Welcome from the Mayor of Villers-sur-Mer

We are pleased and honored to welcome at the Paléospace Museum of Villers-sur-Mer the "6th Symposium on Mesozoic and Cenozoic Decapod Crustaceans".

Villers-sur-Mer is a place universally known by specialists and amateurs of palaeontology due to its famous Vaches Noires cliffs. Villers-sur-Mer has also the distinction of being the only French seaside resort located on the Greenwich Meridian line.

The Paléospace is a Museum funded in 2011 with the label *Musée de France*. Three main animations linked to the Time are presented: palaeontology, astronomy and nature with the neighbouring marsh.

The museum is in a constant evolution. For instance, an exhibition specially dedicated to dinosaurs was opened two years ago and a planetarium will open next summer. Every year a very high quality temporary exhibition takes place during the summer period with very numerous animations during all the year. The Paléospace does not stop progressing in term of visitors (56 868 in 2015) and its notoriety is universally recognized both by the other museums as by the scientific community. We are very proud of these unexpected results. We thank the dynamism and the professionalism of the Paléospace team which is at the origin of this very great success.

We wish you a very good stay at Villers-sur-Mer, a beautiful visit of the Paléospace and especially an excellent congress.

Jean-Paul Durand, Mayor and President of Paléospace

Mot du Maire de Villers-sur-Mer

Nous sommes très heureux et très honorés d'accueillir à Villers-sur-Mer, le « 6e Symposium on Mesozoic and Cenozoic Decapod Crustaceans » dans le cadre du Paléospace.

Villers-sur-Mer est connu des spécialistes et amateurs de paléontologie grâce au magnifique site des falaises des Vaches Noires mais Villers-sur-Mer est également le point d'entrée du Méridien de Greenwich sur le continent.

Le Paléospace, Musée de France, crée en 2011, intègre 3 domaines bien individualisés mais interconnectés par le Temps: la paléontologie, l'astronomie et la nature avec le marais voisin.

Le musée est en évolution constante, une salle spécialement dédiée aux dinosaures a été ouverte il y a 2 ans et un planétarium va voir le jour cet été. Tous les ans une exposition temporaire de très grande qualité se déroule pendant la période estivale et de très nombreuses animations l'animent tout au long de l'année.

Le Paléospace ne cesse de progresser en terme de fréquentation avec 56 868 visiteurs en 2015 et sa notoriété est universellement reconnue tant par les autres musées que par la communauté scientifique ce dont nous sommes très fiers. Il faut saluer le dynamisme, le professionnalisme de toute son équipe sans qui cette très belle réussite n'existerait pas.

Nous vous souhaitons un très bon séjour à Villers-sur-Mer, une belle visite du Paléospace et surtout un excellent congrès.

Jean-Paul Durand, Maire et Président du Paléospace

Crustacean reconstructions: Charlène Letenneur
Infography: Manuel Pichon

Welcome from the Directors and Organizer

The Center for Research on Palaeobiodiversity and Palaeoenvironments (CR2P) and the National Museum of Natural History, Paris (MNHN) are pleased and honored to support the *6th Symposium on Mesozoic and Cenozoic Decapod Crustaceans*.

The CR2P laboratory is completely devoted to palaeontology and is supported by the MNHN, the CNRS (National Center for Scientific Research) and the Pierre & Marie Curie University (UPMC-Paris 6).
Our laboratory has a long history, enriched during the past ten years through the interaction of all the Paris palaeontologists within a common structure. The diversity of our current research topics ranges from comparative anatomy or palaeohistology to theoretical systematics; from palaeobotany to historical biogeography or to the analysis of environmental stress during major biotic crises, and from early hominid environments to exceptional soft tissue preservations in fossils. Our expertise includes a large spectrum of fossil animal and plant groups, from very primitive Precambrian forms of life up to hominids, from infinitesimally small organisms to giant vertebrates.

The organization of a symposium dedicated to the Mesozoic and Cenozoic decapod crustaceans is new for our laboratory, but is based on long standing tradition, which dates back to the pioneer work of Latreille, Desmarest and Milne Edwards.
We wish you a very good stay at Villers-sur-Mer, and an excellent congress with successful discussions.

Finally, we hope you all will come back in France in 2018 for the 5th International Palaeontological Congress.

Dr Sylvie Crasquin
Director of the laboratory
Center for Research on Palaeobiodiversity and Palaeoenvironments, Paris.

Dr Christian de Muizon
Director of the Earth History Department
Muséum national d'Histoire naturelle, Paris.

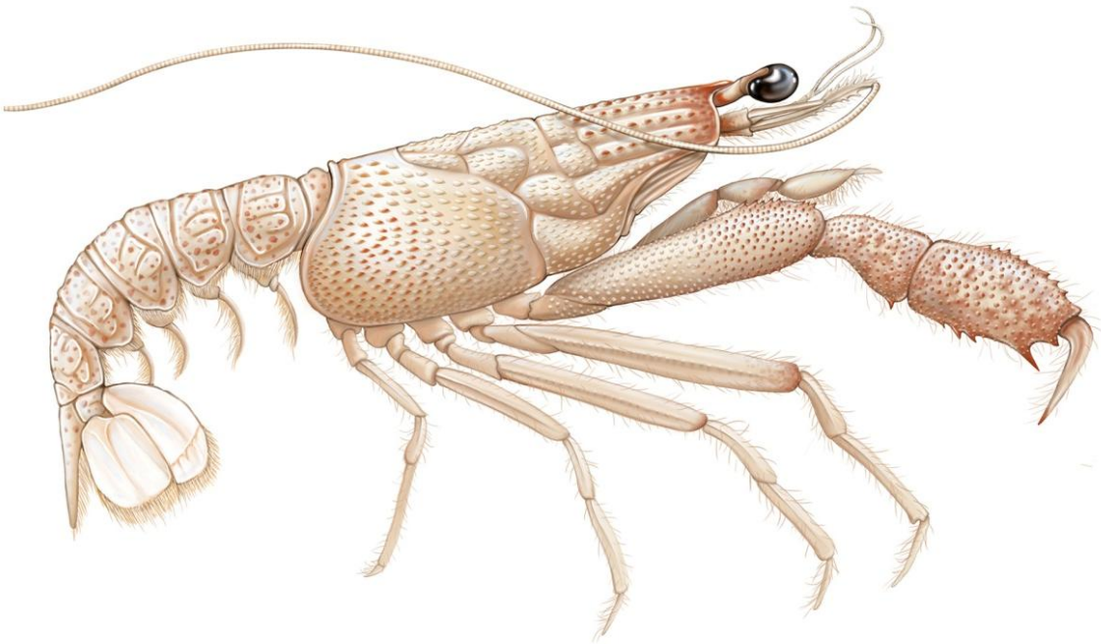
Dr Sylvain Charbonnier
Organizer of the Symposium, President of the French Geological Society
Muséum national d'Histoire naturelle, Paris.

6TH SYMPOSIUM ON MESOZOIC AND CENOZOIC DECAPOD CRUSTACEANS

VILLERS-SUR-MER, NORMANDY, FRANCE

14 – 18 JUNE 2016

Organized by Sylvain Charbonnier and Laurent Picot



Glyphea muensteri

Monday 13th June

11:30 – 18:00 — Registration at the Paléospace-l'Odyssée
Free visit of the Museum during the whole symposium with your personal badge.

18:30 – Icebreaker party. Welcome address by Jean-Paul Durand, mayor of the town and Karine Boutiller, director of the Paléospace.

Tuesday 14th June

8:30 — Arrival of the participants at the Cinéma of the town. Installation of the posters in the panoramic room of the Casino (near the Cinéma).

8:45 – 9:00 — Welcome address

Session 1, chairman: Günter Schweigert

9:00 – 9:30 **— Recent Revolution in Decapod Paleontology**
- *Rodney M. Feldmann, Carrie E. Schweitzer*

9:30 – 10:00 — **Epibioses of fossil decapod crustaceans: palaeoecological insights, new palaeosymbioses and extant record**
- *Ninon Robin, Gilles Petit, Barry van Bakel, Annachiara Bartolini, Sylvain Bernard, Jennyfer Miot, Jean-Michel Pacaud, Jean-Loup d'Hondt, Didier Merle, Martin Simpson, Sylvain Charbonnier*

10:00 – 10:30 — **A new look at Achelata**
- *René H.B. Fraaije, Barry W.M. van Bakel, John W.M. Jagt*

10:30 – 11:00 — **Coffee break**

Session 2, chairwoman: Carolin Haug

11:00 – 11:30 — **Phylogeny of Polychelidan lobsters**
- *Denis Audo, Sylvain Charbonnier*

11:30 – 12:00 — **Virtual dissection and lifestyle of a 165 million-year-old female polychelidan lobster**
- *Clément Jauvion, Denis Audo, Sylvain Charbonnier, Jean Vannier*

12:00 – 12:30 — **Visual systems in Brachyura shed light on early crab evolution**
- *Javier Luque, A. Richard Palmer*

12:30 – 14:00 — **Lunch break**

Session 3, chairman: Michał Krobicki

14:00 – 14:30 — **Following the steps of Hermann v. Meyer: a newly collected brachyuran fauna from Late Jurassic sponge–microbial limestones near Geislingen an der Steige, SW Germany**

- *Günter Schweigert, Horst Kuschel, Armin Scherzinger*

14:30 – 15:00 — **Mesozoic and Cenozoic record of decapod crustaceans in the Basque-Cantabrian basin (Western Pyrenees)**

- *Mikel A. López-Horgue, Arantxa Bodego*

15:00 – 15:30 — **Fossil decapods from Panama, other Western Atlantic and Eastern Pacific regions, and the closure of the Isthmus of Panama**

- *Adiël A. Klompmaker, Roger W. Portell, Javier Luque, Cristina M. Robins*

15:30 – 16:00 — **Coffee break**

Session 4, chairman: Rodney Feldmann

16:00 – 16:30 — **Phylogenetic analysis of Jurassic Tanidromitidae and Goniodromitidae**

- *Natalia Starzyk*

16:30 – 17:00 — **A synopsis of Early Paleocene (Danian) crustaceans from Denmark, Sweden, and N. Germany found in glacial erractics**

- *Sten L. Jakobsen, Adiël A. Klompmaker, Matúš Hyžný, Cristina M. Robins*

17:00 – 17:30 — **Cenozoic palaeobiogeography of the Western Tethys based on decapod crustaceans**

- *Matúš Hyžný*

17:30 – 18:00 — **Biostratigraphy and paleoecology of the decapod fauna from the Jurassic of the Vaches Noires cliffs (Calvados, France)**

- *Damien Gendry, Jean-Philippe Pezy*

Poster session, chairman: Adiël Klompmaker

18:00 – 19:00

Cretaceous shrimps disguised as gastropod shells

- *Denis Audo, Alessandro Garassino, Matúš Hyžný, Sylvain Charbonnier.*

On the sighted ancestry of blindness – exceptionally preserved eyes of Mesozoic polychelidan lobsters

- *Denis Audo, Joachim T. Haug, Carolin Haug, Sylvain Charbonnier, Günter Schweigert, Carsten H. G. Müller, Steffen Harzsch*

Decapod crustaceans of the "tufa to *Lophoranina*" (lower Lutetian) from the Chiampo Valley (Vicenza, NE Italy)

- *Claudio Beschin, Antonio De Angeli*

Ypresian Decapod Crustaceans from the coral-algal environments in the lessini orientali (Vicenza and Verona territory - NE Italy).

- *Claudio Beschin, Alessandra Busulini, Giuliano Tessier, Roberto Zorzin*

New decapod fauna at midway of the Tethys Sea and Atlantic Ocean. Central Pyrenees of Huesca (Aragón, Spain)

- *José Luis Domínguez, Àlex Ossó*

New Middle Eocene Hermit Crabs from "Main" quarry at Vicenza (NE Italy)

- *Antonio De Angeli*

***Typilobus*: a catch-all genus for leucosioid crabs of uncertain affinities?**

- *Matúš Hyžný, Pedro Artal*

Unexpected diversity of the Upper Cretaceous and Paleocene axiidean shrimps from West Greenland

- *Matúš Hyžný, Sten L. Jakobsen*

Documentation techniques for fossil leucosioid crabs

- *Erfan Khosravi, Matúš Hyžný*

***Ferroranina fritschi* (Brachyura, Palaeocorystoidea) from the Coniacian claystones of Březno locality in the Bohemian Cretaceous Basin, Czech Republic**

- *Martina Kočová Veselská, Barry van Bakel, Tomáš Kočí*

A re-examination of the decapods fauna from the Upper Bathonian of Ranville (Calvados, France)

- *Jean-Philippe Pezy, Damien Gendry*

19:00 — Visit and reception at the Palaeontological Association of Villers-sur-Mer (Le Villare association building).

Wednesday 15th June

Session 5, chairwoman: Carrie Schweitzer

9:00 – 9:30 — **Middle Jurassic (Bajocian) dromiacean crabs expansion – their stratigraphical distribution and paleoenvironmental preferences**

- *Michał Krobicki, Michał Zatoń*

9:30 – 10:00 — **Evolution of malacostracan crustaceans beyond the "adult paradigm" – why fossil larvae and juveniles increase the explanatory power of evolutionary reconstructions**

- *Joachim T. Haug*

10:00 – 10:30 — **Sexual Dimorphism and Ontogeny within the fossil brachyuran crabs *Falconoplax* (Chasmocarcinidae) and *Palaeopinnixa* (Hexapodidae) from the lower Miocene Culebra Formation of Panama**

- *Cristina M. Robins, Adam A. Freierman, Hannah K. O'Neill, Lillian K. Pearson, Javier Luque, Roger W. Portell*

10:30 – 11:00 — **Coffee break**

Session 6, chairman: Matúš Hyžný

11:00 – 11:30 — **A new species of *Bucculentum* from the Upper Jurassic of Poland (Decapoda Brachyura: Bucculentidae)**
- *Ewa Krzemińska, Natalia Starzyk, Wiesław Krzemiński*

11:30 – 12:00 — **Phylogenetic analysis of the shrimp-like decapods (Dendrobranchiata, Caridea & Stenopodidea) using fossil and extant representatives**
- *Sergio Sudarsky*

12:00 – 12:30 — **Erymid lobsters from France**
- *Julien Devillez, Sylvain Charbonnier, Lucien Leroy*

12:30 – 14:00 — **Lunch break**

Session 7, chairwoman: Cristina Robins

14:00 – 14:30 — **Fossil Crustacea from the Cretaceous Konservat-Lagerstätten of Lebanon**
- *Sylvain Charbonnier, Denis Audo, Alessandro Garassino, Matúš Hyžný*

14:30 – 15:00 — **New Miocene decapod crustaceans from Tunjice Hills (Central Slovenia)**
- *Rok Gašparič, Rok Brajkovič*

15:00 – 15:30 — **A new hermit crab from the type Maastrichtian (the Netherlands) and further phylogenetic refinement of the Paguroidea**
- *René H.B. Fraaije Barry W.M. van Bakel John W.M. Jagt*

15:30 – 16:00 — **Coffee break**

Session 8, chairman: René Fraaije

16:00 – 16:30 — **Brachyura during the Cretaceous: Niche partitioning, evolution, and diversity**
- *Carrie E. Schweitzer, Rodney M. Feldmann*

16:30 – 17:00 — **Cretaceous enigmatic crabs reveal great versatility of form and rapid radiation in early brachyurans**
- *Javier Luque, Rodney M. Feldmann, Hiroaki Karasawa, Carrie E. Schweitzer, Christopher B. Cameron, Kecia A. Kerr, Francisco J. Vega, A. Richard Palmer, Carlos Jaramillo*

17:00 – 17:30 — **Convergent patterns of the evolution of body organisation in three eumalacostracan lineages – comparing Hoplocarida, Eucarida and Peracarida**
- *Carolin Haug*

17:30 – 18:30 — **Closing session and announcements**

20:00 — Conference dinner at the Panoramic room of the Casino (near the Cinéma)

Thursday 16th June

Morning

Field trip to the Bajocian stratotype (Sainte-Honorine-des-Pertes) and visit of parts of Normandy Landing: Pointe du Hoc and American Cemetery (Omaha Beach)
8:00 — Departure in front of the Tourism Information office
13:30 — Return to Villers-sur-Mer
Free time for the lunch (numerous restaurants in the town center)

Afternoon

Field trip to Callovian-Oxfordian cliffs of the "Vaches noires" (Villers-sur-Mer) organized by Laurent Picot
14:30 — Departure in front of the Tourism Information office

Evening

18:30 — **Public conference (Cinéma) :** Les crustacés au Jurassique et au Crétacé (Sylvain Charbonnier)

Friday 17th June

Morning

Field trip to the hard-ground of Pétreval (Fécamp region; Seine-Maritime) organized by Gérard Breton and Sylvain Charbonnier.
8:00 — Departure in front of the Tourism Information office
12:00 — Lunch at Etretat in a French creperie (typical "pancake" house)

Afternoon

Free visit of the famous Étretat cliffs which attracted artists including Gustave Courbet and Claude Monet
17:00 — Return to Villers-sur-Mer

Evening

18:30 — **Public conference (Cinéma) :** La Haute-Normandie : une grande région paléontologique méconnue (Gérard Breton)

Saturday 18th June

Morning

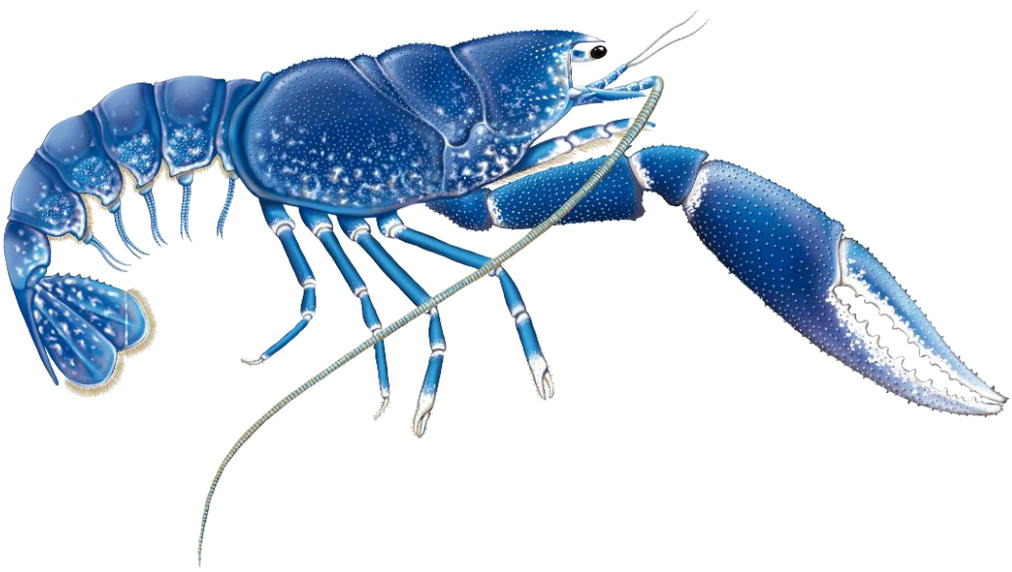
Visit of the Bayeux Museum to see The Bayeux Tapestry (229 feet long, 19 inches high, 350 kilos) which relates the conquest of England by William the Conqueror, from 1064 to the outcome of the Battle of Hastings (1066).

