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A new species of hesionid worm, *Hesiocaeca methanicola* sp. nov. (Polychaeta: Hesionidae), living in ice-like methane hydrates in the deep Gulf of Mexico

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Abstract: On July 14, 1997, in the Gulf of Mexico, a dense population of polychaete worms dwelling in methane hydrates associated with cold seeps was discovered and sampled at 538 meters depth. The worms belong to the family Hesionidae and represent a new species of the genus *Hesiocaeca*. They differ from the two previously described species by the shape of the prostomium, the shape of the setae and the presence of anal cirri.

Résumé : Le 14 juillet 1997, dans le Golfe du Mexique et par 538 mètres de fond, une population très dense de vers polychètes a été découverte, colonisant la surface de dépôts d'hydrates de méthane situés à proximité des zones de suintements froids d'hydrocarbures. Les spécimens récoltés appartiennent à la famille des Hésionidés et à une nouvelle espèce du genre *Hesiocaeca*. Cette espèce diffère des deux espèces précédemment décrites par la forme du prostomium, celle des soies et la présence d'urites bien développés.

Keywords : Annelida, Polychaeta, Hesionidae, deep-sea, methane hydrates, Gulf of Mexico.

Introduction

In July 1997, during a programme on cold-seeps in the deep Gulf of Mexico, a dense "colony" of pink polychaete worms was discovered by Charles R. Fisher and sampled by the submersible "Johnson Sea-Link 2" from Harbor Branch Oceanographic Institution, at 538 meters depth, on ice-like methane hydrate mounds. These hydrocarbon hydrates are crystallized structures combining water and hydrocarbon gases and they are formed under conditions of low temperature and high pressure. They rise off the seafloor because this "methane ice" is lighter than the sediment or sea water. The worms, nicknamed "iceworms", clearly belong to the polychaete family Hesionidae (see Mlot, 1997).

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Material and methods

Type locality: Gulf of Mexico, 27°44.77' N., 91°13.33'W, 538 meters depth. Animals living at the surface of ice-like methane-hydrate mounds (Fig. 1A).

Type material: holotype (USNM, Washington DC) from 27°44.77'N, 91°13.33'W, depth 538 m (Johnson Sea Link dive #97. 2867). Paratypes (MNHN Paris n° UE 934 and USNM) from the same locality (Johnson Sea Link dive

