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Mithracia oppionii sp. nov. (Crustacea, Decapoda, Brachyura) from the Eocene of Chiampo (Vicenza, Italy)

Cristiano Larghi

Università degli Studi di Milano, Dipartimento di Scienze della Terra, Via Mangiagalli, 34, 20133 Milano, Italy
<cristiano.larghi@unimi.it>

Abstract

A new species of brachyuran decapod crustacean of the family Majidae Samouelle, *Mithracia oppionii*, is described. The new species was collected from lower Eocene rocks of Chiampo near Vicenza (Veneto, Italy). *Mithracia oppionii* sp. nov. is similar to the type species, *M. libinioides* Bell, 1858 (lower Eocene of Southern England) but differs from it in the shape of the supraorbital margin and in the development of the epibranchial and protogastric lobes. The supraorbital margin of *Mithracia oppionii* sp. nov. exihibits better developed preorbital and postorbital teeth than does *M. libinioides*; the epibranchial and protogastric lobes are wider than in *M. libinioides*. In *Mithracia oppionii* sp. nov. the epibranchial lobes are less evident because they are separated from the mesobranchial lobe by a subtle groove. The paleoecological significance of the fossiliferous assemblages from the Chiampo Ypresian levels is here discussed. The Eocene paleogeography of the Lessini mountains is described and the paleobiogeography of *Mithracia* Bell, 1858, herein reported for the first time in lower Eocene Italian rocks, is discussed.

Riassunto

Viene istituita la nuova specie *Mithracia oppionii*, Crostaceo Decapode Brachiuro della famiglia Majidae Samouelle, proveniente dall'Eocene inferiore di Chiampo in provincia di Vicenza (Veneto). Simile alla specie-tipo *M. libinioides* Bell, 1858 (Eocene inferiore dell'Inghilterra meridionale) se ne differenzia essenzialmente per una diversa conformazione del margine sopraorbitale e per un diverso sviluppo dei lobi epibranchiali e protogastrici.

Nella nuova specie il margine sopraorbitale mostra i denti preorbitali e postorbitali molto più sviluppati di quelli presenti in *M. libinioides*, anche i lobi epibranchiali e protogastrici sono più ampi che in *M. libinioides*. I lobi epibranchiali sono però meno evidenti in *Mithracia oppionii* sp. nov., perché sono separati dai lobi mesobranchiali da un solco inciso debolmente. Viene discusso il significato paleoecologico delle associazioni fossilifere provenienti dai livelli ypresiani di Chiampo. È inoltre descritta la paleogeografia eocenica dei Lessini e viene discussa la paleobiogeografia del genere *Mithracia* Bell, 1858, per la prima volta segnalato nell'Eocene inferiore italiano.

Key words: Crustacea, Decapoda, Brachyura, Eocene, Ypresian, Northern Italy

Introduction

The decapod crustacean described in this paper, for which the name *Mithracia oppionii* sp. nov. is here introduced, comes from the classic locality of "Lovara Quarry", which is located in the south-west of Chiampo, on the west side of the Chiampo Valley (eastern Lessini range), at an altitude of 400 m (Fig. 1).

Several workers have studied the geology and paleontology of this part of the Lessini Mountains;



Fig 1. Map showing the Lovara and Rossi Quarries locations (the hilly regions are indicated in gray).

amongst them Oppenheim (1913), Schweighauser (1953), Hottinger (1960), Schaub (1981), Bosellini and Dal Cin (1966), Coletti et al. (1973), Beschin et al. (1988; 1991) and Bosellini and Trevisan (1992). The stratigraphic units cropping out in the Lovara Quarry were described by Munier-Chalmas (1891), Fabiani (1915), Hottinger (1960), Schaub (1962) and De Zanche (1965).

The described specimen was collected in the reworked green-grey hyaloclastite underlying the "Lophoraninae Tuffs" of Beschin et al. (1991). According to De Zanche (1965), the levels including these hyaloclastites occur between the middle Cuisian and the lower Lutezian. Similar levels, cropping out in the Rossi Quarry near Monte di Malo, were attributed to the middle-upper Cuisian by Ungaro in Beschin et al. (1996). These levels contain a rich macroforaminiferal fauna (Nummulitidae and Orbitoidacea), mollusks and coralline algae. A complete list of the Crustacea found in the Lovara Quarry was recently given by De Angeli (2000).