8:30 — Departure in front of the Tourism Information office
12:00 — Lunch at the restaurant la Taverne des Ducs

Afternoon

Visit of the “Mémorial de Caen” which is a museum and war memorial in Caen, Normandy, France commemorating the Second World War and the Battle for Caen.

18:30 — Return to Villers-sur-Mer



Eryma ventrosum

TALK

Phylogeny of Polychelidan lobsters

Denis Audo[1,2], Sylvain Charbonnier[2]

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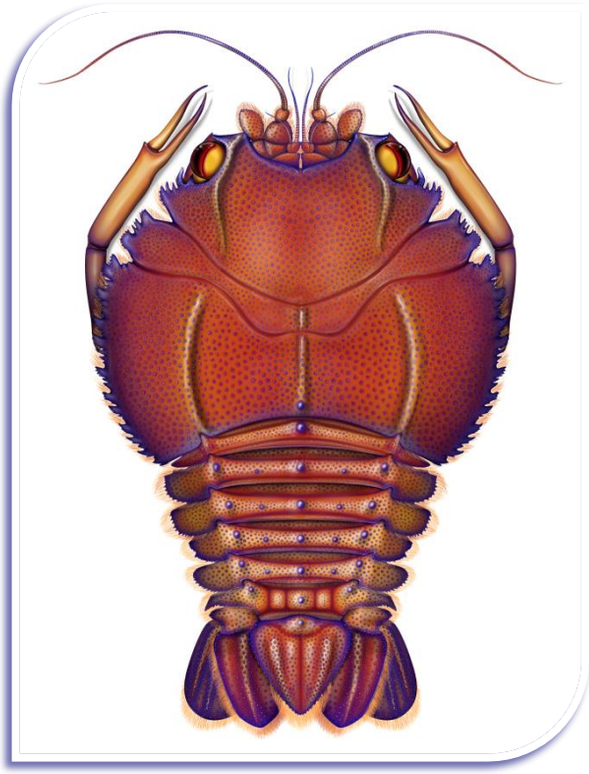

Tethyseryon campanicus

Polychelidan lobsters are a puzzling group of decapod crustaceans first discovered associated with shallow water and terrestrial animals in Solnhofen, and only later discovered in modern deep-sea environments. A notable portion of the diversity of polychelidan lobsters was described between 19th and 20th century; as a result, many species were assigned to waste basket genera such as *Eryon* Desmarest, 1817 and *Coleia* Broderip, 1835. Quite recently, Ahyong (2009) and Karasawa *et al.* (2013) proposed phylogenies including a few fossil polychelidans, which gave some glimpse at their evolution. However, with up to seven fossil species, and without prior systematic revision of the faunas, leave a large portion of polychelidan diversity and evolution unexplored. In order to better understand polychelidans evolution, we propose the first phylogeny focused on fossil polychelidans and including 37 fossil species.

Our results confirm the monophyly of polychelidans, a division into two major clades: Eryonidae+Palaeopentachelidae and paraphyletic Coleiidae+Polychelidae. We also observe that most clades occurring in shallow-water environments went extinct by the end of Jurassic; they therefore cannot include ancestors of extant deep-water species.

POSTER

Cretaceous shrimps disguised as gastropod shells

Denis Audo[1,2*], Alessandro Garassino[3], Matúš Hyžný[4], Sylvain Charbonnier[2]

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Numerous animals hide or disguise themselves to avoid being detected by visual predators; two main strategies exist to avoid being identified as a potential prey: Camouflage: a transparent body, or a body with colours, colour patterns and/or texture matching that of the environment. Mimicry: a body resembling that of a dangerous species or resembling to an inedible object. Such strategies are documented in extant crustaceans, and probably existed also in extinct species. However, the preservation of fossil generally does not allow the observation of such adaptations, since colour and their patterns are rarely preserved in fossil crustaceans.

In 2011, the Muséum national d'Histoire naturelle organized a scientific expedition in the Upper Cretaceous Lagerstätten of Lebanon. This expedition allowed us to discover a new species of caridean shrimp resembling strikingly to a gastropod shell. A detailed study of this new species has allowed us to describe it as a new species in a new genus of Glyphocrangonidae, one of the only one known in the fossil record.

Currently, only one other genus of caridean shrimp is known to mimic dead sea-snail shells: *Vercoia* Baker, 1904, a Crangonidae. The newly described fossil species and *Vercoia* are not particularly closely allied phylogenetically; both are assigned to different families, each family comprising numerous species that do not mimic shells.

As a conclusion, we can safely assume that mimicry of sea-snail shells has probably evolved at least two times independently in Crangonidae and Glyphocrangonidae. ⬢

POSTER

On the sighted ancestry of blindness – exceptionally preserved eyes of Mesozoic polychelidan lobsters

Denis Audo[1,2], Joachim T. Haug[3] (both authors contributed equally), Carolin Haug[3], Sylvain Charbonnier[2], Günter Schweigert[4], Carsten H. G. Müller[5,6],Steffen Harzsch[6]

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Polychelidan lobsters are intriguing decapod crustaceans: the first species discovered as fossil possess well-developed eyes; eyes of their extant relatives are reduced to a stalk or completely vestigial. Phylogenies generally consider polychelidans as a sister taxa of eureptantians: more closely related to lobsters and crabs than shrimp-like crustaceans. Considering their key position in the phylogeny of decapod crustaceans, the current absence of information on their eye-types deprives us of important data on the evolution and repartition of eye-types. Indeed, decapod crustaceans can have several distinct types of compound eyes: apposition eyes, where each ommatidium collect and detect light; and multiple types of superposition eyes, where light detected by each ommatidium comes not only from its own lens but also from lenses of adjacent ommatidia, thus increasing eye sensitivity, but decreasing its resolution. By studying fossilized eyes, we discovered that polychelidan lobsters are mostly equipped with eyes similar to modern reflective superposition type eyes. One species, *Rosenfeldia oppeli* differs from other fossil species by its eyes with hexagonal facets. These facets are more typical of apposition type of eye. This leads us to believe that this species probably lived relatively near to the surface, where light is abundant.

Palaeopolycheles longipes
Photograph: Günter Schweigert

POSTER

Decapod crustaceans of the "*Lophoranina* tuff" (lower Lutetian) from the Chiampo Valley (Vicenza, northeastern Italy)

Claudio Beschin[1], Antonio De Angeli[2]

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The monographic study describes the crustacean decapod fauna of the volcanodetritic sandstones from the lower Lutetian (*Lophoranina* tuff) of the Chiampo Valley (Vicenza, NE Italy). The studied species are: *Eoacanthacaris tethysianus* n. gen., n. sp. (Nephropidae), *Galathea lovarica* n. sp. (Galatheidae), *Albunea cuisiana* Beschin & De Angeli, 1984 (Albuneidae), *Lessinipagurus boschettensis* n. sp. (Paguridae), *Noetlingocarcinus claudiopolitana* (Bittner, 1893) (Basinotopidae), *Pseudodromilites hilarionis* (Bittner, 1883) (Dromiidae), *Dromiopsis vicetinus* n. sp., *Kromtitis pseudolothi* n. sp., *Graptocarcinus eocenicus* n. sp. (Dynomenidae), *Homola vanzoi* Beschin, De Angeli & Zorzin, 2009 (Homolidae), *Antonioranina globosa* (Beschin, Busulini, De Angeli & Tessier, 1988), *Lianira beschini* Beschin, Busulini, De Angeli, Tessier & Ungaro, 1991, *Lianira isidoroi* Beschin, De Angeli & Checchi, 2007, *Lovarina cristata* Beschin, Busulini, De Angeli, Tessier & Ungaro, 1991, *Italianira punctulata* (Beschin, Busulini, De Angeli & Tessier, 1988), *Raniliformis ornata* De Angeli & Beschin, 2007, *Raniliformis clampensis* n. sp., *Rugosanilia rugosa* (De Angeli & Beschin, 2007), *Umalia guinotae* De Angeli & Beschin, 2007, *Lophoranina marestiana* (König, 1825), *Notopoides exiguus* Beschin, Busulini, De Angeli & Tessier, 1988, *Raninoides budapestiniensis* (Lőrenthey, 1897), *Quasilaeviranina ombonii* (Fabiani, 1910) (Raninidae), *Calappilia gemmata* Beschin, Busulini, De Angeli & Tessier, 1994 (Calappidae), *Hepatiscus pulchellus* Bittner, 1875, *Pseudohepatiscus minimus* (Beschin, Busulini, De Angeli & Tessier, 1994), *Pseudohepatiscus silvanoi* De Angeli & Beschin, 1999, *Sakaila italica* n. sp. (Aethridae), *Periacanthus horridus* Bittner, 1875 (Epialtidae), *Mithracia oppionii* Larghi, 2002, *Mithracia lovatoi* n. sp. (Majidae), *Parthenope menini* n. sp., *Pseudolambrus antiquus* n. sp., *Bittnerilia granosa* n. sp., *Eogarthambrus* cf. *E. guinotae* De Angeli, Garassino & Alberti, 2010 (Parthenopidae), *Ceronnectes boeckhi* (Lőrenthey, 1897) (Cancridae), *Liocarcinus priscus* n. sp. (Carcinidae), *Carpilius petreus* Beschin, Busulini, De Angeli & Tessier, 2007, *Eocarpilius lessineus* n. sp., *Lovaracarpilius incisus* n. gen., n. sp (Carpiliidae); *Lovaracarcinus granulatus* De Angeli & Beschin, 2010 (Lovaracarcinidae), *Galenopsis* cf. *G. similis* Bittner, 1875 (Pilumnidae), *Parhalimede ornata* n. gen. n. sp. (Galenidae), *Balcacarcinus attenuatus* (Bittner, 1875), *Palaeograpsus inflatus* Bittner, 1875, *Metopocarcinus fragilis* n. sp. (Panopeidae), *Phlyctenodes postulosus* A. Milne-Edwards, 1862 (Xanthidae), *Magyarcarcinus loczyanus* (Lőrenthey, 1898) (Goneplacidae), *Santeexanthus caporiondoi* n. sp. (Pseudoziidae), *Lovaroides elegans* n. sp. (Carinocarcinoididae), *Spinipalicus italicus* Beschin & De Angeli, 2003 (Palicidae). Some propodus of indefinite chelipeds are present. The fauna of the "*Lophoranina* tuff" from the Chiampo Valley shows a significant abundance of decapods that live in the bottom of the sea as the Albuneidae and Raninidae and the presence of three forms of Carpiliidae (*Eocarpilus*, *Carpilius*, *Lovaracarpilius*). Some genera (*Albunea*, *Antonioranina*, *Lophoranina*, *Eocarpilius*, *Pseudohepatiscus*, *Santeexanthus*) allow correlations with the Eocene fauna of Carolina (United States) and others (*Umalia, Notopoides, Raninoides*, *Sakaila*, *Carpilius*, *Parthenope*, *Pseudolambrus*, *Metopocarcinus*) with the Recent Indo-Pacific and Central America faunas.

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POSTER

Ypresian Decapod Crustaceans from the coral-algal environments in the Lessini Orientali (Vicenza and Verona territory - NE Italy).

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For centuries the palaeontological studies about the lower Eocene in the Lessini Orientali have focused above all on the Bolca area and particularly on the faunas of the laminated limestones of the "Pesciara" and Monte Postale: fish and other vertebrates, worms, molluscs, insects, crustaceans but also plants are world famous for their amazing preservation.

The palaeoenvironment that originated these *Fossil-Lagerstätten* has been explained as a lagoon or a coastal depression on the carbonate Lessini Shelf separated from the open sea by a ridge, that has recently been interpreted as a true coral reef (Papazzoni *et al*., 2014); in the past the real existence of this structure had been only assumed on the basis of the peculiar faunistic associations there found. In the last two decades many coral-algal buildups have been discovered in different outcrops in the Vicenza and Verona territories: these finds not only supported this hypothesis but also allowed to increase the knowledge about fossil Ypresian crustaceans.

The first analyzed crustacean fauna was found in Contrada Gecchelina at Monte di Malo, a site located some kilometers East from Bolca; the organogenic deposits without a clear stratification strongly recrystallized there cropping out, probably little coral-algal domes, yielded more than three-hundred-fifty specimens belonging to forty-eight species (Beschin *et al.*, 2007); in the close Rossi quarry, already known for the presence of crustaceans, the mostly middle Eocene in age (Beschin *et al.*, 1998), one species of Parthenopidae was found in Ypresian rocks representing analogous paleoenvironmental conditions (De Angeli *et al.*, 2010).

Moving westwards, coral associated decapods remains were found in various sites: from the Nullipore limestones rich in coral fragments, molluscs and echinids, cropping out at Monte Magré, eighteen species of Ypresian decapods were reported (see De Angeli & Ceccon, 2015, with other references); the little buildups observed in Bertocchi quarry at San Pietro Mussolino in Chiampo Valley in Ypresian calcareous levels yielded fifty-eight specimens referred to fifteen species (Tessier *et al.*, 2011) and finally in Braggi quarry at Vestenanova, inside a biohermal deposit, about two-hundred specimens referred to forty-six species were discovered (Beschin *et al.*, 2015).

The existence of small early Eocene reefs around Bolca is described in Beschin *et al.* (*in press*): fossil remains were gathered at Cracchi, Laisi, Monte Postale, Rama, Valecco and Zovo.

The recifal limestones, showing biohermal features, are mostly white, mildly compact, but somewhere also reddish and more consistent. Apart from the crustaceans, nummulites, corals, small molluscs and echinids can be found inside the rocks associated with the abundant calcareous algae. The crustaceans remains, consisting of tiny carapaces and parts of chelipeds, here

collected are about eight-hundred referred to more than one hundred taxa; they are housed in the Museo Civico di Storia naturale in Verona. The stratigraphic closeness, even if in a situation of *facies* heteropy, between the studied fauna and the "Pesciara" is confirmed by the discovery in the latter of a carapace on a limestone slab referred to *Eotrachynotocarcinus airaghii*, a species found in almost all the mentioned outcrops.

The mentioned crustacean faunas show apparent similarities, as they characterize coeval layers and analogous environments: *Lessinigalathea regalis*, *Dromiopsis paucigranosa*, *Kromtitis koberiformis, Cyamocarcinus angustifrons*, *Eotrachynotocarcinus airaghii*, *Daira sicula, Gecchelicarcinus lorigae, Galenopsis similis*, *Lobogalenopsis quadrilobata, Laevicarcinus lioyi, Paratetralia convexa, Etisus arduinoi, Phlyctenodes multituberculatus* and *Prochlorodius ellipticus* have been reported from Contrada Gecchelina, San Pietro Mussolino, Cava Braggi and the surroundings of Bolca; Monte Magré shares with the other sites only *L. regalis*, *C. angustifrons*, *G. similis* and *P. convexa.* ⬢

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Captions

Fig. 1 – *Dromiopsis paucigranosa* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 93980) – Rama.
Fig. 2 – *Kromtitis levigatus* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 94020) – Rama.
Fig. 3 – *Eotrachynotocarcinus airaghii* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 94095) – Rama.
Fig. 4 – *Gecchelicarcinus lorigae* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 94149) – Rama.
Fig. 5 – *Lobogalenopsis quadrilobata* (Lőrenthey, 1898) (VR 94191) – Rama.
Fig. 6 – *Etisus arduinoi* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 94379) – Rama.
Fig. 7 – *Phlyctenodes tuberculosus* A. Milne Edwards, 1862 (VR 94276) – Rama.
Fig. 8 – *Phlyctenodes multituberculatus* Beschin, Busulini, De Angeli & Tessier, 2007 (VR 94315) – Rama.

TALK

Fossil Crustacea from the Cretaceous Konservat-Lagerstätten of Lebanon

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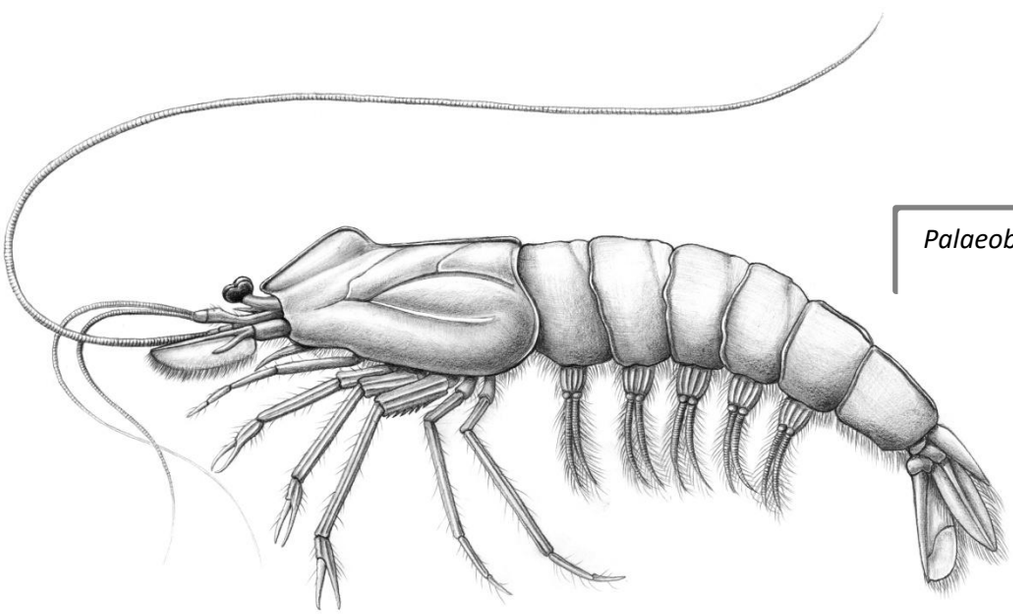
Introduction. — We present a revision to the fossil crustaceans (Crustacea: Decapoda, Isopoda, Lophogastrida, Stomatopoda, Cirripedia) from the Late Cretaceous Konservat-Lagerstätten in Lebanon, Middle East. Even though knowledge about these groups has increased during recent years, fossil crustaceans from Lebanon remain poorly studied and their importance widely under-estimated. The main purpose of this study is to provide a new synthesis taking into account both the historical works and recent advances in crustacean studies. An overall review of the fossil crustacean faunas is presented and encompasses material from Cenomanian (Hakel, Hadjoula, En Nammoura) and Santonian (Sahel Alma) outcrops. The taxonomic treatment includes detailed descriptions of each species known to occur in the aforementioned Lagerstätten.

