure of recent and Jurassic serpulid polychaetes and the question of the Palaeozoic “spirorbids”. *Acta Palaeontologica Polonica* 39: 1–15.
- Zibrowius, H. 1968. Étude morphologique, systématique et écologique des Serpulidae (Annelida Polychaeta) de la région de Marseille. *Recueil des Travaux de la Station Marine d'Endoume, Bulletin* 43: 81–252.
- Zibrowius, H. 1971. Revision of *Metavermilia* Bush (Polychaeta, Serpulidae), with descriptions of three new species from off Portugal, Gulf of Guinea and Western Indian Ocean. *Journal of the Fisheries Research Board Canada* 28: 1373–1383.
- Ziegler, V. 2006. *The Fossil Serpulids*. 108 pp. Univerzita Karlova v Praze, Praha.

Rossana Sanfilippo [sanfiro@unict.it] and Antonietta Rosso [rosso@unict.it], Department of Biological, Geological and Environmental Sciences, University of Catania, Corso Italia 57, Catania, Italy.

Agatino Reitano [tinohawk@yahoo.it] and Gianni Insacco [g.insacco@comune.comiso.rg.it], Museo Civico di Storia Naturale di Comiso, Via degli Studi 9, 97013 Comiso, Italy.

Received 29 September 2015, accepted 10 December 2015, available online 21 December 2015.

Copyright © 2016 R. Sanfilippo et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License (for details please see <http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.