



Jurassic sea spiders from the La Voulte-sur-Rhône Lagerstätte (SE France)

S. Charbonnier (1,2), J. Vannier (2) and B. Riou (3)

(1) Université Paris-Sud 11, Département des Sciences de la Terre, UMR CNRS 8148 IDES, Bâtiment 504, 91405 Orsay Cedex, France (sylvain.charbonnier@u-psud.fr), (2) U.F.R. des Sciences de la Terre, UMR CNRS 5125 PEPS, Université Lyon 1 - Campus de La Doua, 2 rue Raphaël Dubois - Bâtiment Géode, F-69622 Villeurbanne Cedex, France, (3) quartier Rondette 07250 Rompon, France

Three new species of sea spiders or pycnogonids (Arthropoda: Pycnogonida) have been recently described from the Middle Jurassic La Voulte Lagerstätte (SE France, Ardèche) (Charbonnier *et al.* 2007). These exceptionally well-preserved fossils fill a 400 million year gap of knowledge in the evolutionary history of these enigmatic marine arthropods that constitute today a small group of more than 1,300 described species. Sea spiders resemble arachnids and are particularly recognizable by their extremely long legs, prominent proboscis, ovigers and, vestigial abdomen. They occupy a wide range of exclusively marine habitats from shallow water to abyssal depths.

Considerable uncertainties remain concerning the evolutionary history of pycnogonids due to the patchiness of the fossil record. Fossil evidence obtained from exceptional fossil sites have been of crucial importance to this issue but concern only the early stages of the evolution of the group: (1) the Cambrian with 3D-preserved pycnogonid larvae from the "Orsten" deposits (ca. 500 Myr), (2) the Silurian with a complete adult pycnogonid reconstructed digitally from the Herefordshire Lagerstätte (ca. 425 Myr) that shows resemblances with Recent pycnogonids, although lacking demonstrably close relations to any extant lineage and, (3) the Devonian with 4 species from the Hunsrück Slate Lagerstätte (ca. 400 Myr) that do not reveal the origin of Recent forms. The group had no previous record in the Mesozoic or Tertiary.

The three new species (*Collossopantopodus boissinensis*, *Palaeopycnogonides gra-*

cilis, *Palaeoendeis elmii*) of pycnogonids from the La Voulte Lagerstätte (Callovian, ca. 160 Myr) provide altogether the most detailed information so far available on the morphology, mode of life and habitats of Mesozoic sea spiders. They reveal very close morphological and functional (locomotion, feeding) similarities with present-day pycnogonids (e.g. Ammotheidae, Colossendeidae, Endeidae) and, by contrast, marked differences with the aforementioned Palaeozoic representatives of the group. *C. boissinensis* displays some of the diagnostic features of the extant family Colossendeidae, such as a pantograph-like shape, a very long proboscis, a narrow trunk without external segmentation and, 10-segmented ovigers. *P. gracilis* shows remarkable similarities with typical representatives of the extant family Ammotheidae (compact trunk, often short proboscis, small reduced chelifores) such as *Ammothea*. *P. elmii* presents close affinities with Recent Endeidae mainly indicated by its spindly shape, relative proportion of trunk and proboscis, long walking legs, its distinctly segmented trunk, and the absence of palps and chelifores (lacking in all Recent Endeidae). These three species have long legs that may be slender (*P. elmii*), thicker (*P. gracilis*) or with a very large leg span (*C. boissinensis*). This appendage design characterizes the Recent epibenthic pycnogonids that use their long legs to walk on the muddy bottom of bathyal to abyssal environments. Direct evidence for their diet is not available. However, potential prey such as ophiuroids, small bivalves and polychaetes are abundant at La Voulte and are found associated with pycnogonids. The sucking up of small organisms from mud via a well-developed proboscis may have been one of the feeding strategies of the pycnogonids from La Voulte as observed in the extant *Colossendeis colossea*.

Combined evidence from Recent analogues, faunal associates (e.g. vampire squids, cirrate octopods, thylacocephalan arthropods) and depositional environment indicate that the La Voulte pycnogonids probably lived in the bathyal zone at depth exceeding 200 m. The results point to a remarkable morphological and ecological stability of this arthropod group over at least 160 million years and suggest that the colonization of the deep-sea by pycnogonids occurred before the Jurassic.

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