All the diagnoses and descriptions are presented using standard criteria and common descriptive terminology. As much as was possible, we endeavoured to figure all the species recorded in the literature with photographs and reproductions of the historical illustrations. Thus, approximately 900 specimens have been studied. This revision also greatly improves our knowledge of fossil crustaceans by providing formal descriptions of thirteen new genera and twenty new species. The present review will be published in a monograph (collection *Mémoires du Muséum*) before the end of 2016.

Main results. — Among the decapod crustaceans, dendrobranchiate shrimps are particularly diverse, represented by five families (Aegeridae, Penaeidae, Benthesicymidae, Carpopenaeidae, Sergestidae) including 15 genera and 21 species. Three new genera are erected to accommodate the unique characters of benthesicymid shrimps (*Palaeo-benthonectes* n. gen.), carpopenaeid shrimps (*Epipenaeus* n. gen.), and penaeid shrimps (*Joinvilleicaris* n. gen.). Five new species are described: *Epipenaeus abisaadorum* n. sp., ?*Bentheogennema phoenicia* n. sp., *Carinacaris antennae* n. sp., *Libanocaris curvirostra* n. sp. and *Joinvilleicaris longirostris* n. sp. The caridean shrimps are represented by four families (Hippolytidae, Pandalidae, Crangonidae, Glypho-crangonidae) including three new genera and five new species. Hippolytid shrimps from Lebanon currently constitute the earliest known occurrence of the family in the fossil record. *Armacrangon edwardsi* n. gen., n. sp. and *Gladicrangon coriacea* n. gen., n. sp. are the only fossil representatives of the Glyphocrangonidae known to date, indicative of the antiquity of this family. Crangonid shrimps are now represented by two species: *Odontochelion cretaceum* (Roger, 1946) and *Odontochelion bicarinatum* n. sp.

The pandalid shrimp *Palaepandalus komaii* n. gen., n. sp. is the oldest known representative of the family. Stenopodid shrimps are also recorded in Hadjoula. Polychelida are only represented by larval stages. Glypheid lobsters include the unique *Angarestia damesi* (Garassino, 2001). Astacidean lobsters are represented by two families, including erymids (*Eryma oscari* n. sp., *Pustulina cretacea* (Roger, 1946) n. comb.)) and nephropids with the new genus *Notahomarus*. Achelata are represented by diverse slipper lobsters (Scyllaridae) and spiny lobsters (Palinuridae) including two new species: *Palinurus teruzzii* n. sp. and *Linuparus secretanae* n. sp. Axiidea are particularly diverse with new axiid shrimps (*Cretaxiopsis libanotica* n. gen., n. sp., *Libanoaxius beatae* n. gen., n. sp., *Magila cretacica* n. sp.), and new callianassid shrimps (*Calliaxina hadjoulaensis* n. sp.). Material from Lebanon also adds important new morphological data concerning "*Neocallichirus*" *agadirensis* Garassino, De Angeli & Pasini, 2011. Anomura are represented by hermit crabs (Diogenidae) and squat lobsters (Chirostylidae) including a new genus (*Phalangiopsis* n. gen.) and two new species (*Phalangiopsis rogeri* n. sp., *Phalangiopsis antoinei* n. sp.). Among the brachyuran crabs, five families are present (Cenomanocarcinidae, Necrocarcinidae, Raninidae, Homolidae, Telamonocarcinidae), including the new raninoid crab *Pseudoranina guinotae* n. gen., n. sp. Isopods (Cirolanidae), stomatopods (Pseudosculdidae, Sculdidae) and cirripeds (Stramentidae) are also revised. Gnathophausiidae (Lophogastrida) are recognized for the first time in the fossil record with *Palaeognathophausia libanotica* n. gen. from Sahel Alma.



Palaeobenthesicymus libanensis

Conclusion. — To summarize, we describe and/or redescribe in total 67 species of crustaceans from the Late Cretaceous Lebanese Lagerstätten. These outcrops offer a unique view into the palaeobiodiversity of crustaceans and will help to understand better the evolution of crustacean clades. ⬢

TALK

Early Cretaceous erymid lobsters (Crustacea: Decapoda) from the Western Tethys

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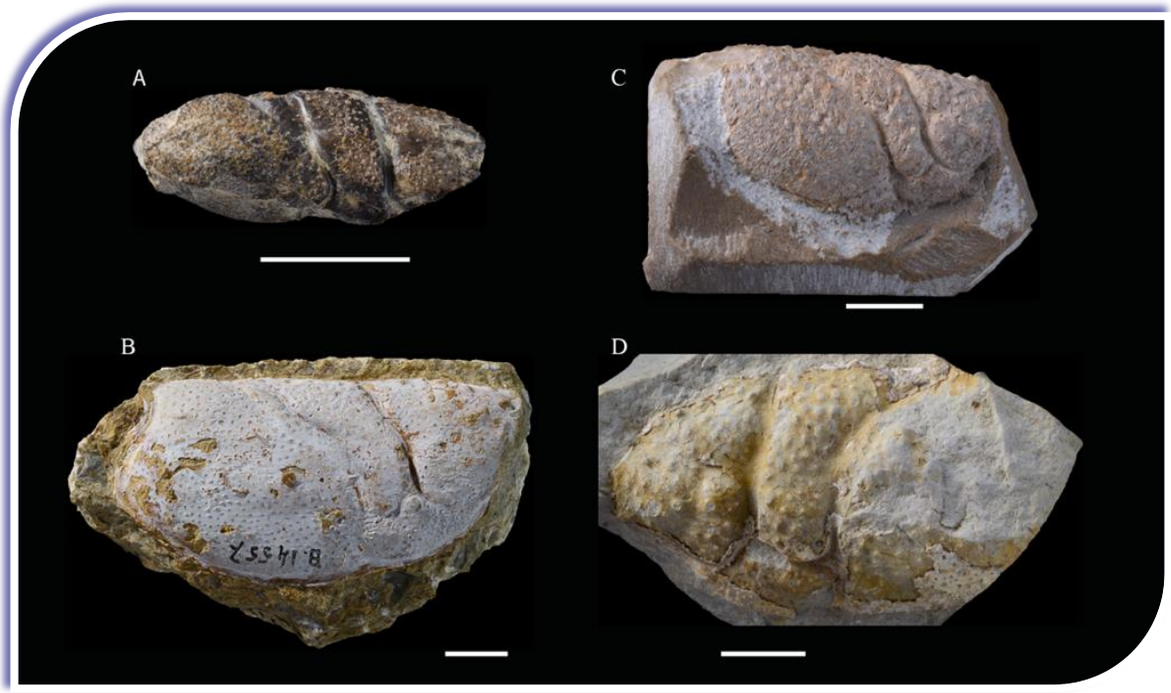

Figure1. A: *Eryma vocontii* n. sp.; B: *Enoploclytia augustobonae* n. sp.; C: *Pustulina occitana* n. sp.; D: *Pustulina colossea* n. sp. Scale bars: 10 mm. Photographs: Lilian Cazes.

Erymid lobsters (Crustacea, Decapoda, Erymidae) are relatively common and abundant in Jurassic rocks (*ca* 70 species) but are far less common in the Early Cretaceous with about 20 species only listed in Europe, North America, South America, Australia, Antarctic, Japan and Madagascar.
A study of the twelve species of erymid lobsters from the Early Cretaceous of Europe (9 from France, 3 from Great-Britain) is here presented. Based on new observations, the concepts of some erymid genera are updated and new diagnoses are proposed for *Eryma* Meyer, 1840, *Enoploclytia* M'Coy, 1849, *Pustulina* Quenstedt, 1857 and *Stenodactylina* Beurlen, 1928, including carapace groove pattern, first pereiopods and also a complex new structure –the post-orbital area– located in front of the cephalic region. The new genus *Tethysastacus* is erected on the basis of its very simple groove pattern compared to the previous genera and includes *Tethysastacus tithonius* (Van Straelen, 1936) n. comb. (Valanginian, France) as type species. Four new species from France are also described: *Eryma vocontii* n. sp. (Albian) which extends the stratigraphic range of *Eryma* to the Albian, *Pustulina occitana* n. sp. (Berriasian), *Pustulina colossea* n. sp. (Hauterivian) and *Enoploclytia augustobonae* n. sp. (Barremian) which is the oldest known *Enoploclytia* representative.

POSTER

New Middle Eocene Hermit Crabs from "Main" quarry at Vicenza (NE Italy)

Antonio De Angeli

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The "Main" quarry of Arzignano (Vicenza, NE Italy) is known for the rich and well preserved carcinological fauna coming from the volcanodetritic marnes of the middle Eocene. New materials of this layer, present in the paleontological collection of the Civic Museum "G. Zannato" of Montecchio Maggiore, has favored the study of some fossil hermit crabs (Crustacea, Decapoda, Paguroidea). The studied species are: *Eocalcinus eocenicus* Vía, 1959, *E. cavus* Beschin, Busulini, De Angeli & Tessier, 2002, *Paguristes prealpinus* Beschin, De Angeli, Checchi & Zarantonello, 2005, *Paguristes* cf. *P. prealpinus* Beschin, De Angeli, Checchi & Zarantonello, 2005, *Paguristes* n. sp. (2), *Paguristes* n. sp. (3), *Calcinus agnoensis* Beschin, De Angeli, Checchi & Zarantonello, 2005, *Petrochirus savii* Beschin, De Angeli, Checchi & Zarantonello, 2012, and "*Paguridae*" (A) n. gen., n. sp. (Diogenidae Latreille, 1802), *Pagurus* n. sp. (1), *P. valdagnensis* Beschin, De Angeli, Checchi & Zarantonello, 2012, "*Paguridae*" (B) n. gen. n. sp., *Lessinipagurus granulatus* Beschin, De Angeli, Checchi & Zarantonello, 2012, *Lessinipagurus* n. sp. (2), and *Lessinipagurus* n. sp. (3) (Paguridae Fabricius, 1775). *Paguristes extentus* Beschin, Busulini, De Angeli & Tessier, 2007 from the lower Eocene of Gecchelina at Monte di Malo (Vicenza) is included in the new genus "*Paguridae*" (A). *Lessinipagurus* and "*Paguridae*" n. gen (B) and are included in the new subfamily. ⬢

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Homepage: *http://www.muse.it/it/Editoria-Muse/Studi-Trentini-Scienze-Naturali*

6TH SYMPOSIUM ON MESOZOIC AND CENOZOIC DECAPOD CRUSTACEANS

VILLERS-SUR-MER, NORMANDY, France, 14 – **18 JUNE 2016**

Antonio De Angeli

New Middle Eocene Hermit Crabs from "Main" quarry at Vicenza (NE Italy)

The "Main" quarry of Arzignano (Vicenza, NE Italy) is known for the rich and well preserved carcinological fauna coming from the volcanodetritic marnes of the middle Eocene. New materials of this layer, present in the paleontological collection of the Civic Museum "G. Zannato" of Montecchio Maggiore, has favored the study of some fossil hermit crabs (Crustacea, Decapoda, Paguroidea). The studied species are: ***Eocalcinus eocenicus*** Vía, 1959, ***E. cavus*** Beschin, Busulini, De Angeli & Tessier, 2002, ***Paguristes prealpinus*** Beschin, De Angeli, Checchi & Zarantonello, 2005, ***Paguristes* cf. *P. prealpinus*** Beschin, De Angeli, Checchi & Zarantonello, 2005, ***Paguristes* n. sp. (2)**, ***Paguristes* n. sp. (3)**, ***Calcinus agnoensis*** Beschin, De Angeli, Checchi & Zarantonello, 2005, ***Petrochirus savii*** Beschin, De Angeli, Checchi & Zarantonello, 2012, and **"*Paguridae*" (A) n. gen., n. sp.** (Diogenidae Latreille, 1802), ***Pagurus* n. sp. (1)**, ***P. valdagnensis*** Beschin, De Angeli, Checchi & Zarantonello, 2012, **"*Paguridae*" (B) n. gen. n. sp.**, ***Lessinipagurus granulatus*** Beschin, De Angeli, Checchi & Zarantonello, 2012, ***Lessinipagurus* n. sp. (2)**, and ***Lessinipagurus* n. sp. (3)** (Paguridae Fabricius, 1775). ***Paguristes extentus*** Beschin, Busulini, De Angeli & Tessier, 2007 from the lower Eocene of Gecchelina at Monte di Malo (Vicenza) is included in the new genus **"*Paguridae*" (A)**. ***Lessinipagurus*** and **"*Paguridae*" n. gen (B)** and are included in the new subfamily.

De Angeli A., Caporiondo F. – Hermit crabs (Crustacea, Decapoda, Anomura, Paguroidea) from the middle Eocene of "Main" quarry of Arzignano (Vicenza, northeastern Italy). *Studi Trentini di Scienze Naturali*: 96 (2017): *in press*.
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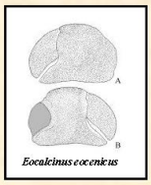
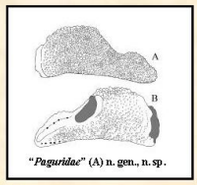
Texts, photo, sketches and graphic elaboration of Antonio De Angeli



Eocalcinus eocenicus



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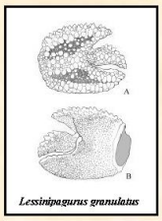

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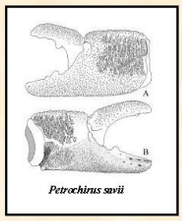
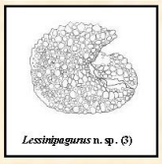


Petrochirus savii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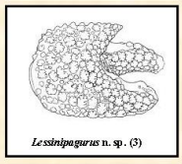
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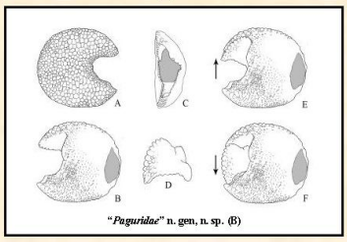

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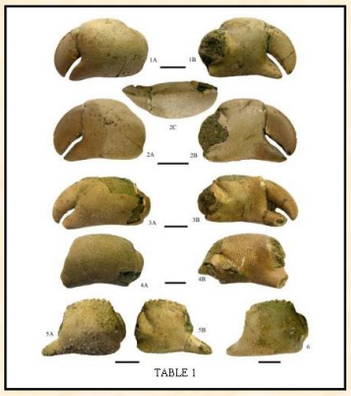
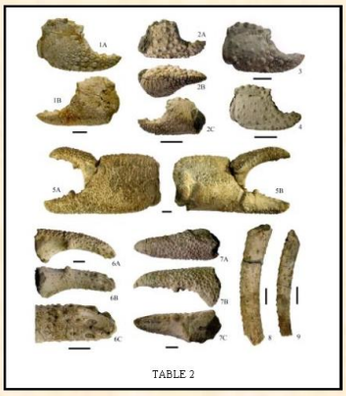


TABLE 1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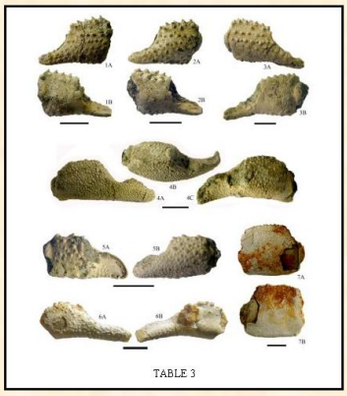
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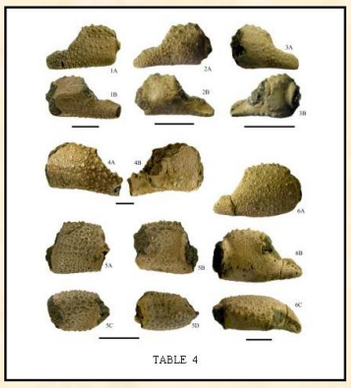
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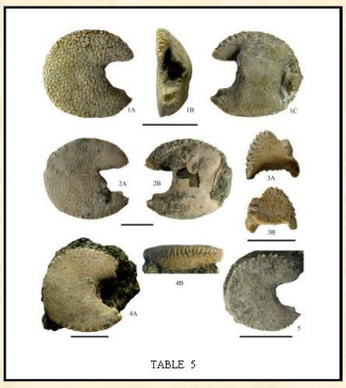
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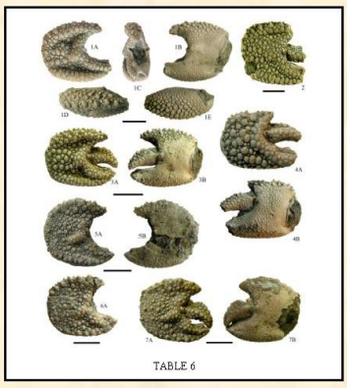
TABLE 6

POSTER

New decapod fauna at midway of the Tethys Sea and Atlantic Ocean. Central Pyrenees of Huesca (Aragón, Spain)

José Luis Domínguez[1], Àlex Ossó[2]

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Over the past decade road construction in the vicinity of the village of Fanlillo, in the municipality of Yebra de Basa (Huesca, Aragón, Spain) have exposed Middle-Late Eocene strata which belong to the so-called Margas de Pamplona-Arguís Formation (see Puigdefàbregas, 1975). Biostratigraphic and magnetostratigraphic data (Pueyo et al., 2002) establish the lower and upper limits of the Margas de Pamplona-Arguís Formation from 40.32 to 37.17 Ma, which, according the ICS ICC 2015, correspond to a Bartonian-early Priabonian age. This formation consists of marly deposits corresponding to a distal offshore that grade into sandstone mouth bars with abundant vegetal remains. Plant remains consisting of leaves, stems and mangrove palm fruits of Nypa (Arecaceae) and other indeterminate remains, suggest the area was a delta under tidal and/or storm influences (Oms & Remacha, 1992). The early Priabonian uppermost deposits consist of marls interbedded with thin sandstone deposits, which have yielded a rich and varied decapod assemblage. Several deposits have a high percentage of fossils including disarticulated brachyurans, suggesting a high energy environment. In the deposits that have low accumulation of decapod remains, the decapods are articulated and appear to be in life position, suggesting a low energy environment. Size of decapod remains varies from carapaces of 100 or 120 mm in Portunus catalaunicus Vía, 1959 to 5 mm in Chasmocarcinus cf. guerini (Via, 1959) (see Ossó et al. 2014).