Systematic paleontology

Superfamily Majoidea Samouelle, 1819
Family Majidae Samuelle, 1819
Subfamily Micromaiinae Beurlen, 1930

Genus *Mithracia* Bell, 1858

Mithracia Bell, 1858, p. 2, pl. 5, figs. 10-12.

Type species: *Mithracia libinioides* Bell, 1858, by monotypy.

Discussion: Bell (1858) erected the monotypic genus *Mithracia* with the type species *Mithracia libinioides*, on the basis of the study of some specimens from the lower Eocene "London Clay". Among the specimens studied by Bell, only one has exhibited an unbroken anterior margin, with moderately projecting and furrowed rostrum. When Bell described the new genus and new species, he considered the shape of the rostrum to be an important diagnostic character; this diagnosis was confirmed by Glaessner (1969).

Beschin et al. (1994) described *M. margaritifera* based upon some specimens from the middle Lutezian of Nogarole Vicentino; this species lacks a defined rostrum and exhibits a narrow, bilobed frontal margin. Beschin et al. (1996) pointed out the presence inaccuracy in the descriptions of the genera belonging to the subfamily Micromaiinae Beurlen, 1930. They defined some characters that make it possible to distinguish *Micromaia* Bittner, 1875, from *Mithracia*. In particular, *Mithracia* has more projecting hepatic regions and more evident epibranchial lobes than *Micromaia*. In addition, *Mithracia*, lacks the anterior mesogastric process; the urogastric lobe is narrower than the metagastric one; the cardiac and posterior regions of the carapace are scarcely defined, they did not consider the frontal rostrum as a diagnostic character.

Mithracia oppionii sp. nov. exhibits these typical characters of genus *Mithracia*, like developed hepatic regions and evident epibranchial lobes; as concerns the features of the frontal margin, they were not included in the diagnosis of *Mithracia oppionii* sp. nov. because, in this case, the rostrum could have been removed by biostratinomic processes.

The subfamily and family-group taxonomy is taken by Glaessner (1969).

Mithracia oppionii sp. nov.
(Figs. 2, 3)

Non ?*Mithracia* sp., Beschin et al., 1996, p. 23, fig. 9.3, 11.

Diagnosis: Carapace subcircular in outline, with more or less distinct regions and well defined, smooth furrows; upper orbital margin well developed, divided into three triangular teeth by two narrow fissures; well developed mesobranchial lobe and poorly defined epibranchial lobe separated by a shallow incised furrow; anterior process of mesogastric lobe absent; dorsal carapace surface very finely granulated.

Description: Carapace subcircular in outline, almost as long as wide, widest in medial part of branchial region.