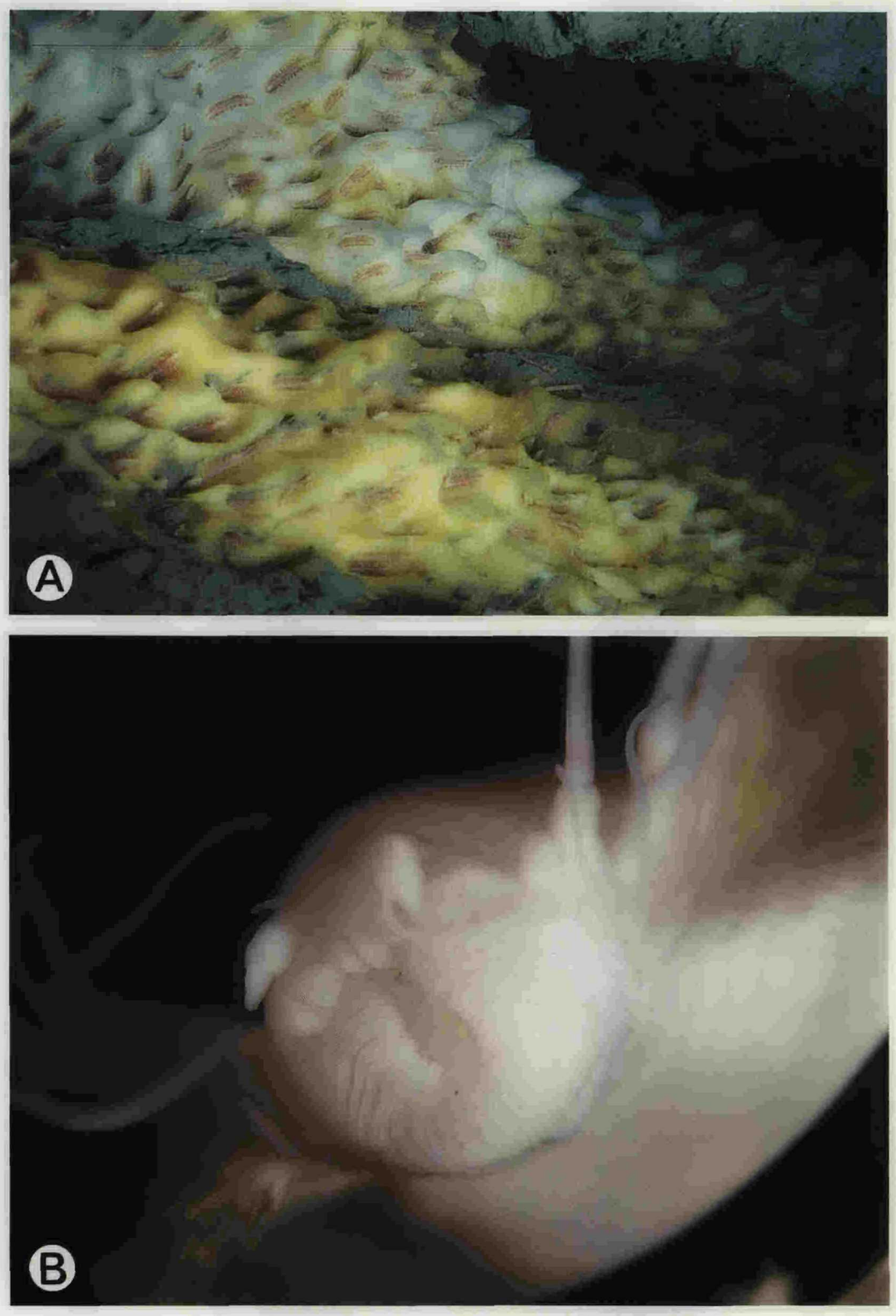


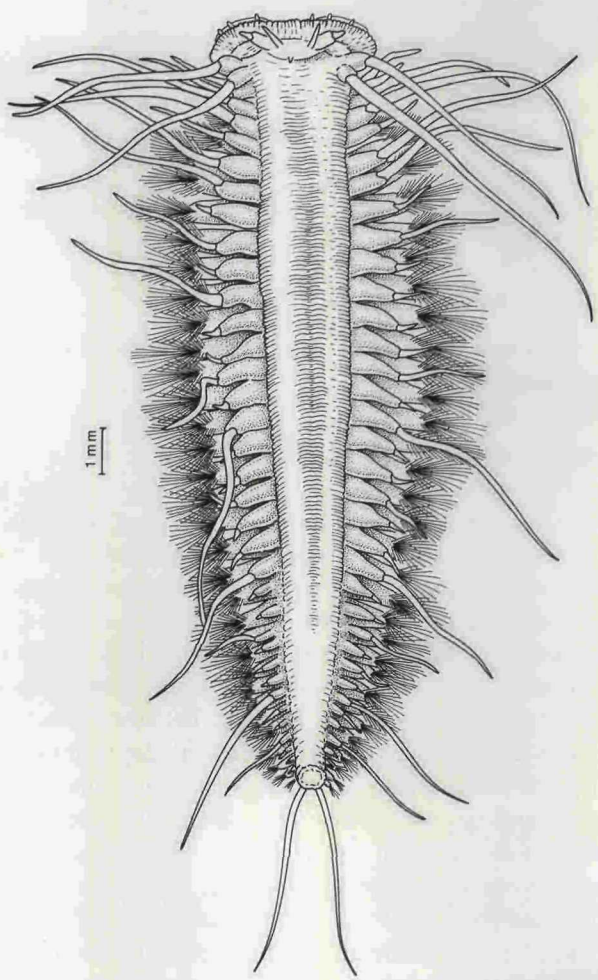
Figure 1. (A) Part of the ice-like hydrate deposit at the type locality, showing the iceworms, each in a small hollow at the surface of the ice mound. (B) Anterio-ventral view of an iceworm.

Figure 1. (A) Vue partielle du dépôt de glace de méthane découvert à la localité type, montrant les "vers de glace" logés chacun dans une petite dépression de la surface du monticule de glace. (B) Vue antéro-ventrale d'un "ver de glace".

#97. 2867). Nine fixed specimens were examined. The habitus of the worm was drawn under a binocular microscope fitted with a camera lucida. Three specimens were prepared for SEM, two of them fixed with 10% formalin and the third one, a relaxed specimen, was fixed in glutaraldehyde (2% in 0.2 M cacodylate buffer). The specimens were critical point dried with carbon dioxide, sputtered with gold, and examined with a Philips scanning electron microscope (XL 30).

Description of *Hesiocaeca methanicola* sp. nov.