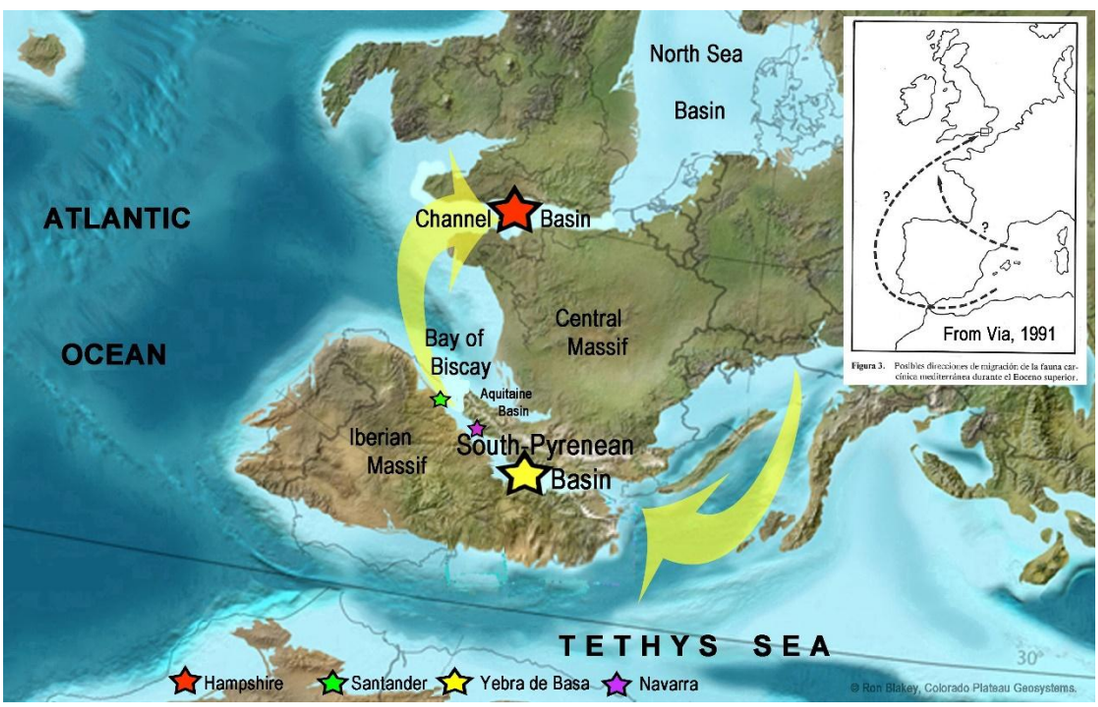

Figure. *Paleomap: approximate palaeogeography of the westernmost Tethys during the Eocene, showing the possible migration path of the Tethyan fauna toward the North Atlantic Sea and the British Islands through the South-Pyrenean Basin (modified from Ron Blakey and Colorado Plateau Geosystems, INC.)*

The fauna of the Yebra de Basa decapod assemblage have clear Tethyan affinities, being noteworthy the existing similarities amongst both faunas, not only at familial level, but also at generic and even specific level in some cases, and surprisingly also related to the Bartonian fauna described by Quayle & Collins (1981, 2012) of Hampshire and Isle of Wight (southern of British Islands). The presence of these Tethyan decapod fauna at midway of the western margin of the Tethys Sea and the North Atlantic could confirm the hypothesis of Via (1969 and 1991), who suggested how the middle-late Eocene Tethyan faunas from Hungary, Italy and Catalonia could have reached the southern British Islands, either via the southern Iberian Peninsula or through the northern Iberian Peninsula. Our study confirms the connection via the South-Pyrenean Basin in the northern Iberian Peninsula. This basin was the migration path used by the Tethyan faunas to reach the North Atlantic Ocean (Bay of Biscay) from the Tethys Sea, which were connected at least during the second Eocene relative sea level rise in the Bartonian (Puigdefàbregas et al., 1986). The westward presence of middle-late Eocene Tethyan decapod fauna, in Navarra Region (Spain) and in the Cantabrian coast (Santander Province, Spain) reinforces the hypothesis of Vía (see paleomap).

Preliminary observation of the recovered fossil decapods, shows a great variety of taxa belonging to Axiidea, Paguroidea, Cyclodorippoidea, Dromioidea, Raninoidea, ?Aethroidea, Calappoidea, Cancroidea, Dorippoidea, Goneplacoidea, Majoidea, Palicoidea, Parthenopoidea, Pilumnoidea, Portunoidea, Retroplumoidea, ?Xanthoidea and Grapsoidea. Several taxa or very related taxa are also present either in the Hampshire outcrops or in the western Tethys outcrops. From the approximately thirty different species recovered in the outcrops, several of them have been described recently as new taxa (see Artal et al., 2013, Ossó et al., 2014, Artal et al., 2016 and Domínguez & Ossó, in press).

Future work will allow us to study in detail the yet undescribed fauna in order to establish and confirm the apparent affinities between the British and the Tethyan Middle-Late Eocene faunas. ⬢

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TALK

Recent Revolution in Decapod Paleontology

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Historically, the study of fossil decapods has been confined largely to the realm of Alpha Taxonomy. It can be argued that this is, of necessity, the critical foundation for all subsequent work. However, stepping beyond alpha taxonomy with the decapod fossils has lagged behind advances in some other fossil groups and certainly in decapod zoology. Within the past two or three decades, major innovations in studies have rapidly transformed decapod paleontology and, as a result, have elevated it beyond simple description to true paleobiological analysis. To be sure, alpha taxonomy remains vital, but now broader questions can be asked and answered. It is possible to consider these advances in manifold ways – systematic, phylogenetic, morphologic, ecologic and biogeographic; that is, considering the fossils as taxa and considering them as animals.

Systematic work on fossil decapods has virtually exploded within the past three decades. A recent compilation (Schweitzer and Feldmann, in press, U. Chicago) records about 3700 species and over 1000 genera of fossil decapods, whereas Schweitzer et al. (2009, Crustaceana Monog.) listed 3270 species within 916 genera. At the time of publication of the *Treatise on Invertebrate Paleontology*, Glaessner (1969, Treatise on Invert. Paleo. V. R. 4(2)) recognized about half those numbers. This certainly demonstrates that alpha taxonomy is flourishing; but there is a far more important aspect of these studies than just the numbers. This work has not only filled in gaps in diversity patterns, but it has also vastly increased our understanding of fossil decapods in the Southern Hemisphere and in previously understudied regions in the Northern Hemisphere. It is now possible to analyze decapod diversity patterns through time at the generic level demonstrating patterns of turnover in dominance of major groups as well as ecological stability through time in other groups (Schweitzer, 2015, Geol. Soc. Am. Abs, v. 47). Until very recently, little was known about the decapod fossils on the southern continents. Recent research in South America, Antarctica, New Zealand, and Australia have vastly increased the number of known taxa (Feldmann and Schweitzer, 2006, J. Paleo., v. 80) permitting biogeographic distributional patterns to be analyzed for the first time. Work in Japan, China, and the Middle East has made it possible to cast their occurrences in a global context. These critical studies have made possible the re-evaluation of classical systematic in a phylogenetic framework. The availability of computer programs permitting analysis of vast amounts of data now makes it possible to recognize degrees of relationship based upon shared derived characters. Although these studies have been applied to extant organisms, molecular arrays, and some other fossil groups, it has only been within the past decade that fossil decapods have been subjected to this treatment. Large data sets, based upon features preserved on fossils, can now be assembled and analyzed (Karasawa et al., 2011, J. Crust. Biol, v. 31). Among others, two significant observations have resulted; reasonably objective tests of classic classifications can be made, and demonstrations that many taxa previously assigned to extant families and superfamilies likely reside in extinct groups (Karasawa et al. 2014, J. Crust. Biol. V. 34). This mode of analysis of the decapod fossil record can only be viewed as transformative.

Morphological studies of fossil decapods have also extended beyond simply describing and classifying taxa. In many ways, recent observations have been transformative. Indeed, the landmark contributions of Guinot (1979, Mém. Mus. Nat. d'Hist. Nat., v.112) and others have articulated the importance of coupling zoological studies with paleozoological work to transform fossils as rocks to the level of fossils as once living organisms.

Waugh (Waugh and Feldmann, 2003, Cont. Zool., v. 72) and others have scrutinized the microstructure and ultrastructure of cuticle in extant and fossil decapods, demonstrating that patterns of cuticle morphology can be recognized based upon variations in patterns of layering and presence of a variety of structures normal to the layers. Prior to his work, studies of cuticular microstructure in fossils was largely descriptive. Waugh's recognition of patterns had several outcomes. Cuticle morphology could be coded and the phylogenetic analyses could be run (Waugh, 2013, PhD Diss., Kent State U.). This work is still in its infancy. Jakobsen and Feldmann (2004, J. Paleo., v. 78) recognized that surfaces of the endocuticle, exocuticle, and epicuticle could have very different expression and that recognition of these differences may have been used in defining species. Waugh et al. (2004, J. Paleo., v. 78) refined this work and considered its implication for systematics and preservation of epibionts. Cuticle architecture also affected the preservational potential of different elements of decapod exoskeletons (Mutel et al., 2008, PALAIOS, v. 23). Thus, his work can truly be considered innovative.

The research on fossil hermit crabs by Fraaije and colleagues have elucidated the history of that group primarily in the Jurassic and Cretaceous, recognizing morphological features useful in classification. At the same time, Fraaije (2003, Palaeo., v. 46) called attention to the use of cephalopod shells as living sites. This work has stimulated further research by Fraaije and several others to consider the occurrence of pagurids in association with other organisms and to elevate the study of inquilinism to a new level. A variety of shells were used throughout history as living sites, refugia, and possibly accidental association. The work has shed new light on the history of this fascinating group.

Historic roots of the Decapoda continue to be explored, and Jones et al. (2015, J. Crust. Biol., v. 35) have suggested that the origin of the Eumalacostraca may lie within Silurian Phyllocarida. This work is grounded in detailed examination of rarely preserved anatomical structures.

Taken together, these remarkable advances have been the result of an increase in the number of paleontologists devoted to the study of the decapods. Their efforts, coupled with increasingly sophisticated research promises even more innovations in the future.

TALK

A new look at Achelata

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Although the biology of lobsters, also known as reptantian decapods, has been investigated in great detail, studies of reptantian systematics are limited. According to biologists and palaeontologists, extant marine lobsters comprise four decapod infraorders, namely Polychelida, Achelata, Glypheidea and Astacidea (e.g., De Grave *et al*. 2009; Chan, 2010; Karasawa *et al*. 2013).

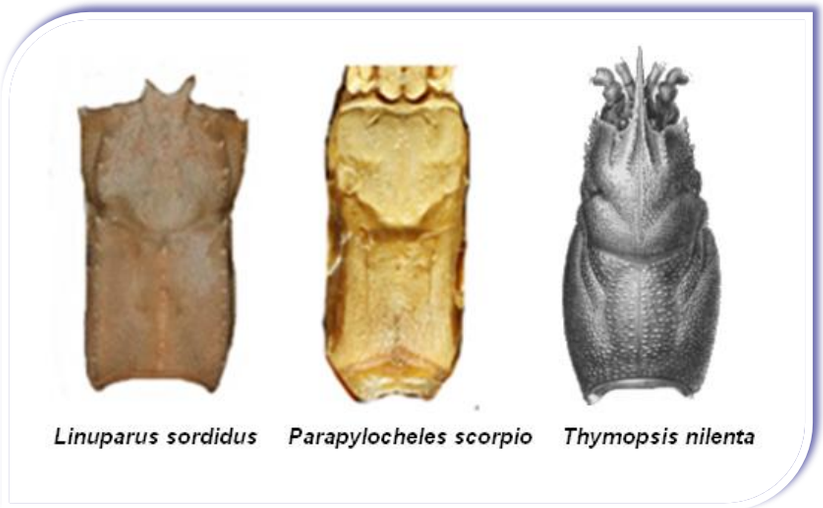

Figure 1. *Dorsal carapace morphology of (from left to right) members of the Achelata, Paguroidea and marine lobsters.*

During ongoing field research and studies on Mesozoic anomurans (e.g., Fraaije *et al*. 2012a-c, 2013, 2014; Fraaije, 2014), a newly discovered Late Jurassic specimen of *Palaeopalinurus* sp. from southern Poland came to our attention. At first glance the subcylindrical shape of the carapace, the morphology of the cervical groove and the strong carapace ornamentation reminded us much more of a basal paguroid-anomuran form, of which we studied and described many during the last decade, rather than of a lobster. So the question arose, 'Why are the Achelata classified as marine lobsters?'. Based on a thorough comparative research we shall demonstrate that the Achelata, better known as the group of spiny, slipper and furry lobsters, are not in their right place at the moment (as an infraorder within the marine lobsters), but rather constitute another (new) member of the Anomura.

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TALK

A new hermit crab from the type Maastrichtian (the Netherlands) and further phylogenetic refinement of the Paguroidea

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Carapaces or shields of Cretaceous hermit crabs are rare, with about a handful having been recorded to date. On the basis of a fragmentary carapace, a new extinct paguroid is described from the upper Meerssen Member (Maastricht Formation, upper Maastrichtian) of the Maastrichtian type area in the southeast Netherlands. The new taxon represents the fifth and stratigraphically youngest member of the genus *Annuntidiogenes* Fraaije, Van Bakel, Jagt & Artal, 2008, and shows a remarkably close resemblance to extant diogenids. Morphological features of paguroid carapaces, not previously used by neontologists, form the basis for a further phylogenetic refinement of the Paguroidea.

The oldest member of the genus, *Annuntidiogenes jurassicus* Fraaije, 2014, has recently been recorded from the Upper Jurassic (Kimmeridgian) of southern Germany. Based on the apomorphy of intragastric grooves that are parallel to the cervical groove, Fraaije (2014) erected the paguroid family Annuntidiogenidae. In the literature, these grooves are occasionally referred to as Y-linea in those cases where the intragastric grooves are connected medially (see e.g., Morgan & Forest 1991).

A new partial shield from the upper Meerssen Member (Maastricht Formation), at the ENCI-HeidelbergCement Group quarry south of Maastricht, adds new data on the development of the Paguroidea. ⬢

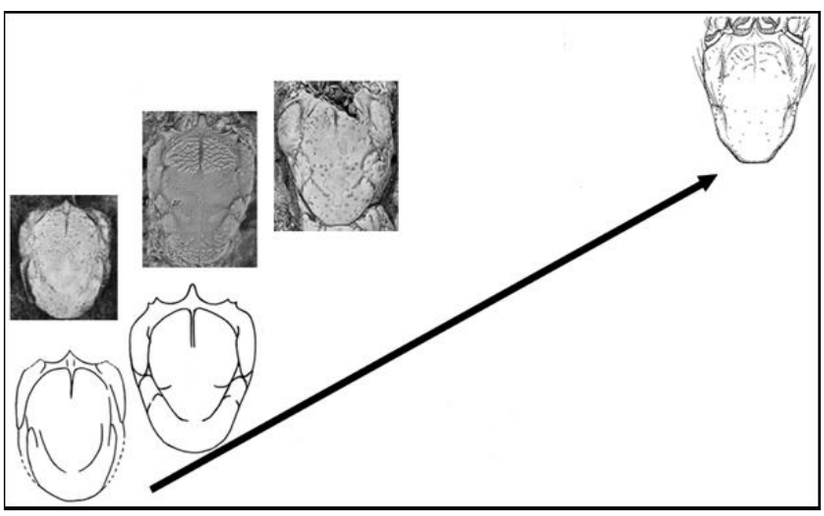

Figure 1. *Annuntidiogenidae – from left to right: A. jurassicus (Kimmeridgian), A. worfi (upper Albian), A. sunuciorum (upper Maastrichtian) and extant Paguristes.*

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TALK

New decapod crustacean community from Neogene strata of Tunjice Hills (Central Slovenia)

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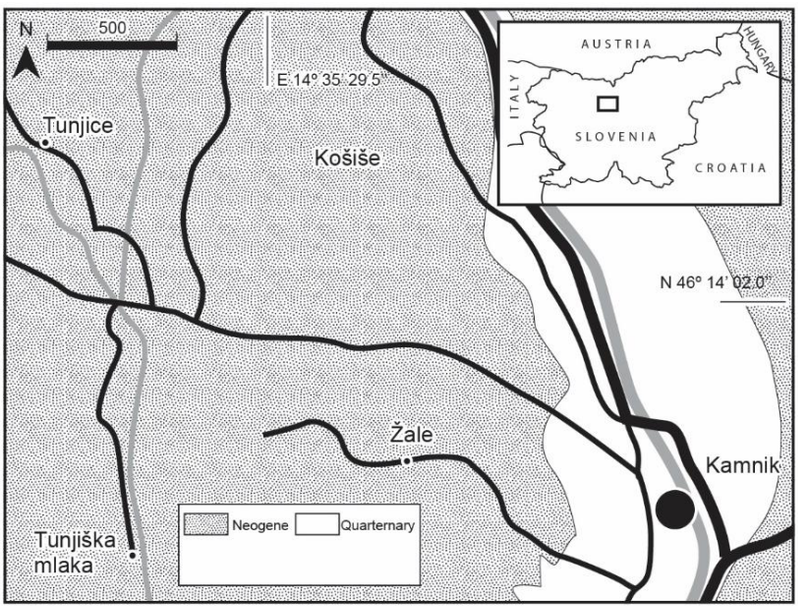

Figure 1. *Simplified geological map of Tunjice Hills and Kamnik region*

The fossiliferous localities in Tunjice Hills are situated approximately 3 km northeast of the city of Kamnik in central Slovenia (Figure 1) and represent a *locus typicus* for a decapod crustacean *Tasadia carniolica* (Bitner, 1884).

Tertiary beds of Kamnik and Tunjice Hills are very rich with fossils and span from the upper Oligocene to the end of the Miocene. These beds were deposited in the Sava Folds Basin, which represented one of the most western basins in Miocene Central Paratethys (Pavšič & Horvat, 2009). The area is known for its wealth of fossil remains from the 19th century onwards, when a well-known naturalists and local priest Simon Robič (1882) started collecting fossils and sending them to palaeontologists from the Nature History Museum in Vienna, among others also first specimens of decapod *Tasadia carniolica*. So far the decapod fauna of Tunjice Hills is largely undescribed and understudied, despite the fact that over 300 specimens belonging to at least 10 species were collected in recent years by local collectors. The present report is a first attempt of an overview of decapod finds from Neogene beds of Tunjice Hills.

The Tunjice syncline belongs to a geotectonic unit of the Sava folds (Premru, 1983). In the south it borders to Triassic rocks of Trojane anticline and in the north to Teharje anticline and Menina mountain massif, both consisting of Triassic Dachstein limestone. Axis of syncline runs east to west, slightly deepening to the west. The Tunjice syncline consists of Oligocene and Miocene sedimentary rocks lying discontinuously on Triassic fine-grained clastic rocks. Successive regression and transgression sequences suggest switching cycles of deepening and shallowing of sedimentary environment.