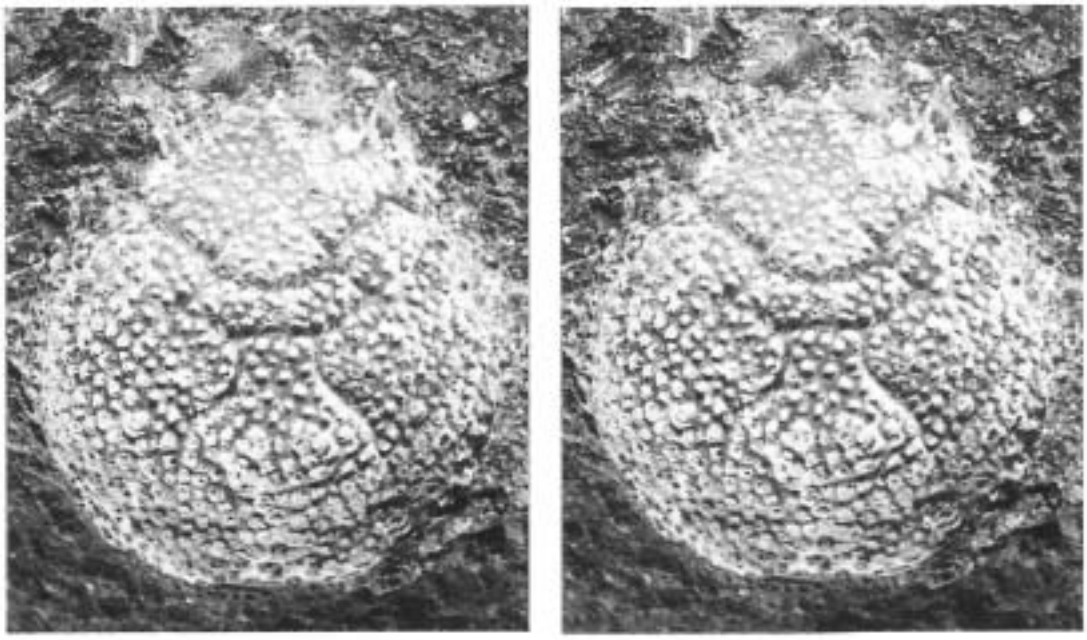


Fig. 2. *Mithracia oppionii* sp. nov., stereopair of the holotype, IG286342, × 2.5.

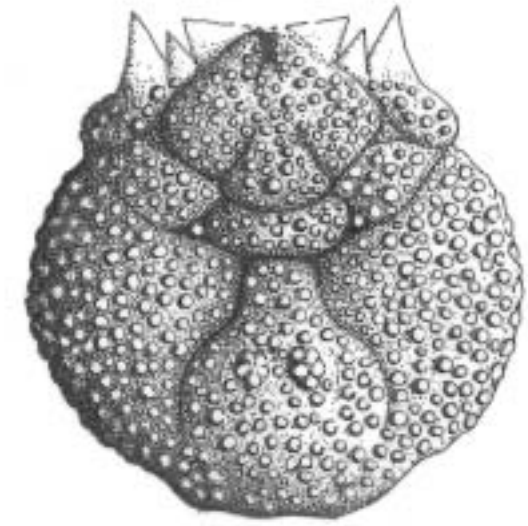


Fig. 3. *Mithracia oppionii* sp. nov., carapace reconstruction.

Dorsal surface gently convex in both longitudinal and transverse sections with highest relief in cardiac lobe. Fronto-orbital margin well developed, occupies about two thirds of carapace width; frontal margin poorly preserved, appears narrow and bilobed because of a deep furrow. Upper orbital margin well developed; pre- and postorbital teeth large, triangular; sharp triangular supraorbital tooth less developed than the others (unfortunately, the best preserved supraorbital tooth was broken during final preparation of the specimen); orbital teeth smooth without granules dorsally. Postorbital tooth a continuation of hepatic lobe. Cervical and branchiocardiac lobes well defined, smooth, incised; subtle incised furrow between epibranchial and mesobranchial lobes. Protogastric lobes undivided because of absence of anterior process of mesogastric lobe. Mesobranchial lobe well defined and tumid; epibranchial lobe poorly developed weakly separated by shallow incised furrow; epibranchial lobe wider than mesogastric lobe. Cardiac lobe well developed, showing two large tubercles, not delimited posteriorly. Posterior margin rectilinear, rather narrow, as wide as margin between points of preorbital teeth. Dorsal surface finely granulated, with granules tending to form spinules at lateral margins; above cardiac region granules join and form two much larger composite tubercles.

Etymology: The species is named in honour of Stefano Oppioni.

Type: The holotype and sole specimen, IG286342, a carapace, is deposited in the collections of Museo Civico "G. Zannato" of Montecchio Maggiore.

Occurrence: This species is from the reworked green-grey hyaloclastite of the upper lower Eocene (upper Ypresian) of the Lovara Quarry of Chiampo (Vicenza, Italy).

Measurements: Carapace: length = 17.3 mm, width =

15.6 mm, frontorbital margin = 7.6 mm.

Discussion: The species belonging to *Mithracia* in the literature are few; today only three species are known: *M. libinioides* (lower Eocene, England); *M. hollandi* Förster and Mundlos, 1982 (upper Eocene, Germany); and *M. margaritifera* Beschin et al., 1994 (middle Eocene, northern Italy). *Mithracia oblita* Carter, 1898, not discussed in Förster and Mundlos (1982) and Beschin et al. (1994), should be referred to another genus. It shows marked differences in its carapace morphology and ornamentation. The most evident differences are found in the carapace outline; in the frontorbital margin; and in the morphology of the branchial, gastric and cardiac regions. There are many similarities between *M. oppionii* and *M. libinioides* as concerns the development of the regions, the ornamentation, and the shape of the carapace; but *M. oppionii* has a different conformation of the orbital regions, with large pre- and postorbital teeth and a small supraorbital tooth. *Mithracia oppionii* differs also from *M. libinioides,* in having wider protogastric lobes; *M. oppionii* also possesses wider epibranchial lobes, but they are shallowly separated by a subtle incised furrow. There are fewer resemblances with *M. hollandi,* which is longer and has small supra- and postorbital teeth. *Mithracia hollandi* also has small epibranchial lobes which are surrounded by subtle incised furrows. There are even fewer resemblances with *M. margaritifera,* which has a pyriform outline and a much wider posterior margin than *M. oppionii;* in addition, this species has different ornamentation, with large tubercles on the gastric, mesobranchial, and cardiac regions. The frontal margin of *M. margaritifera* is narrow and bilobed as in *M. oppionii,* but these similarities derived perhaps from the preservation conditions of the examined specimen.