Holotype: length 18 mm for 37 setigers, and width 1.7 mm (4 mm including parapodia), anteriorly truncate and tapering posteriorly (Fig. 2). Length of other specimens ranging from 11 to 22 mm for 36 to 38 segments. Colour of living specimens red-pinkish, whitish or flesh colour in alcohol.



Prostomium wider than long, trapezoid and slightly bilobated anteriorly (Fig. 3A). Facial fold, a feature connecting anterio-ventral side of prostomium to dorsal part of mouth (Pleijel, in press), visible only on specimens with invaginated pharynx. Palps biarticulated, palpophore ovoid, flattened, slightly longer than wide; palpostyle conical and shorter than palpophore (Figs 1B, 3B). Three antennae; paired antennae ciliated, conical, five times longer than wide basally and roughly same length as palpostyle (Fig. 3A, B). Median antenna very short, hardly visible, inserted on dorsal posterior part of prostomium (Fig. 3A). Median antenna furrows absent. Eyes absent. Nuchal organs not visible. Prostomium with posterior edge entire. Prostomium and palpophores densely covered with small tufts of short cilia (Fig. 3A, B). Papillose peristomial membrane and lip glands absent. Eversible pharynx with a folded aperture (Fig. 1 B) and with three to four paired conical papillae (Fig. 4) located more deeply.

Noto- and neuropodial lobes and setae absent on segments 1 and 2 (Fig. 2). Anterior dorsal cirri present on segments 1 and 2 with cirrophores elevated, not fused. Ventral cirri enlarged on segments 1 and 2. Following parapodia subbiramous with reduced notopodia bearing long and weakly segmented dorsal cirri, and two-three aciculae with slightly curved tip but without extending setae (Figs 2, 3C, 5A). Slight segmentation of dorsal cirri, more visible and longer than wide distally. Enlarged dorsal cirri in segments 1 to 5 or 1 to 4, irregular in length. Length of posterior dorsal cirri irregular on all the specimens studied, some of them very long, others very short, this likely linked to a regeneration process (Fig. 2). Segments posterior to segment 2 with ventral cirri smaller than parapodia and without cirrophore. Ciliated bands on dorsal part of segments.

Neuropodium well developed, postsetal lobe with rounded apex. Four aciculae with slightly curved tips and spreading fascicle of numerous (> 90) compound setae. In the upper fascicle, ca. 30 spiniger setae with long needle-shaped, serrated blades, varying in length (Figs 3D, 5B). In the lower fascicle, ca. 60 falcigers with shorter serrated blades ending with a small terminal hood (Fig. 5B).

Anal cirri, ventral, well developed but shorter than anterior dorsal cirri. No pygidial papillae, anus dorsal (Fig. 2).

Figure 2. Dorsal view of *Hesiocaeca methanicola* sp. nov. Segmentation of the cirri not shown.

Figure 2. Vue dorsale de *Hesiocaeca methanicola* sp. nov. La segmentation des cirres n'est pas représentée.