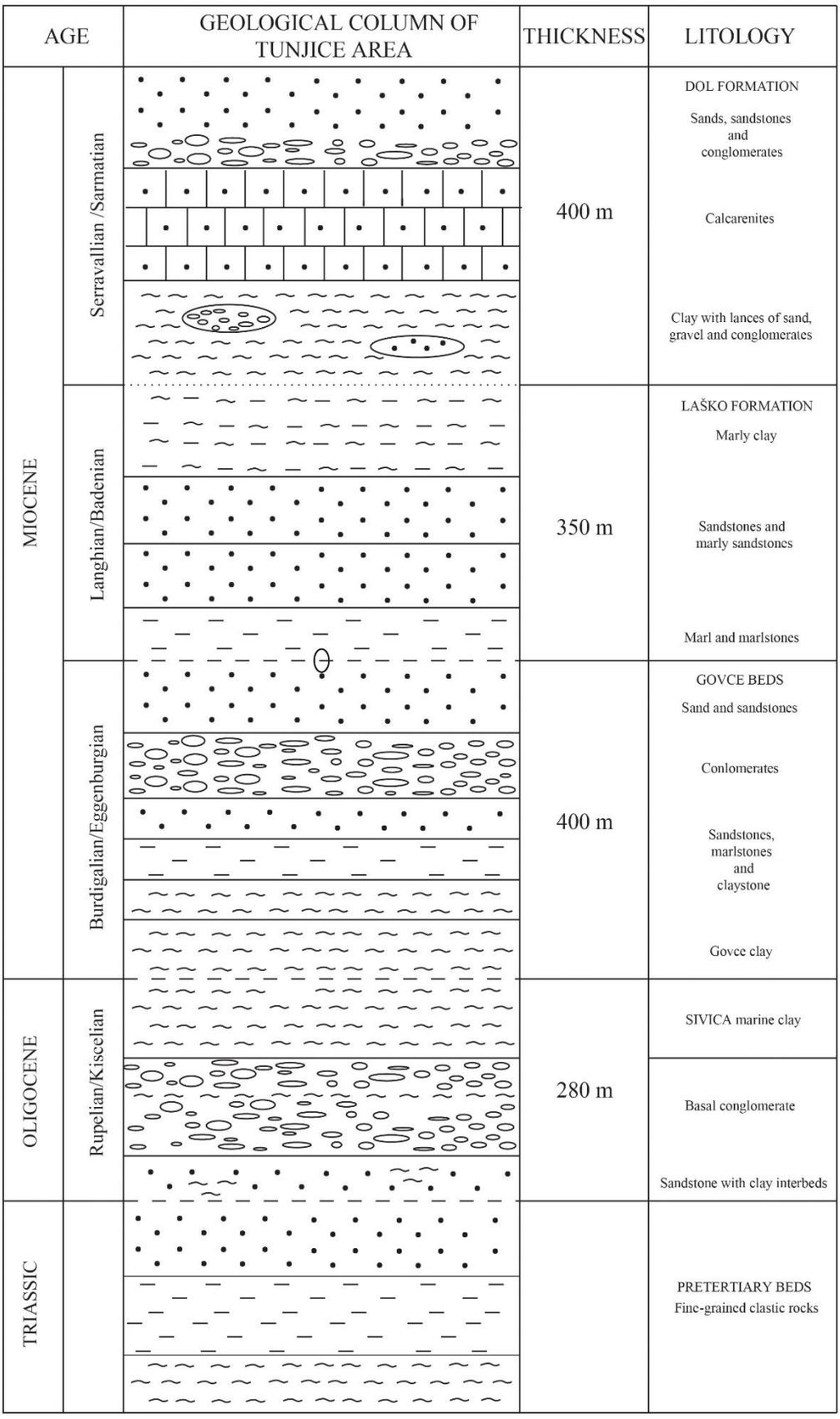

Figure 2. *Stratigraphical section of fossiliferous beds of Tunjice Hills*

The stratigraphic sequence of the Tunjice Hills Neogene beds (Figure 2) starts with Oligocene sandstones layers and a few metres thick fluvial conglomerates. The Oligocene sequence continues by a 80 to 100 metre thick horizon of grey marine clay called "Sivica". The total thickness of Oligocene layers in Tunjice hills is estimated at around 280 metres. The Oligocene marine clay is fossiliferous and here contains plant (*Platanus aceroides, Eucalyptus oceanica, Laurus ocoteaefolia*) and marine mollusc fauna (*Ervilia* sp.*, Calyptraea chinensis, Melongena deschmanni, Natica* sp.*, Ostrea fimbriata, Turritella turris, Venus* sp.), which indicates the transition to the lower Miocene (Mikuž, 2005). Decapods remains are exclusively found inside hard concretions washed out from soft clay, which are considered to be reworked from older Oligocene beds. The decapod fauna is similar to the Oligocene fauna of Denmark with predominantly (80 %) represented specimens of *Chaceon* sp. and rarer fragmented finds of lobster *Homarus* sp.

Above the unconformity lie lower Miocene Govce beds. The Govce sequence starts with a deposition of clay with lenses of sand and sandstones but consists mostly of interchanging conglomerates, sandstones and fine-grained marls. The succession of retrogradational and progradational sequences implies alternation of deepening and shallowing cycles (Vrabec, 2000). Sediments of Govce beds were deposited in a shore-zone depositional environment with variable terrestrial and marine influence. Marine fauna retrieved from marls also indicates near coastal environment with common plant remains drilled by terenidid bivalves and carbonized pine cones. Other present molluscs are bivalves: *Corbula gibba, Pholadomya alpine, Tellina* sp., *Lutraria* sp.*, Thracia* sp.*, Ostrea* sp.*, Glycymeris* sp*. Mactra* sp*.* and *Acanthocardia* sp.; gastropods: *Ampullina crassatina, Tympanotonus margaritaceum, Naticarius* sp., *Polinices* sp., *Turritella* sp. and *Clithon* sp. (Žalohar & Zevnik, 1998). Decapod remain are rare in the Govce beds and so far the only finds are a handful of specimens of *Retropluma cf. slovenica* from deeper depositional sandy beds of the Govce formation.

Govce beds are discordantly overlapped by beds of Laško formation, which consist of mudstones, sandstones and limestone. Repetitions of retrogradational sequences reflect a rise in sea level or rapid subsidence of the terrain. Similarly to the underlying layers of Govce beds, the Laško formation was deposited in the shallow infralittoral coastal environment. In the upper parts of the sequence, increasing terrestric influence can be observed (Vrabec et al., 2014). Sandstones, followed by marly clay, already represent transitional beds to the Sarmatian layers. Sandstones and sandy limestone of the Laško formation are famous for their fossil molluscs finds (Mikuž & Pavšič, 2000). Well preserved bivalves belonging to genera *Glossus*, *Corbula, Anadara, Lucinoma, Thracia, Tellina, Cardium, Acanthocardia, Lutraria, Mytilus, Panopea* and *Ostrea*, as well as gastropod genera *Xenophora*, *Trochus*, *Conus*, *Ancilla*, *Turritella*, *Lunatia* and *Hinia*, are commonly found (Žalohar & Zevnik, 2006). Apart from the mollusc fauna also some vertebrate remains are present, shark teeth of *Carcharias* sp. and *Isurus* sp. are common and rare whale remains represented by isolated vertebrae and ribs were also described (Gašparič & Križnar, 2014). These layers also show high biodiversity of decapods with five fossil genera and numerous specimens (Figure 3). By far the most abundant decapod crab from the Laško beds is a dominant species of *Tasadia carniolica* in close association with *Jaxea kuemeli.*

The youngest litho-stratigraphic unit of Tunjice hills is represented by Serravallian (Sarmatian) layers of the Dol formation. Clay, found in the upper part of the Laško formation, is upwards becoming sandier. In the upper parts clay contains an increasing number of lenses filled with sand, gravel and poorly lithified conglomerate. These layers are overlapped by layers of fluvial sands, sandstones and conglomerates. The

environment of the upper parts of the Dol formation in the Tunjice Hills shows tectonic uplift and shallowing of the marine basin. The total thickness of the the Sarmatian layer is about 300 to 450 metres. Characteristic horizons for Serravallian beds are cerithid sandstone and coprolitic horizon, which represent "Lagerstätten" deposits of clays with frequent bivalves from genera *Macoma, Cerastoderma* and *Ervilia*, and abundant small gastropods from genus *Mohrensternia.* Interbedded between these are layers of finely laminated clays with exceptionally preserved fishes, coprolites, insects (order Diptera and Hymenoptera) and medusa. These layers became world famous as *locus typicus* for the oldest described seahorse and sygnathid fish fauna with species *Hippocampus sarmaticus* and *Hippocampus slovenicus* (Žalohar & Hitij, 2014). Decapod remains from Dol formation beds are rare and only found in the lower part of the formation, well below the coprolitic horizon. In the clay beds of the lower Dol formation specimens of *Macrophthalmus* cf. *vindobonensis* can be found (Križnar, 2006). The paleontological richness of the Tunjice Hills region and the accessibility of the locations from the Oligocene to the upper Miocene deserve further investigation and protection under the local »Lagerstätten« status. In the future, an initiative to establish an international paleontological workgroup is needed that would revise the macrofossil taxons from the region. ⬢

Epoch	Age	Formation	Higher taxon	Species	Specimens
MIOCENE	Serravallian	Dol formation	Cancroidea / Cancridae	*Lobocarcinus* sp.	1
			Ocypodoidea / Macrophthalmidae	*Macrophthalmus* cf. *vindobonensis*	6
	Langhian	Laško formation	Axiidea / Callianassidae	*Calliax michelottii*	11
			Axiidea / Callianassidae	*Callianassa* sp.	8
			Gebiidea / Laomediidae	*Jaxea kuemeli*	29
			Calappoidea / Calappidae	*Calappa* sp.	1
			Cancroidea / Cancridae	*Tasadia carniolica*	174
	Burdigalian	Govce formation	Retroplumoidea / Retroplumidae	*Retropluma* cf. *slovenica*	5
OLIGOCENE	Rupelian	"Sivica" marine clay	Astacidea / Nephropidae	*Homarus* sp.	9
			Portunoidea / Geryonidae	*Chaceon* sp.	42

Figure 3. *Decapod crustaceans from Tunjice Hills (Sava Folds Basin, Slovenia)*

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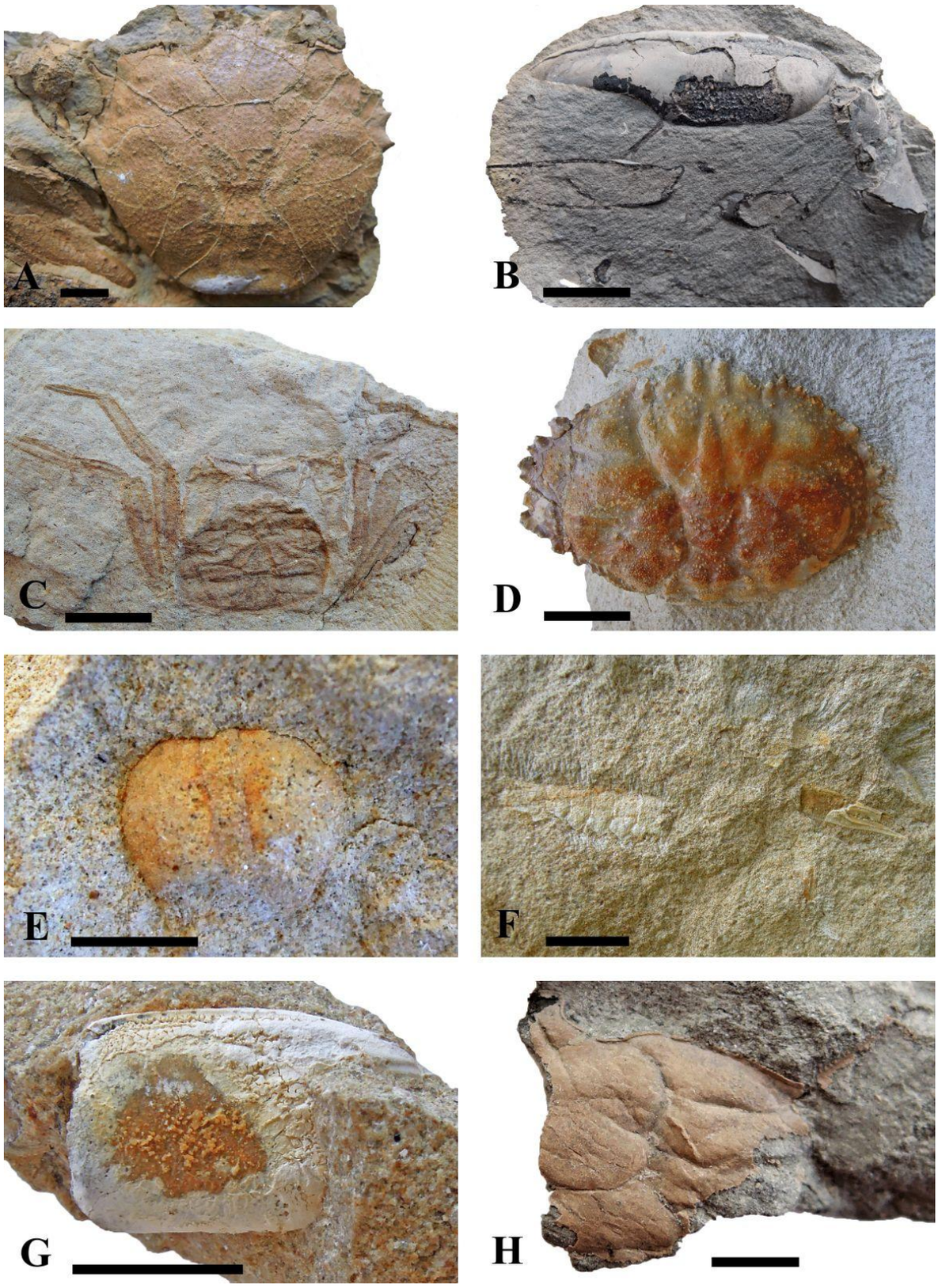

Plate 1. *A) Chaceon sp., B) Homarus sp., C) Retropluma cf. slovenica, D) Tasadia carniolica, E) Calappa sp., F) Jaxea kuemeli, G) Calliax michelottii H) Macrophthalmus vindobonensis*. Scale bar in all figures is 10 mm.

TALK

Biostratigraphy and paleoecology of the decapod fauna from the Jurassic of the Vaches Noires cliffs (Calvados, France)

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Crustaceans from the Jurassic of Normandy (France) were described in the 19th and at the beginning of the 20th century (Bassompierre, 1938; Morière, 1882; Raspail, 1901) and later revised by Hée (1924) and Van Straelen (1925). In Calvados, the Vaches Noires cliffs expose interesting layers for the study of decapods from the Upper Callovian to Middle Oxfordian, which can be compared to the equivalent English Oxford Clay Formation. Before our work, only two taxa assigned to erymids, were described in the Callovian-Oxfordian of Villers-sur-Mer: *Eryma villersi* Morière, 1882 (Upper Callovian, Lamberti Zone) and *E. morieri* Hée, 1924 (Lower Oxfordian, Mariae Zone); another was cited as "small crustaceans not yet described" (Callovian-Oxfordian).

A first preliminary study was published by Charbonnier & Gendry (2014) to synthesize the knowledge about Jurassic crustaceans of the 'Vaches Noires'. Here, we provide an updated synthesis of the biostratigraphy and add new informations about taxa found in the Jurassic of the 'Vaches Noires' with the evidence of erymids (*Eryma villersi* Morière, 1882 - Upper Callovian; Erymidae indet. - Lower Oxfordian), mecochirids (*Mecochirus socialis* (Von Meyer, 1841) - Upper Callovian to Lower Oxfordian), glypheids (*Glyphea regleyana* (Desmarest, 1822); *Glypheopsis* sp. – Upper Callovian) and pagurids (*Goniochirus cristatus* Carter, 1886 – Upper Callovian; indeterminate propods – Middle Oxfordian).

Eryma villersi
Photograph: Jean-Philippe Pezy

This locality appears to be the richest decapods deposit of Normandy. Of particular interest is pyritised specimens of *M. socialis* preserved in small calcareous nodules. We analyzed about thousand of them found in place in several layers during our prospects in the foreshore and cliffs of Villers-sur-Mer (France) and Weymouth (England). Preliminary results show that *M. socialis* and *E. villersi* occupied different environments. Erymids are found as isolated fingers or cephalothoraxes at the surface of condensed-levels in mudflat above storm-wave base (indurated marls); articulated chelipeds are found in quieter environment with high sedimentation rate but without mecochirids. Episodic accumulations of mecochirids in nodules at several beds (until 72% of nodules with rests), mostly articulated, are indicating regular mass-decay. These levels globally poor in fossils are highly disturbed. Also, some episodic accumulations rich in *Mesosaccella* CHAVAN, 1946 (an infaunal deposit-feeder with some specimens in life position) found at the same level argue for a burrowing taking place later, when more oxygenated conditions have settled on the bottom, some centimeters above mecochirids. Unfortunately, almost all nodules are crossed by small burrows probably attributable to worms, leading to a cracked-aspect of carapaces. All of this indicate dysoxic bottom-water conditions in the Marne de Dives Formation.

The presence of *Glyphea regleyana* and *Glypheopsis* sp. is documented for the first time in the Upper Callovian of France (Charbonnier & al., 2013) and fill the gap between Bathonian and Oxfordian occurrences for *G. regleyana*. Both are usually found in the same beds as erymids but their remains are very rare in proportions and suggest a different habitat for glypheids. Curiously, no isolated chelipeds were found, only cephalothoraxes and an incomplete molting, all in nodules. Finally, epibionts (serpulids) have been found on seven specimens of *Mecochirus* that highlight new biotic interactions. ⬢

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TALK

Convergent patterns of the evolution of body organisation in three eumalacostracan lineages – comparing Hoplocarida, Eucarida and Peracarida

Carolin Haug

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Eumalacostracan crustaceans all have a more or less stereotypic body organisation in the sense of tagmosis. Originally this includes a head with six segments (ocular segment plus five appendage-bearing segments), a thorax region with eight segments (also termed thorax I) and a pleon with six segments (also termed thorax II, which does not represent an abdomen). With this eumalacostracans are comparable to insects, which also possess a rather strict tagmosis. Interestingly, these two lineages with their seemingly "restricted" body organisation seem much more successful from an evolutionary standpoint than groups with less strict body organisation.

Despite these restrictions in variability in terms of tagmosis the morphological diversity within Eumalacostraca is rather high. A group providing representative examples that are commonly known is Decapoda. Decapod crustaceans include shrimp-like forms, lobster-like forms and crab-like forms. The stem species of Eucarida, the group including Decapoda and Euphausiacea, must have possessed a rather shrimp-like morphology, quite similar to the stem species of Eumalacostraca. Also two other lineages within Eumalacostraca, namely Hoplocarida (with the mantis shrimps as modern representatives) and Neocarida (with the two sister groups Thermosbaenacea and Peracarida) evolved from the shrimp-like body organisation to rather diverging ones.