Beschin et al. (1996) described ?*Mithracia* sp. (MCZ 1524, MCZ 1525, MCZ 1526) from the middle Lutezian (*Morozovella lehneri* Zone) of the Rossi Quarry, near Monte di Malo (Vicenza). The carapace of ?*Mithracia* sp. is larger than that of *Mithracia oppionii,* is less convex, with less tumid regions, and it has an indistinguishable epibranchial lobe on the branchial region. Because of these differences and the provenance from younger stratigraphic levels (middle Lutezian), it seems appropriate not only not to include the specimens of ?*Mithracia* sp. in the type series of *Mithracia oppionii,* but also not to include them in its synonymy.

The dimensional variability between the carapaces of ?*Mithracia* sp. and *M. oppionii,* could be a phyletic variation, an example of intraspecific variability or could be related to the discovery of exuviae of different growth stages. As with extant Majidae (Gonzales-Guarrián et al., 1995), the holotype of *M. oppionii,* could be a pre-pubertal molt while the specimens of ?*Mithracia* sp. could be adults or at best mature beyond the pubertal (terminal) molt.

To improve the knowledge of *Mithracia oppionii* and clarify the relationship between this species and the most recent ?*Mithracia* sp. is necessary to apply a stratophenetic approach (cfr. Gingerich, 1979; Dzik, 1985, 1987). According to this method a chronospecies may be defined following analysis of groups of specimens coming from levels representing the shortest possible stratigraphic interval from the same locality. It is not possible to define a range of intraspecific variation in a new species based on only one specimen; only the discovery of new specimens coming from the same levels would permit it.

At present, without further data the differences between *Mithracia oppionii* and ?*Mithracia* sp. can be considered almost of specific level.

Paleoecology

According to Ungaro in Beschin et al. (1996) macroforaminifera and calcareous algae-rich assemblages from the Ypresian levels of the Lessini Mountains indicate an infralittoral zone.

On the contrary, it is difficult to assess the depositional depth of the layer from which the examined specimen was collected because of re-sedimentation (De Zanche, 1965). Re-sedimentation also explains the poor preservation of decapod crustaceans, and this could indicate drift of the specimens out of their preferential environment. Examples of transport of nummulites also into deep environments are not unusual (Schaub, 1983). The information from the macroforaminiferal assemblage (*Discocyclina, Asterocyclina* and *Nummulites*) collected from the layer from which *Mithracia oppionii* was collected, and the facies analysis regarding the overlying succession could indicate a deep infralittoral or an upper circalittoral zone.

According to the observations by Ungaro in Beschin et al. (1996), the presence of intraclasts, rodoliths, and molluscan and hermatypic coral bioclasts could indicate that the sea bottom was affected by marine currents and occasional storm waves. The facies sequence and the faunas in the Eocene units of the Lovara Quarry indicate

a regressive pattern which culminates in lignitiferous lenses in the volcanic deposits cropping out in the upper slopes of the Middle Chiampo Valley (De Zanche, 1965); these lenses indicate a lagoonal environment (Beschin et al., 1996). This regressive event has been attributed by De Zanche (1965) to the Alpine Orogeny. In general, the Lessini area was affected during the early Eocene by the development of a carbonate platform and by occasional volcanic activity, in the framework of the African-Eurasian convergence. Since the lower to middle Eocene, eight volcanic events have taken place in the Lessini area, with pyroclastic layers and submarine lava emplacement (De Vecchi and Sedea, 1995). The pyroclastic activity is probably the main event responsible for the rapid burial and, therefore, preservation of the decapods crustacean with excellent preservation.