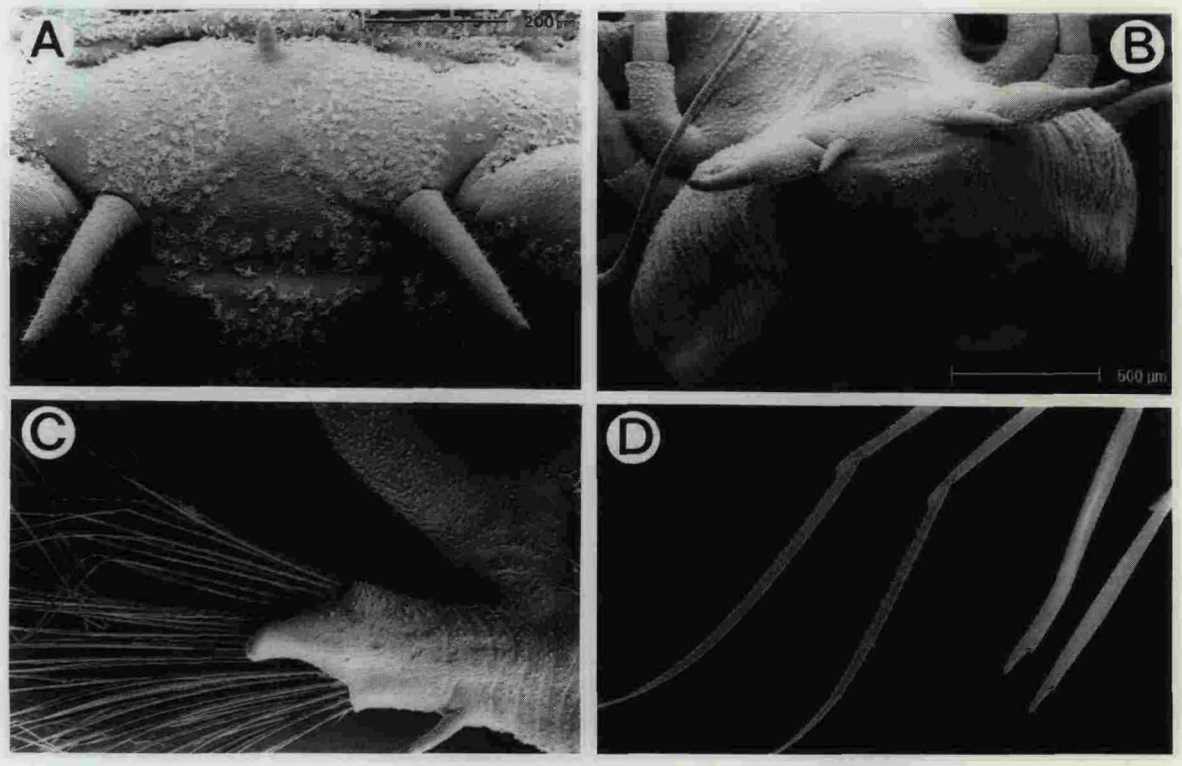


Figure 3. *Hesiocaeca methanicola* sp. nov. (A) Frontal view of the prostomium showing the three antennae. (B) Anterio-dorsal view of the prostomium and partly everted pharynx. (C) Anterior view of the 5th right subbiramous parapodium. (D) Detail of composite neurosetae (distal blades lost on two setae on the right).

Figure 3. *Hesiocaeca methanicola* sp. nov. (A) Vue frontale du prostomium montrant les trois antennes. (B) Vue antéro-dorsale du prostomium et du pharynx partiellement évaginé. (C) Vue antérieure du cinquième parapode droit sub-biramé. (D) Détail des soies composées du neuropode avec leurs lames denticulées (perdues sur les deux soies de droite).

Figure 4. *Hesiocaeca methanicola* sp. nov. Anterio-ventral view of a specimen with everted pharynx, showing its inside parts, bordered with 3-4 pairs of soft conical papillae (arrow).

Figure 4. *Hesiocaeca methanicola* sp. nov. Vue antéro-ventrale d'un spécimen montrant le pharynx évaginé et sa partie interne bordée par 3-4 paires de papilles coniques (flèche).

Etymology

methanicola: which is dwelling inside methane (hydrates).

Discussion

Hesiocaeca was erected by Hartman (1965) for *Hesiocaeca bermudensis* from the deep-sea off Bermuda. It is a hesionid with three antennae, biarticulated palps, four pairs of tentacular cirri, parapodia uniramous, first setae in the third segment, eversible pharynx with a few distal papillae, jaws absent. More recently Blake (1991) described a second species of this genus, *H. hessleri* from the deep-sea hydrothermal vents of the Mariana Back-Arc Basin. *H. hessleri* differs from *H. bermudensis* by the position and shape of the median antenna (short vs. long), the relative proportions of the prostomium and the presence of one notopodial acicula (parapodia subbiramous). *H. methanicola* sp. nov. differs from *H. bermudensis* by the shape and position of the median antenna and differs from *H. hessleri* (a) by the shape of the prostomium which is wider and shorter, (b) by the number of segments and size,