I will demonstrate that there are specific patterns of evolutionary events in all these three lineages Hoplocarida, Eucarida and Peracarida that lead to very similar types of derived body organisation. This evolutionary reconstruction is based not only on observations of modern fauna, but especially on exceptionally preserved Mesozoic fossils. With this, Mesozoic eumalacostracans, including Mesozoic decapods, represent an important (if not unique) "experimental set-up" for research on factors leading to convergent evolution. As understanding of convergent evolution is still one of the puzzling challenges of modern evolutionary theory, such an approach will have an impact even beyond the taxonomic limitations of malacostracan crustaceans. ⬢

TALK

Evolution of malacostracan crustaceans beyond the "adult paradigm" – why fossil larvae and juveniles increase the explanatory power of evolutionary reconstructions

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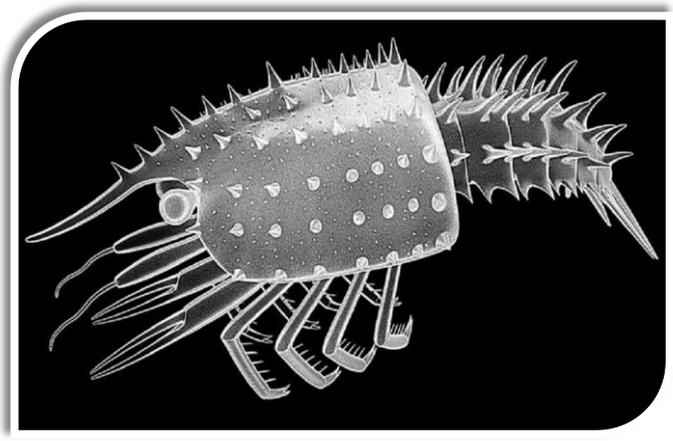

Cretaceous Polychelida larva
Drawing: Joachim Haug

Modern evolutionary biology and phylogenetic systematics tend to be adult-centered. The "adult paradigm" sets unspoken rules for taxonomic treatments, phylogenetic reconstructions and reconstructions of character evolution. In extant-centered evolutionary biology the inclusion of developmental data into an evolutionary framework, Evo-Devo, has led to significant new insights of evolutionary processes.

I will demonstrate that a related approach is also applicable to palaeo-centered approaches, hence Palaeo-Evo-Devo. Especially the Mesozoic has provided a growing fossil record of larvae or juveniles of malacostracans, including stomatopods, but especially decapods. Younger strata have recently additionally provided peracarid larvae. I will present examples how the recognition of fossil larvae and juveniles complicates, but also enriches our practices of 1) taxonomy, 2) phylogenetic reconstructions, and 3) reconstructions of character evolution.

Taxonomic treatment becomes much more complex when recognising juveniles and larvae as distinguishing between features characterising species may be restricted to specific stages and may hence not be present in a specimen at hand. On the other hand, seeming species differences might represent nothing more than ontogenetic differences. 2) Phylogenetic reconstructions suffer from the challenges of taxonomy; if two conspecific specimens differing in ontogenetic stage are erroneously treated as separate species, severe artefacts in the phylogeny are to be expected. On the other hand, phylogenies benefit as developmental data may provide additional characters, hence enriching the number of available characters. 3) Character evolution benefits significantly from developmental data as this may lead to the recognition of heterochronic events, identifying seeming novelties as simple shift in developmental timing. Also evolution of early stages does not have to be coupled to evolution of adult features which can only be identified by actively including such data. With this I aim at emphasising that a more holistic view especially on the Mesozoic history of decapods and other groups demands for a Palaeo-Evo-Devo approach. ⬢

TALK

Cenozoic palaeobiogeography of the Western Tethys based on decapod crustaceans

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A considerable part of the Western Tethys is formed by the circum-Mediterranean area which experienced dramatic geodynamic and environmental changes during the last 30 million years. Significant biogeographic differentiation of this area has been documented (Harzhauser et al. 2007), mainly during the Miocene, when connections between Proto-Mediterranean, Paratethys and Proto-Indo-West Pacific (Proto-IWP) were intermittently opening and closing. Extensive data collecting provided a basis for estimation of decapod species diversity within the circum-Mediterranean area during the last 30 million years; altogether 392 decapod species in 178 genera were recorded (Hyžný in revision). Most species are known from the Middle Miocene, when many decapod species were associated with coral reefs occurring in the Paratethys Sea – a type of high-diversity habitat that later vanished from the area. During the Oligocene and Early Miocene decapod faunas of the Paratethys in general had more affinities to the Atlantic Ocean than to the Mediterranean (Fig. 1). These relationships probably reflect remains of relatively uniform marine faunas from the time before the Oligocene when organisms could migrate freely across vast areas of today's Europe.

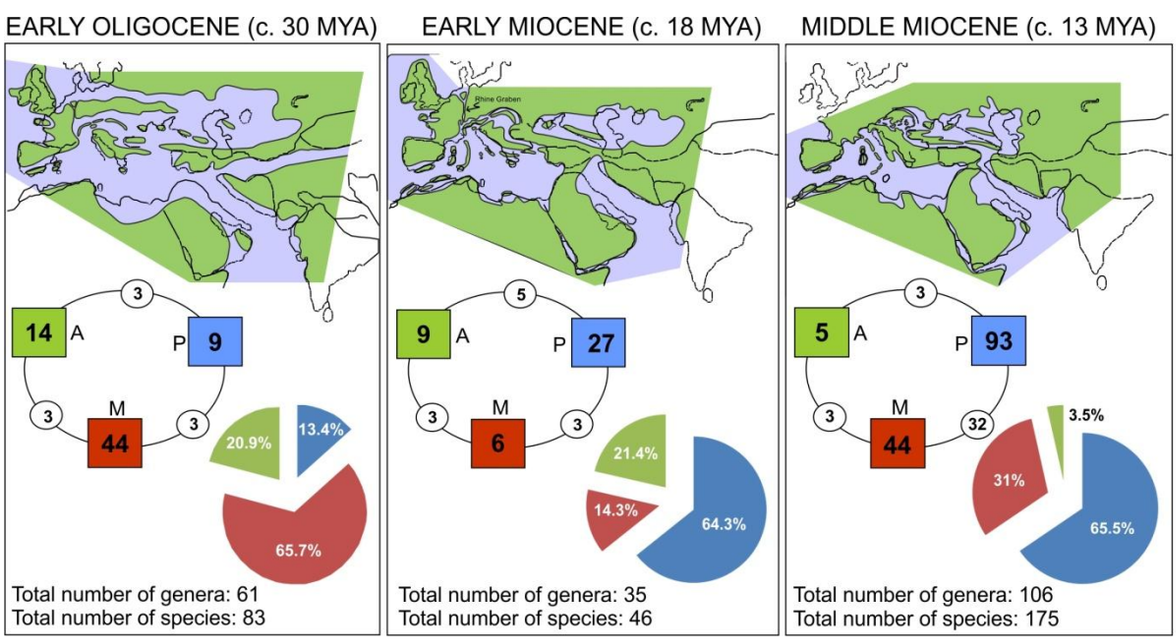

Figure 1: *Relationships between decapod faunas of the Western Tethys in selected time-slices. Number in squares represent the number of species reported from the respective area; number in circles represent the number of shared species between respective two areas. A (green) = Atlantic (including North Sea Basin); M (red) = (Proto-) Mediterranean; P (blue) = Paratethys.*

During the Early and Middle Miocene, when the Paratethys and the Mediterranean became well-separated seas, Mediterranean decapod species migrated into the Paratethys, but taxa that had evolved in the Paratethys did not spread to the Mediterranean (Hyžný in revision). The same pattern is known from other marine groups as well, such as molluscs, echinoderms or bryozoans. As a result, in the Paratethys numerous endemic species evolved by the Middle Miocene. Later, the Paratethys shrunk and transformed to a lacustrine system – Lake Pannon – which hosted the last remains of the marine decapod faunas approximately 10 million years ago, as suggested by indirect evidence of their fossil burrows. Today the IWP is considered a centre of diversity of decapods, particularly brachyurous crabs. However, Renema et al. (2008) argued that today's biodiversity hotspot in the IWP has its origin in the Western Tethys and that major shifts of marine faunas occurred within the last 50 million years. Decapod crustaceans do not necessarily show a simple pattern of directional migration of marine organisms from the area of today's Europe to the IWP. In future studies, a contraction of a much larger biodiversity hotspot rather than a shift should be considered as possible explanation for the patterns observed. ⬢

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POSTER

Typilobus: a catch-all genus for leucosioid crabs of uncertain affinities?

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Typilobus Stoliczka, 1871 is an extinct brachyuran genus of the family Leucosiidae. As many as seventeen species has been assigned to *Typilobus*, spanning from the Early Eocene to the Middle Miocene. The type species, *Typilobus granulosus* Stoliczka, 1871 was described on the basis of several specimens reported from the Lower Miocene of Pakistan. Since its description, numerous species have been assigned to the same genus on the basis of the carapace outline, dorsal granulation, distribution and shape of carapace regions, carapace grooves and the development of the orbito-frontal margin. Gradually, however, the concept of the genus has become rather broad and now it embraces taxa with high degree of variation in the main characters. Thus, *Typilobus* has become something like a catch-all taxon for accommodating fossil leucosioid crabs with uncertain affinities. Several authors already pointed out the heterogeneity of the genus (Vía Boada 1969: 159; Müller 1993: 10; Feldmann et al. 2011: 327). A re-evaluation of the type species, *Typilobus granulosus*, presented by Artal & Hyžný (submitted) forms the first stepping stone for the revision of all species attributed to *Typilobus* to date. Revision of *Typilobus boscoi* Vía Boada, 1959 from the Middle Eocene of Spain based on the type material and newly collected specimens exhibiting venters of both sexes allows recognition of not only a new genus but also a new family to accommodate this species (Artal & Hyžný submitted). This particular case study further strengthens the need of detailed revision of *Typilobus*. ⬢

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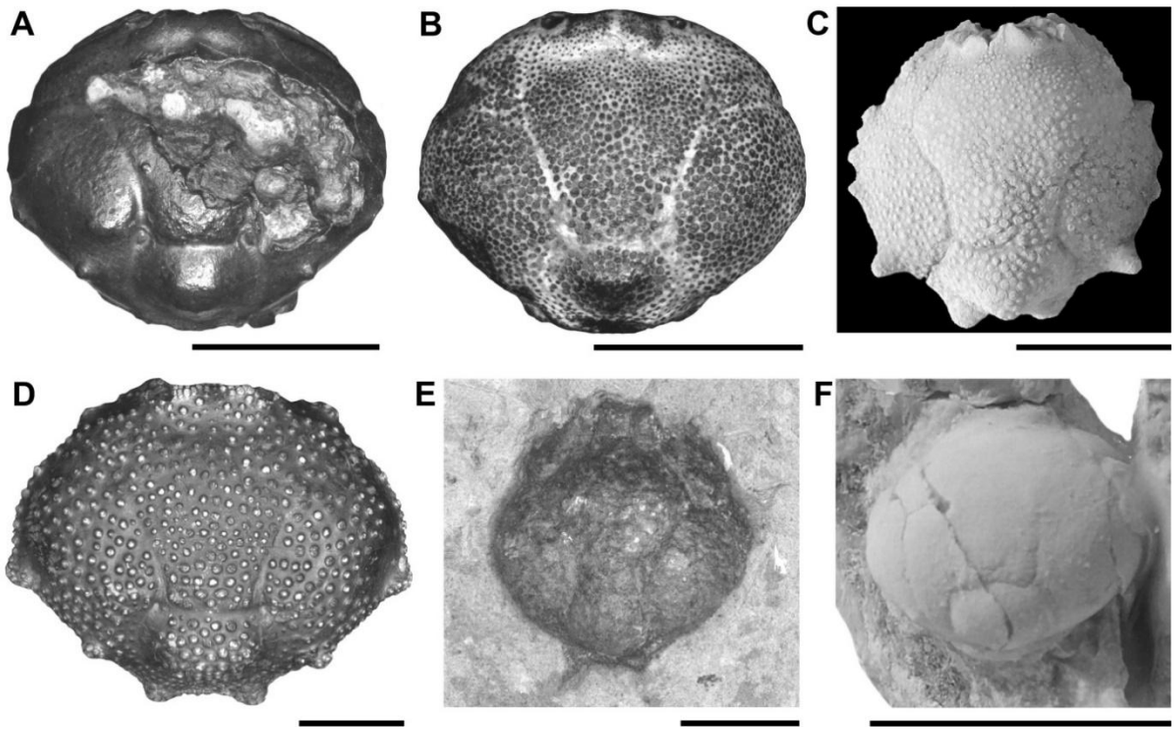

Figure 1: *Morphological variability shown on several species assigned to Typilobus. All specimens are holotypes.* ***A:*** *Typilobus granulosus Stoliczka, 1871, Lower Miocene of Pakistan;* ***B:*** *Typilobus sadeki Withers, 1925, Middle Miocene of Egypt;* ***C:*** *Typilobus boscoi Vía Boada, 1959, Middle Eocene of Spain;* ***D:*** *Typilobus marginatus Morris & Collins, 1991, Middle Miocene of Sabah;* ***E:*** *Typilobus belli Quayle & Collins, 1981, Middle Miocene of England;* ***F:*** *Typilobus moralejai Müller, 1993, Middle Miocene of Spain. Scale bar equals 5 mm.*

POSTER

Unexpected diversity of the Upper Cretaceous and Paleocene axiidean shrimps from West Greenland

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As it was in the case of *The Hobbit* by J.R.R.Tolkien, also the present project of West Greenland callianassids started with a single sentence. "Also, the numerous callianassid specimens present in the West Greenland collection still await attention" (Wienberg Rasmussen et al. 2008: p. 35). This collection resulted from a huge effort of the late Professor A. Rosenkrantz and co-workers during 18 expeditions to West Greenland in 1938–1939 and 1946–1968 (see Rosenkrantz 1970 for a summary). In the Upper Cretaceous–Lower Tertiary strata exposed at number of outcrops of the Nûgssuaq peninsula, hundreds of decapod specimens were collected. They were studied in detail by Collins & Wienberg Rasmussen (1992). Their work, however, did not include ghost shrimps, which constitute a large portion of the sample. Although Wienberg Rasmussen started sorting out the ghost shrimp material, he never finished the job due to his untimely death in 1980. After more than three decades from then the task is finally close to its completion.

Altogether, 1554 axiidean shrimp specimens were studied. They come from several different outcrops where Campanian, Maastrichtian and Danian strata are exposed. All the material is preserved three-dimensionally and in many cases retains the original cuticular surfaces. At least seven taxa have been identified, including callianassid ghost shrimps ?*Comoxianassa* n. sp. (Figs 1C–D); ?*Cowichianassa* n. sp.; *Calliaxina* n. sp.; N. gen. 1 n. sp. (Figs 1A, E); and N. gen. 2 n. sp.; axiid shrimp *Brecanclawu* n. sp. (Fig. 1B); and axianassid shrimp *Axianassa* n. sp. In several taxa, sexual dimorphism has been identified. Preservation of carapace, pleon, telson, uropods and other appendages (Figs 1D–E) allows near-complete reconstruction and direct comparison with extant taxa. Based on the Greenland material, the extinct genus *Brecanclawu* is transferred from Callianassidae to Axiidae. *Axianassa* n. sp. from the Maastrichtian of Greenland is considered the oldest representative of its family and as such it represents important calibration point for future studies on divergence points of axiidean shrimps. ⬢

The research has been supported by VEGA 02/0136/15 and European Commission's Research Infrastructure Action via SYNTHESYS Project (DK-TAF 3775).

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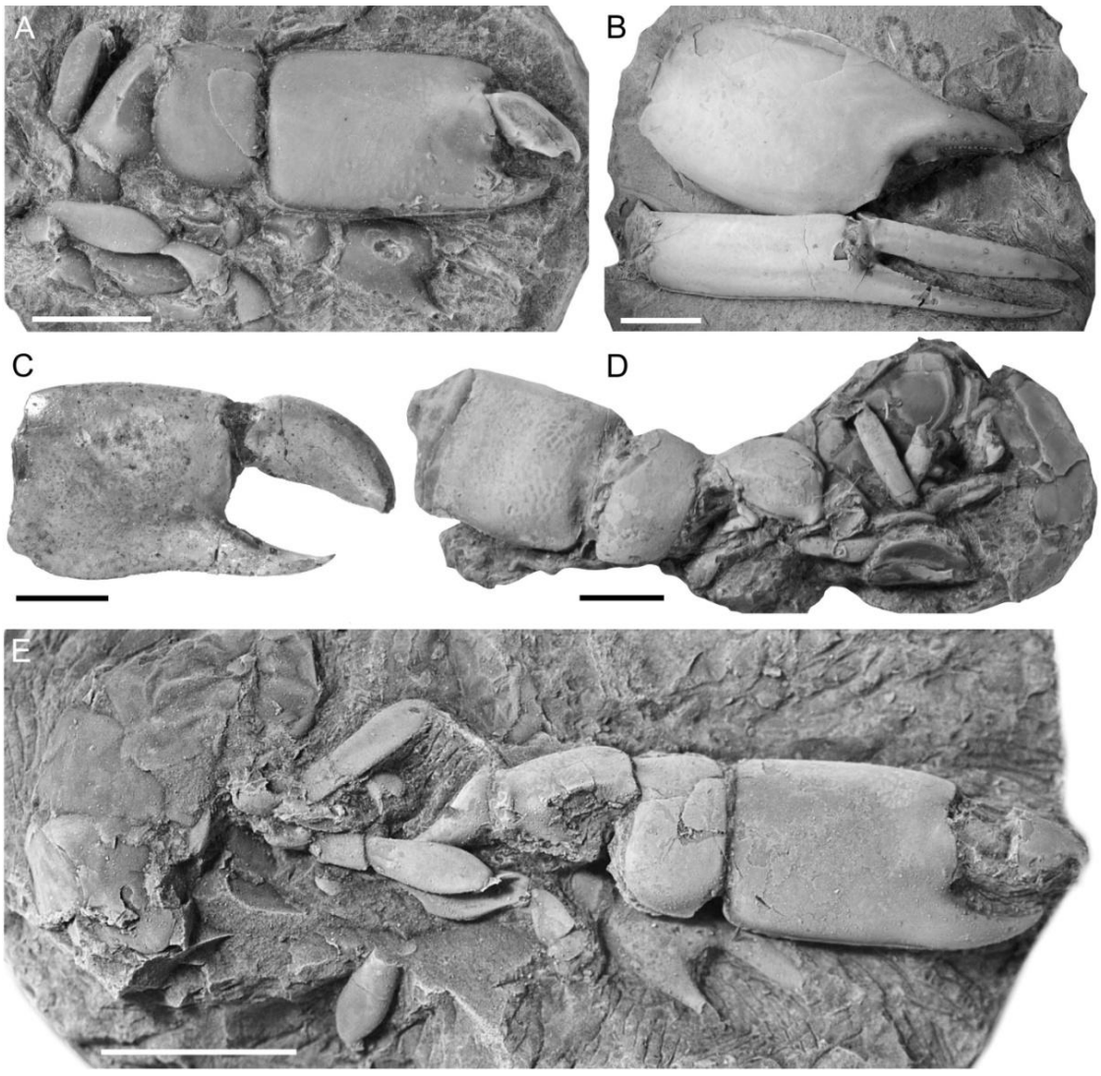