The faunal assemblages are typical of a warm tropical sea with normal salinity. In the Mediterranean area, coral reefs have been known from the Palaeocene to Miocene (Budd et al., 1996). In the Venetian region, rich Eocene hermatypic coral assemblages have been reported since the nineteenth century (D'Achiardi, 1868). According to the recent maps prepared by the Peri-Tethys Program (Dercourt et al., 2000), the Lessini area during the early Eocene should be placed at a latitude of approximately 35° north, perfectly in agreement with the faunal data. Several authors have documented the faunal similarities between the Venetian Eocene and the present Indo-Pacific tropical region, though Sorbini (1983) showed that a considerable number of fish genera, similar to those coming from Monte Bolca, presently live in the warm waters of the North Atlantic.

Paleobiogeography

Mithracia is known only from Eocene sediments. During the Ypresian this genus was represented by *M. libinioides* from the London Clay and *M. oppionii* from the hyaloclastite of Chiampo. Basing on the presence of more species of *Mithracia* in the early Eocene it is possible to suppose that this genus should have appeared, with an ancestral species, earlier than the Ypresian and spread into the Tethys and into the northern European basins; establishment of geographical or ecological barriers would have facilitated allopatric speciation. The ancestral species, if it appeared in the western Tethys, could then have migrated toward the north through the trans-European corridor, which, according to Meulenkamp et al. (2000), connected the North Sea basin with the Tethyan/Indo-Pacific domains via the Polish lowland basin and the Dniepr-Donetz depression during the Paleocene (Fig. 4). This connection was temporarily disrupted in the early Ypresian (Fig. 5), probably in response to a eustacy-controlled regression at the end of the Paleocene, and this resulted in different faunal developments on either side of the closed corridor (Beniamovskii, 1998). Obviously this species could have taken an opposite direction, from the northern basins toward the Tethys. Another passage-way could have been via the Aquitanian basin (Figs. 4, 5), which during the early and middle Ypresian, still connected the Atlantic with the western-most parts of the Tethyan domain (Meulenkamp et al., 2000). This connection was particularly strong toward the east through a marine corridor bordered by carbonate platforms rich in large, tropical foraminiferal assemblages (*Alveolina*, *Nummulites*) similar to those of the Lessini area. In this case *M. libinioides* and *M. oppionii* could have appeared during the middle-late Ypresian. Because of the emergence of the Pyrenean orogenic belt, during Ypresian, these marine connections were reduced with respect to the Paleocene and during Lutetian they were certainly closed (see Meulenkamp et al., 2000).

It is therefore possible that the development of the Pyrenean and Alpine belts was a barrier to the faunal exchange between the Mediterranean area and the northern basins. The connection between the Tethys and the Atlantic in the area between the Iberian massif and the Northern African coast, which was not interrupted during the Paleocene and Eocene (Figs. 4, 5), cannot be invoked as the cause of the faunal differences developed between the Mediterranean area and northern Europe during the Eocene. According to the model of oceanic circulation by Adams in Berggren and Hollister (1974), the Atlantic itself constituted a barrier to the migration of Tethyan species, except during period of extreme storm activity. The Paleogene oceanic circulation is, however, still debated; Haq (1984) proposed a circulation model suggesting a westward flow out of the Tethys through the Atlantic towards Central America. Feldmann et al. (1998) proposed an oceanic circulation pattern, developed using the Parallel Ocean Climate Model (POCM) forced by the GENESIS atmospheric circulation model reference, which corroborates the conclusions drawn from analysis of the Castle Hayne (North Carolina) sediments and fauna. This pattern suggests westward flow along the northern