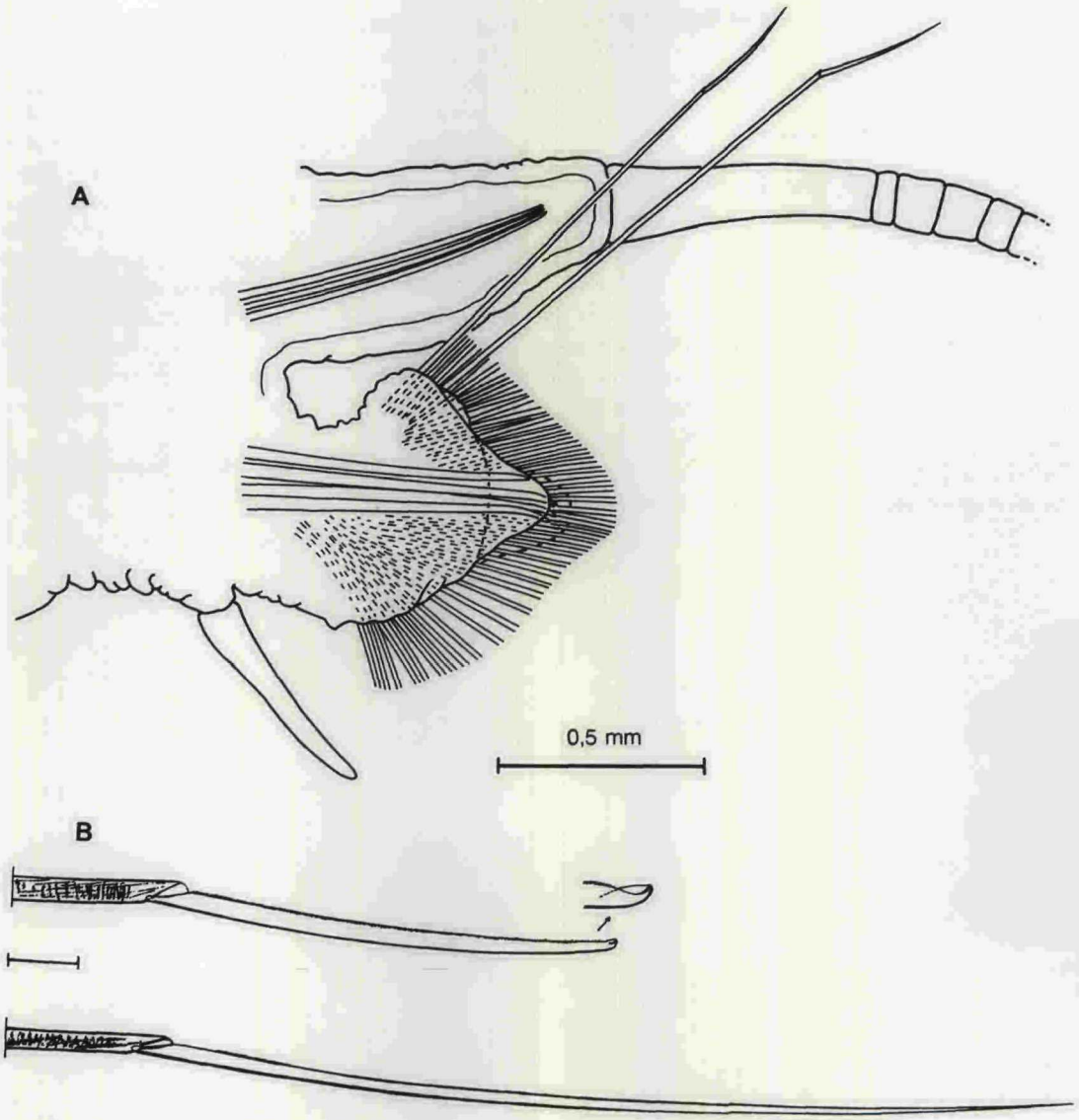


Figure 5. *Hesiocaeca methanicola* sp. nov. (A) Fourth left parapodium in anterior view after lightening in hot lactate. (B) Detail of the two types of compound setae from the sixth left parapodium of a specimen 21 mm in length (scale bar 50 μm).

Figure 5. *Hesiocaeca methanicola* sp. nov. (A) Quatrième parapode gauche en vue antérieure après éclaircissement de la pièce à l'acide lactique chaud. (B) Détail des deux types de soies composées du sixième parapode gauche d'un spécimen de 21 mm de longueur (barre d'échelle 50 μm).

(c) by the presence of anal cirri in the present species, lacking in *H. hessleri* and (d) by the number of notopodial aciculae (two-three in *H. methanicola*, one in *H. hessleri*).

Pleijel (in press) considering that the two first species descriptions were based on truncate or juvenile worms suggests that *Hesiocaeca* might be considered as an invalid name and proposes to erect a new genus which would include the "iceworm" and *Orseis grasslei* described by Blake (1985) from a sample collected in the vicinity of deep-sea hydrothermal vents in the Guaymas Basin. Due to the smaller size of the deep-sea hesionids as compared to shallow water ones, size remains a questionable criterion and cannot be retained as discriminant among the reproductive stages of the worm (juvenile vs. adult). We do

not agree at this moment with Pleijel because of the shape of the parapodia which are subbiramous in *Hesiocaeca vs.* uniramous in *Orseis* and we have decided to take a conservative position, waiting for further analysis.

Acknowledgements

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