Figure 1: *Selection of the axiidean shrimps from the Upper Cretaceous of West Greenland.* ***A:*** *N. gen. 1 n. sp.;* ***B:*** *Brecanclawu n. sp.;* ***C:*** *?Comoxianassa n. sp.;* ***D:*** *?Comoxianassa n. sp.;* ***E:*** *N. gen. 1 n. sp. Scale bar equals 5 mm.*

TALK

A synopsis of Early Paleocene (Danian) crustaceans from Denmark, Sweden, and N. Germany found in glacial erractics

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The studied material comprises two long-ranging species, *Caloxanthus ornata* (von Fischer-Benzon, 1866) and *Dromiopsis elegans* Reuss, 1858, which occur abundantly in the early Danian bryozoan layer (also called the crab layer) at the Danian type localities of Stevns Klint and Fakse (Faxe) Coral Limestone Quarry (e.g., Collins and Jakobsen, 1994; Jakobsen and Collins, 1997). These species also occur in the topmost Danian, mostly found in glacial erractics (e.g., Polkowsky, 2014). In addition to previously described crustaceans from Fakse, two new paguroids (chela) and two new lobsters will be presented: *Oncopareia* sp. and *Homarus* sp. From the late Danian, primarily sourced from glacial erractics, the following new taxa will be presented: raninoids, a galatheoid, a necrocarcinid, a stomatopod, *Hoploparia* M'Coy, 1849, *Linuparus* White, 1847, and a few undescribed ghost shrimps. The material studied is deposited in the collections of the Geological Museum, Copenhagen, Denmark; Lund University, Sweden; and additional material is housed in private collections. ⬢

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TALK

Virtual dissection and lifestyle of a 165 million-year-old female polychelidan lobster

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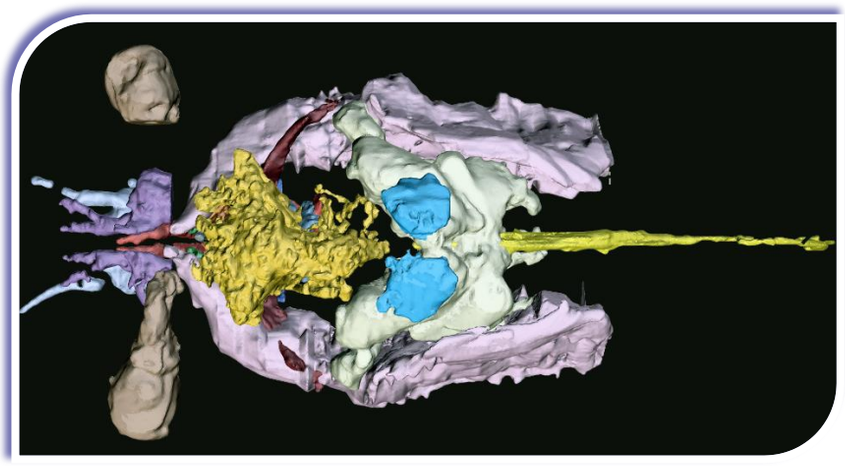

Voulteryon parvulus
Internal organs

Polychelidan lobsters are fascinating crustaceans that were known as fossils before being discovered in the deep-sea. They differ from other crustaceans by having four to five pairs of claws. Although recent palaeontological studies have clarified the systematics and phylogeny of the group the biology of extant polychelidans and first of all their anatomy are poorly documented. Numerous aspects of the evolutionary history of the group remain obscure, in particular how and when polychelidans colonized the deep-sea and became restricted to it. Surprisingly, the biology of extant polychelidans and anatomy of all species, fossil and recent, are poorly documented. Here, X-ray microtomography (XTM), applied to an exceptionally well-preserved specimen from the La Voulte Lagerstätte, reveals for the first time vital aspects of the external and internal morphology of *Voulteryon parvulus* (Eryonidae), a 165-million-year-old polychelidan: 1) its mouthparts (maxillae and maxillipeds), 2) its digestive tract and 3) its reproductive organs. Comparisons with dissected specimens clearly identify this specimen as a female with mature ovaries. This set of new information offers new insights into the feeding and reproductive habits of Mesozoic polychelidans. Contrasting with other Jurassic polychelidans that lived in shallow-water environments, *V. parvulus* spawned in, and probably inhabited, relatively deep-water environments as do the survivors of the group.

POSTER

Documentation techniques for fossil leucosioid crabs

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Although the process of carcinization (brachyurization) involves flattening of the carapace, not all crabs necessarily have flat carapaces. A good example is leucosioid crabs typically exhibiting strongly vaulted or globular carapace. An attempt to document characters of such carapaces may prove troublesome. The presence of the high-relief features, including tubercles and spines, further complicates the task to produce truthful depiction of studied material. Without particular low-angle lightening, most of these features appear completely flat in normal photography. While using ammonium chloride to whiten the studied specimens prior the photography can help to emphasize certain morphological features, it can also "create" artificial tuberculation if not applied carefully (Hyžný et al. 2016: figs 5B–C). Moreover, using ammonium chloride requires low-angle lightening causing undesired comparatively darker areas in the final image, especially when photographing highly vaulted carapaces of leucosioid crabs. In such a case, installing more light sources may not solve the issue completely. To present as much information about the general morphology of leucosioid crabs as possible, we suggest a combination of HDR (High Dynamic Range) and 3D anaglyph photography. For HDR photography we used auto-bracketing feature available in

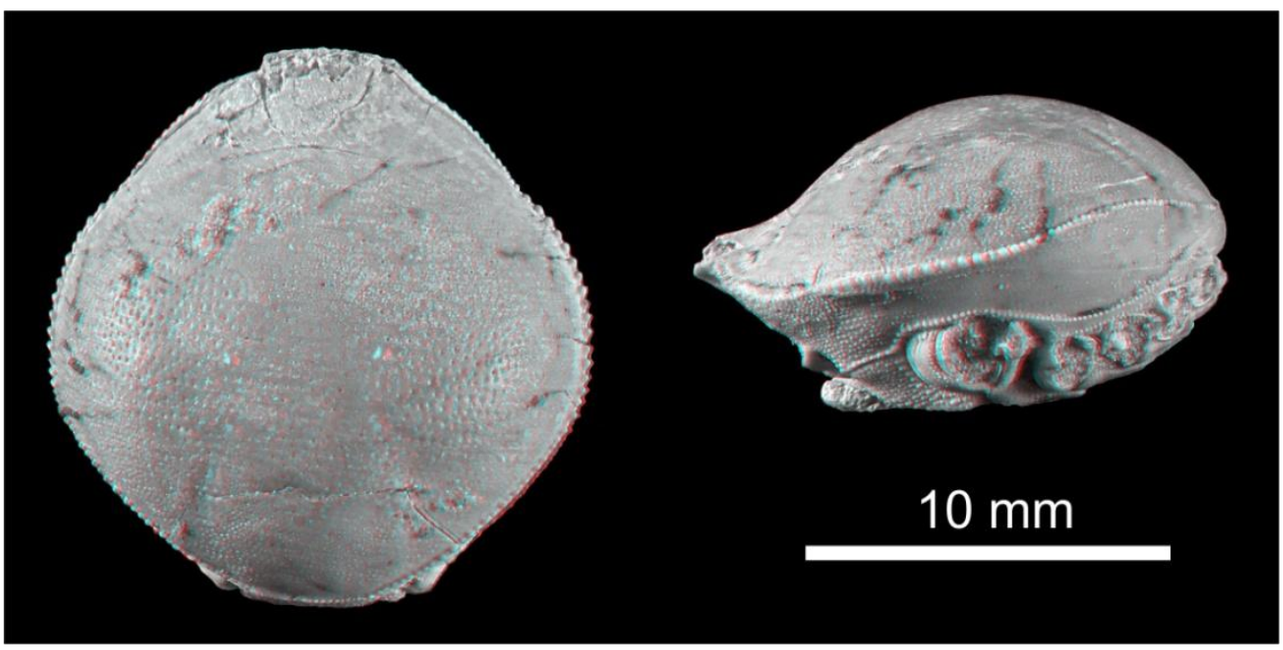

Figure 1: Red-cyan stereo-anaglyph images (use red-cyan glasses to view, red left, cyan right) of *Philyra* s.l. sp. from the Miocene of the Mishan Formation (Iran): dorsal view (left) and lateral view (right).

many digital cameras. In this method different parts of the specimen are photographed with different shades resulting from a different amount of light they receive. Merging these pictures to produce HDR (High Dynamic Range) images is possible using various photo-editing and/or graphical programs. For Anaglyph 3D photography, the specimens are recorded as stereo pairs; half pairs are then assembled to red-cyan anaglyphs. In such a way the globular shape of the leucosioid carapaces can be documented more accurately than the traditional photography which smoothes the high-relief. It should be noted that the documentation methods discussed above are not new to scholars dealing with crustaceans. In fact, there are numerous works by C. Haug and J.T. Haug emphasizing usage of these methods (e.g., C. Haug et al. 2009, 2011, 2013; C. Haug & J. Haug 2014), although they did not discuss the advantages of 3D imaging in studies of leucosioid crabs.

Every method has its pros and cons. Therefore, we would like not to abandon good methods already proved by time (i.e., using ammonium chloride), but rather emphasize the need of applying additional methods to supplement "traditional" photographic documentation. Leucosioid crabs with their globular carapaces are good candidates for such an integrative approach. ⬢

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TALK

Fossil decapods from Panama, other Western Atlantic and Eastern Pacific regions, and the closure of the Isthmus of Panama

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Ferdinand de Lesseps
1805-1894

Fossil decapod crustaceans are known from Panama since Bouvier (1899) described a Miocene crab. Subsequent substantial contributions were made by Rathbun (1918) and much later by Todd and Collins (2005). Both Rathbun (1918) and Todd and Collins (2005) also contributed to the knowledge of fossil decapods from neighboring Costa Rica. Field work in Panama, especially near the Panama Canal Zone, by members of the Panama Canal Project (funded by the National Science Foundation Partnerships for International Research and Education) and the Smithsonian Tropical Research Institute, and reexamination of existing collections has fuelled new interest in fossil decapods from Panama. Recently, peer-reviewed articles were published on ghost shrimps and some co-occurring brachyurans were also mentioned (Hyžný et al., 2013; Klompmaker et al., 2016). In addition, ongoing work on fossil decapods from Panama was presented at various conferences (Portell et al., 2012; Klompmaker et al., 2015; Luque et al., 2015; Robins et al., 2015). A compilation of fossil decapods from Panama, Costa Rica, and other regions based on existing literature and new records based on field work and museum collections has resulted in a large species-level occurrence database with the goal to document paleobiogeographic and diversity patterns throughout the Cenozoic. This is especially interesting for this part of the world because of the closure of the Isthmus of Panama during the latter part of the Cenozoic. This resulted in the separation of decapod communities on both sides of the landbridge ending the migrations from the Atlantic into the Pacific and vice versa through the open seaway. The effect of this closure on decapod crustaceans has not been investigated in great detail, although Todd and Collins (2005) briefly discussed the topic. The new database allows us to assess paleobiogeographic and diversity patterns much more extensively. ⬢

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TALK

A Middle Jurassic (Bajocian) dromiacean crabs expansion – their stratigraphical distribution and paleoenvironmental preferences

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The Jurassic and Cretaceous fossil record of Homolodromioidea superfamily is almost continuous (comp. Karasawa *et al*., 2011, fig. 13) except between the Early Jurassic (Late Pliensbachian) occurrence of the first true brachyuran crab (*Eoprosopon klugi* Förster – Förster, 1986; Schweitzer & Feldmann, 2010; Haug & Haug, 2014) and next member of this superfamily which is late Early Bajocian in age [Tanidromitidae: *Gabriella lugobaensis* (Förster) – Förster, 1985; Schweitzer & Feldmann, 2009]. The Toarcian, Aalenian and the earliest Bajocian crabs are practically unknown and a gap in their fossil record between this species and the next one, an Early Bajocian *Abyssophthalmus hebes* (Von Meyer), caused that the history of the Middle Jurassic crabs is enigmatic. It inferred to fill gaps in our understanding of early phases in origin of brachyurans, and their Middle Jurassic history were represented mainly by single individuals of species up to the Late Jurassic (Oxfordian) explosion of taxa/specimens (Krobicki & Zatoń, 2008; Schweigert & Koppka, 2011; Jagt *et al*., 2015).

Such Middle–Late Jurassic evolution induced origin and increase of decapod communities after the Early Jurassic origin of brachyurans (Brachyuran Pliensbachian Origin Event – BPOE), origin of several new Middle Jurassic dromiacean homolodromioids and glaessneropsoids (Brachyuran Bajocian Expansion Event – BBEE), and finally explosion of the Late Jurassic crustaceans (including anomurans) during the Brachyuran Oxfordian Explosion Event (BOEE) which even resulted in expansion of "European" taxa to the Late Jurassic reef environments in Japan (Karasawa & Kato, 2007; Kato *et al*., 2010; see also – Schweigert & Koppka, 2011). Because of the lack of a good Toarcian-Aalenian fossil record of brachyurans, the key moment in understanding of the first step of their history was connected with BBEE when new species appeared in several, generally shallow-sea environments both in the epicratonic European basins (not numerous but diverse homolodromioids/glaessneropsoids: *Tanidromites*, *Pithonoton*, *Prosopon*, *Homolus*, and *Abyssophthalmus*, *Planoprosopon*, *Coelopus*, respectively) and southern margin of the Tethys (Tanzania: *Gabriella*). Additionally, this event has been mainly connected with Bajocian–Callovian distribution of oolitic (including Fe-ooidal) and/or bioclatic facies of shallow-water, high-energetic environments, generally outside reefal habitats (Müller *et al*., 2000; Krobicki & Zatoń, 2008; Schweigert & Koppka, 2011; Jagt *et al*., 2015), and when such bioconstructions with cryptic habitats expanded (Late Jurassic sponge/coral buildups/reefs, respectively), the BOEE took place. ⬢

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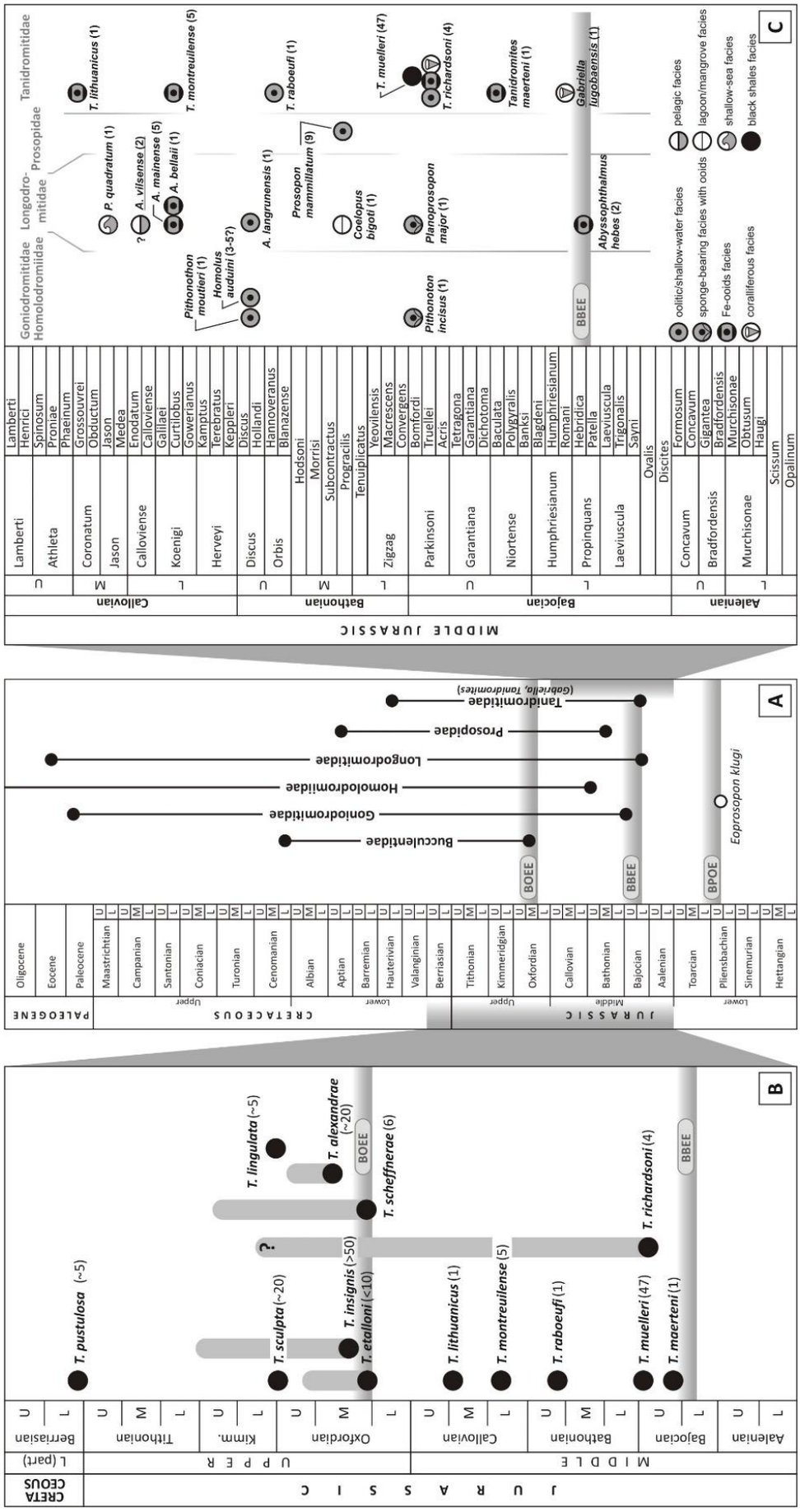

Figure 1. *Stratigraphical distribution of: A. families of the Homolodromioidea Superfamily with position of tanidromitid crabs and three brachyuran events during Early-Late Jurassic times (BPOE – Brachyuran Pliensbachian Origin Event; BBEE – Brachyuran Bajocian Expansion Event; BOEE – Brachyuran Oxfordian Explosion Event), position of the oldest brachyurans known to date – Eoprosopon klugi Förster, 1986 – with the questionable membership to the specific family ("Homolodromioidea incertae sedis" sensu Schweitzer & Feldmann, 2010; see also – Haug & Haug, 2014; Jagt et al., 2015), and stratigraphical range of families after Karasawa et al. (2011); B. Jurassic representatives of the Tanidromites genus; C. Middle Jurassic dromiacean homolodromioid crabs according to their detail stratigraphic position and paleoenvironmental preferences. Question marks indicate vulnerable position of taxa; underline – Tethys locations; number of specimens in brackets. Ammonite zonation after Callomon (2003, with some modification after Rioult et al., 1997; Mangold & Rioult, 1997; Thierry et al., 1997).*

TALK

A new species of *Bucculentum* from the Upper Jurassic of Poland (Decapoda Brachyura: Bucculentidae)

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The genus *Bucculentum* Schweitzer & Feldmann 2009 belongs to an Upper Jurassic family Bucculentidae Schweitzer & Feldmann 2009 and comprises two species, *B. bucculentum* and *B. bachmayeri*, described from Germany and Austria, respectively. Crabs of this family had characteristic augenrests shifted more dorsally than in other brachyurans and guarded by prominent spines, indicative of the benthonic mode of life.