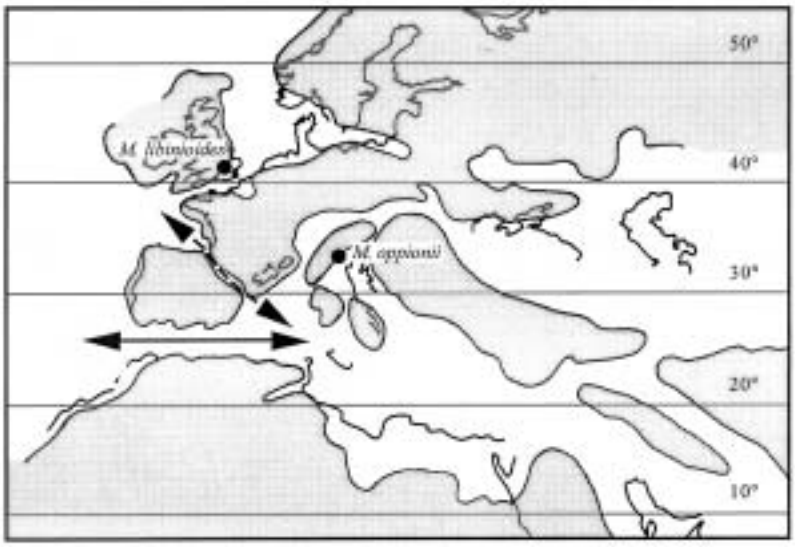


Fig. 4. Simplified paleogeographic map of the western Tethys during the Paleocene; arrows indicate the possible dispersal routes of a hypothetical ancestral species of *Mithracia* (after Philip and Floquet (2000), Meulenkamp et al. (2000); modified).

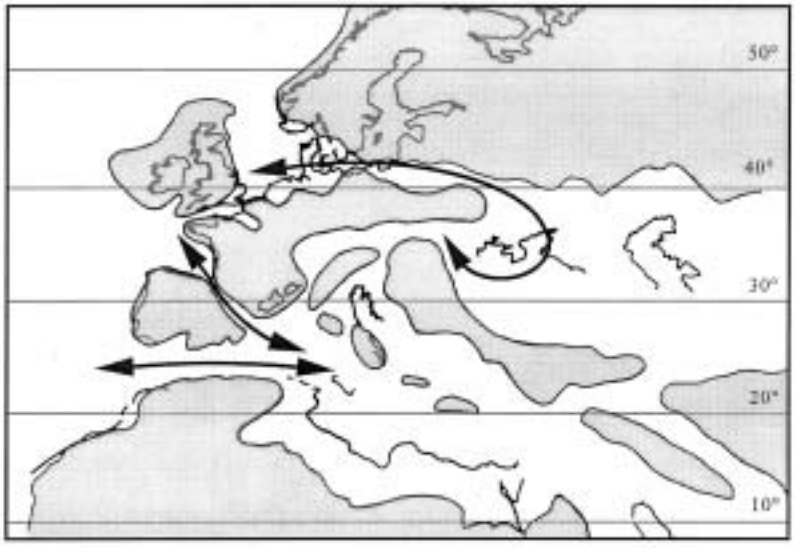


Fig. 5. Simplified palaeogeographic map of the western Tethys during the Ypresian (early Eocene); arrows indicate the possible dispersal routes of *Mithracia*, black circles indicate the localities of provenance of *M. libinioides* and *M. oppionii* (after Meulenkamp et al. (2000); modified).

African margin from the western Tethys into the North Atlantic, which explains the strong faunal relationship between decapods from the Castle Hayne Formation and those from sites of similar age in southern Europe.

The appearance of various species of *Mithracia* could be the result of climatic factors. The Eocene was a climatically rather stable period with warm temperature up to latitudes higher than the present ones. Tropical conditions extended perhaps at least up to 45° N (Dzick and Gaździcki, 2001). In the early Eocene London Clay sea, mangroves developed along the shore (Gale, 1995). During the Ypresian a high latitude glacial event possibly spread, testified by a eustatic fall of sea level, the Kraków Glaciation of Birkenmajer and Zastawniak (1989). The presence of a glacial cover in the southern polar regions at that time is indirectly supported by isotopic and palaeobotanical data (Dzick and Gaździcki, 2001). The appearance of new species could be related to a latitudinal differentiation of environments connected with oceanic thermal changes. The regressive event connected with

this glacial phase could have resulted in a reduction of some platform environments and could have caused the isolation of some populations and subsequent speciation.

The brachyuran fauna from Handorf (Northern Germany), including *Mithracia hollandi*, has affinities with the faunas from the London Clay, northern Belgium, and with the Mediterranean area (Förster and Mudlos, 1982). *Mithracia hollandi* could, therefore, derive from *Mithracia libinioides*, or from some other Tethyan species. Phyletic speciation could explain the strong similarities between *M. oppionii* and ?*M.* sp. from Lutetian of the Rossi Quarry, described by Beschin et al. (1996), while the relationship between *M. margaritifera*, and the other species of the genus is obscure.

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