In our previous paper (Starzyk et al. 2011) the description *Bucculentum bucculentum* from the Polish Oxfordian was supplemented and variation was described. The tubercles covering the carapaces appeared to be distributed according to a stable pattern present also in smallest specimens. Since this study to the collection next specimens have been added, which represent a new species described herein. Particularly, a reconstruction of the rostrum shows fascinating features. ⬢

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TALK

Mesozoic and Cenozoic record of decapod crustaceans in the Basque-Cantabrian basin (Western Pyrenees)

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Introduction

In recent years, the accurate study of Mesozoic and Cenozoic stratigraphic successions of the Basque-Cantabrian Basin, western Pyrenees (henceforth BCB), has allowed to draw its sedimentary history as a response to major geodynamical changes in basin evolution (e.g., López-Horgue et al., 2010). This evolution is related to the opening of the Bay of Biscay and the North Atlantic Ocean. In this context, environmental changes are directly related to factors controlling basinal changes (e. g., transgression after a subsidence change; López-Horgue et al., 2014), as well as to extrabasinal controls (e. g., global modifications in the C cycle) that conditioned the distributions of organisms and faunal turnovers. Despite the scarcity of fossil decapod crustaceans in the BCB, recent discoveries have improved the knowledge on these faunas especially on those inhabiting Albian reefal communities (e. g., Klompmaker, 2013). Twenty-two new localities with decapod remains are here presented for the first time in stratigraphical order and contextualized within environmental changes in a basin-evolution framework.

Main steps in basin evolution

At the end of the Permian a first stage of rifting marked the beginning of the BCB with the creation of areas with arid alluvial environments and a shallow marine phase for the Muschelkalk. At the latest Triassic a phase of sag subsidence led to an overall transgression. An epeiric sea with intervals of hypoxic to anoxic conditions dominated until the early Malm. A second phase of rifting started at the end of the Jurassic. Lacustrine and fluvial to coastal siliciclastic environments filled newly created tectonic troughs. A transgressive phase permitted the development of shallow marine carbonate environments during the Aptian and the retreat of coastal siliciclastics. A fast acceleration of the rifting from the late Aptian to the late Albian originated uplifted blocks with shallow marine carbonate platforms transitional to deltaic and deeper marine siliciclastic areas on troughs with submarine volcanism in the centre of the BCB. Earliest Cenomanian is marked by the beginning of a transgression that flooded continental margins. Shallow marine large carbonate ramps on basin margins transitional prevailed until the Campanian. The late Campanian to Maastrichtian interval marked the initiation of continental plate-convergence of Iberia and Europe. Fluvial to coastal and shallow marine environments advanced towards the basin centre onto a deeper marine area. The Palaeocene was a time of development of carbonate platforms in a sub-arid climate. Foreland subsidence during the Eocene marked the development of warm shallow marine carbonate ramps transitional to a deep marine flysch-trough. This phase terminated with a progressive shallowing of the BCB from the east to the west during the late Eocene-Oligocene. After inversion, small intracontinental basins on fault-bounded blocks formed during the Oligocene-Miocene, where alluvial environments and peripheral wetlands developed.

Decapoda record of the BCB and environmental assignations

New Decapoda records of the BCB are presented arranged in stratigraphical order and with reference to their localities and depositional environment. Provisionally, most of the new material is deposited in the collections of the Department of Stratigraphy and Palaeontology of the UPV/EHU. Published faunas will be taken into account in an expanded version of this work as to present an updated and more complete view of the BCB Decapoda record.

Locality	Preliminary identification	Depositional environment	Age
1	*Glyphea* cf. *muensteri* von Meyer	hemipelagic carbonate ramp	Pliensbachian-Toarcian
2	*Meyeria* sp.	fresh-water shallow lakes	Berriasian
3	*Delclosia* sp.	very shallow coastal lagoon	Hauterivian-Barremian
4	*Meyeria magna* M'Coy	shallow marine prodelta	Early Aptian
Cuchía	Callianassidae	shallow marine prodelta	Early Aptian
5	*Meyeria magna*	marine distal ramp	Late Aptian
6	Callianassidae	marine distal ramp	Late Aptian
Ajo	*Hoploparia* sp.	siliciclastic-carbonate ramp	Early Albian
7	*Joeranina* sp.	intra-platform trough	Late Albian
Egiarreta	*Cenomanocarcinus* sp.	intra-platform trough	Late Albian
8,9, 10,11	Callianassidae	prodelta	Late Albian
12	*Cenomanocarcinus* sp.	offshore siliciclastic shelf	Late Albian
13	cf. *Etyxanthosia* sp.	offshore siliciclastic shelf	Late Albian
Liencres	cf. *Hoploparia* sp.	storm-dominated ramp	Early Cenomanian
14	cf. Paguroidea	open carbonate shelf	Coniacian
15	*Graptocarcinus urbasaensis*	shallow marine carbonate ramp	Late Santonian
16	cf. Callianassidae	shoreface	Early-Middle Campanian
17	decapoda indet., brachyuran	shallow marine distal ramp	Middle Campanian
Pto. Vitoria	macrurans, *Cretacoranina* sp.	prodelta	Late Campanian
18, 19	Callianassidae	prodelta	Late Campanian
20	*Zanthopsis* cf. *dufouri*	marine carbonate offshore ramp	Late Ypresian
21	*Harpactoxanthopsis* gr. *kressenbergensis-quadrilobatus*	shallow marine carbonate ramp	Early Lutetian
22	Potamidae	fresh-brackish wetland	Early Miocene

Conclusions

-New 22 localities of the BCB with decapod crustacean remains spanning from the Lower Jurassic to the Miocene are here presented.
-New preliminary identifications for decapod crustacean taxa are also presented from these new localities and from others known in the literature.
-Although the highest diversity has been reported in shallow marine isolated reefs, decapods from siliciclastic or mixed substrates present good diversity and are widespread in the BCB, mainly in offshore environments.
-Basin and/or global scale environmental changes such as climatic, water depth, nutrient input, among others, show good correlation with some of the decapod-bearing intervals (e. g., Late Aptian to Late Albian) and with the known highest diversity in reefal communities (Klompmaker, 2013). ⬢

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TALK

Visual Systems in Brachyura shed light on early Crab Evolution

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Image-forming eyes are such a valuable adaptation that similar optical mechanisms have evolved independently in many higher taxa. But if such complex organs have evolved independently multiple times, how useful are optical mechanisms for reconstructing phylogenetic relationships? Decapod crustaceans are an ideal group to explore these questions because a) they have a good fossil record, b) they possess a great variety of optical designs, and c) details of eye form can be compared between living and fossil groups. Extant crustaceans exhibit four types of compound eyes: apposition, parabolic superposition, refracting superposition, and reflecting superposition. Each type has a distinctive external ommatidial arrangement and internal properties to focus light on the retina via different light paths. Interestingly, three of these types are known in true crabs, or Brachyura, while most crustacean clades show only one type. Brachyuran crabs are usually divided into Podotremata (basal branches where females have sexual openings on the legs) and Eubrachyura (crown group, where females have sexual openings on the thorax). Although Eubrachyura appears to be monophyletic, the monophyly of 'Podotremata' remains controversial. Significantly, 'lower' podotremes (i.e., Dromiacea and Homoloida) share the plesiomorphic condition of 'mirror' (reflecting superposition) eyes with most anomurans, lobsters and shrimps, but the optical mechanisms of 'higher' podotremes are still poorly known. To better judge the phylogenetic utility of compound eye form, we investigated the distribution of optical mechanisms in fossil and extant podotreme crabs by evaluation of external and internal features. We conclude that the secondary retention of larval apposition eyes has existed in 'higher' podotremes and in eubrachyurans since at least the Early Cretaceous, and that the distribution of eye types among brachyuran crabs supports a paraphyletic podotreme grade increasing in complexity during the Cretaceous. ⬢

TALK

Cretaceous enigmatic crabs reveal great versatility of form and rapid radiation in early brachyurans

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Evolutionary origins of hyperdiverse groups are often obscure because early fossils are rare or fragmentary, and geographic centers of diversification are poorly known. In addition, although the tropics hold much of the world's biodiversity, its fossil record is woefully limited due to enhanced rock weathering and thick vegetation. Here we describe a bizarre new crab body plan from the Cretaceous of tropical America, whose stunning degree of preservation reveals the earliest adaptations for swimming/digging via paddle-like thoracic legs in decapod crustaceans. In addition, this striking 'chimaera' retains many larval features (paedomorphosis), and bears traits seen individually in many extinct and living crabs — the most diverse group of decapod crustaceans — but never together in one organism. Its unique adaptations for swimming/digging are unmatched among arthropods, and only superficially similar to those seen in some eurypterids (sea scorpions), gyrinid beetles (whirligig beetles), raninoids (frog crabs), and portunids (blue crabs). Furthermore, our findings challenge conventional views of crab evolution by revealing repeated convergent loss of the typical 'crab-like' body form across crab lineages during the Cretaceous and Cenozoic, triggered by swimming and fossorial lifestyles. Morphological and stratigraphic data from all major crab clades reveal an immense versatility of form during the Cretaceous, when nearly 80% of higher rank crab clades have their earliest records, and suggest tropical oceans were a cradle for this diversification. ⬢

POSTER

A re-examination of the decapods fauna from the Upper Bathonian of Ranville (Calvados, France)

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Normandy is for long time a rich area that paleontologists traveled in every way since the 19th century (Eudes-Deslongchamps, 1835; Hée, 1924; Morière, 1864; Remy, 1955; Van Straelen, 1925). Many species of crustaceans have been described from that area in the past and, especially, five species of decapods were described in the Bathonian of Ranville (Calvados). Unfortunately, a great number of types disappeared because of bombings during World War II. Two authors explored Jurassic levels for 5 years looking for new specimens of decapods crustaceans. Here, we provide a synthesis about the decapods fauna found in the "Caillasse à céphalopodes de Ranville" Member from the Caillasse de Basse-Écarde Formation (Upper Bathonian) (Rioult & al., 1989). This unit is composed of bioclastic and biomicritic limestone with a very rich fauna (corals, sponges, urchins, bivalves, shark teeth…) inhabited shallow waters in a fore-reef basin.

Preliminary results highlight a clearly diverse crustacean fauna composed of pagurids which are the most frequent as isolated chelipeds ('*Pagurus bathonicus'* Remy, 1955, *Palaeopagurus* sp.), glypheids (*Glyphea* sp.) and brachyuran close to *Protocarcinus auduini* (Eudes-Deslongchamps, 1835). One of isolated brachyuran cephalothoraxes was found embedded in a burrow assigned to *Thalassinoides*. This remain is parallel to the long axis of the burrow and let suppose a hiding place for the crab. This level is also rich in *Atractosoecia incrustans* (d'Orbigny, 1850), a bryozoan species symbiotic with pagurids and encrusting gastropod shells (Buge & Fischer, 1970).

Also, the 'Surface de Lion' yielded one isopod (*Reboursia ranvillensis* Guinot & al., 2005) (Guinot & al., 2005). Finally, *Hebertides jurassica* Guinot & al., 2007 was recently referred to the Tertiary and excluded from the Bathonian of the quarry of Ranville based on the bryozoans study (Taylor & al., 2012).

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TALK

Epibioses of fossil decapod crustaceans: palaeoecological insights, new palaeosymbioses and extant record

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Interspecific associations are key events in species evolution. Hence, detection of these contact associations in the fossil record is of special interest. Fossilized epibiosis, namely organisms (-biosis) fixed on others fossil organisms (-epi), provide access to possible preserved external paleosymbiosis. Decapod crustaceans as hosts are an interesting model to document fossil epibioses and to investigate external symbiosis in a broad group over time. This study is to understand which taxa are found as epibionts on decapod crustaceans both in the fossil and extant records and what different information are revealed by fossilized epibioses.

From an examination of more than 4000 decapod crustacean specimens coming from European palaeontological collections, some sixty fossil epibiosis were detected. Focusing on some key specimens, identifications of epibionts have been performed using geochemical and organic analysis. The *post-mortem* or *syn-vivo* nature of these epibioses has been considered on the basis of taphonomic and biologic criteria covered by an actualistic approach.

The first case of palaeosymbiosis involving unicellular eukaryotes on decapod crustaceans is here described. This symbiosis corresponds to a foraminiferan-erymid lobster association found in the Upper Jurassic of Eichstätt (Germany). Three special cases involving metazoans have been studied. A bryozoans-homolodromioid crab association (Middle Jurassic, Sarthe, France) shows two colonies that differ in location and appearance. One of the colonies necessarily implies a *post-mortem* association that helped to characterize the resistance of the carapace of this very early crab. An enigmatic limpet-dromioid crab has been described from the well-known Danian deposit of Vigny (Early Paleocene, France). Among all of the possible scenarios explaining the observation, only two are biologically consistent. The crab carapace has been used as a grazing substrate when the crab was (1) alive or (2) dead. A bivalve-mecochirid lobster association from the Late Cretaceous (Isle of Wight, UK), involving this time numerous specimens, enabled a qualitative and quantitative approach. These studies indicated the *syn-vivo* nature of the association and its adequacy to the crustacean host morphology. The epibionts distribution led to hypothesize that these extinct mecochirid lobsters had a half-burrowing life habit. The first case of ectosymbiotic fossil prokaryotes has also been identified. It corresponds to a calcifying bacteria-penaeoid shrimp association recovered both from the Late Jurassic of La Voulte-sur-Rhône (France) and from extant specimens (Gulf of California, Mexico). This ectosymbiosis displays a non-homogeneous distribution on the host carapaces and rather parasitic features.

New observations together with the previously described fossil cases outlined the likely fossil ectosymbioses on decapods crustaceans and enabled their comparison to the extant ones. Very few palaeosymbiotic remains are preserved in the fossil record. Indeed, significant biases impact their fossilization. Despite the scarcity of cases, it has to be noticed that very few variations in associations seem to have occurred through time as regard to epibiotic and host taxa. Hence, at the phyla level, the decapod crustacean ectosymbioses seem to exhibit rather a lasting stability. ⬢

TALK

Sexual Dimorphism and Ontogeny within the fossil brachyuran crabs *Falconoplax* (Chasmocarcinidae) and *Palaeopinnixa* (Hexapodidae) from the lower Miocene Culebra Formation of Panama

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Modern decapods are well-known for displaying sexually dimorphic and ontogenetic characteristics. Within the fossil record, however, ontogeny and sexual dimorphism are poorly studied; many fossil species are known from only a few specimens. Recent, focused, collecting of fossil decapods within new exposures of the mudstones of the lower Miocene Culebra Formation of the Panama Canal expansion zone have resulted in hundreds of carapaces of two species of crabs – *Falconoplax kugleri* Van Straelen, 1933 and *Palaeopinnixa prima* (Rathbun, 1918). These crabs are typically 9-20 mm wide, and are often preserved articulated (i.e., legs, claws, and abdomen/sternum intact, with occasional eyes preserved). The exceptional preservation of these crabs presents a rare opportunity to complete a population study, focusing on ontogeny and sexual dimorphism.

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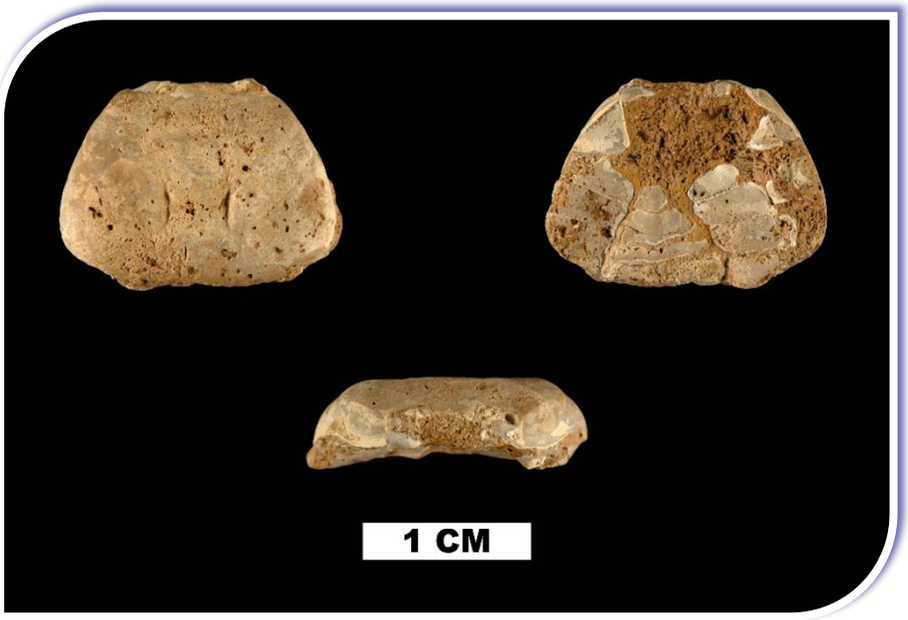

Figure 1. Shown here is a female specimen of *Falconoplax kugleri*, UF 219736. This specimen does not have pereiopods or appendages preserved; however, preserved eyestalks are visible in the dorsal view photo.
Photo courtesy of FLMNH staff.

TALK

Following the steps of Hermann v. Meyer: a newly collected brachyuran fauna from Late Jurassic sponge–microbial limestones near Geislingen an der Steige, SW Germany

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In the 19th century, the renowned German palaeontologist Hermann v. Meyer (1801–1869) described numerous taxa of primitive brachyurans from Upper Jurassic limestones of SW Germany (summarized in v. Meyer 1860). These taxa have been recently revised in several papers, mainly by R.M. Feldmann and C.E. Schweitzer (see Schweitzer et al. 2010 for literature). Most of Hermann v. Meyer's material derived from siliceous sponge–microbial limestones in the eastern part of the Swabian Alb, especially from Braunenberg near Aalen-Wasseralfingen (early Kimmeridgian = late Oxfordian in Mediterranean biozonation), from the vicinity of Geislingen an der Steige (late Kimmeridgian), and from Oerlinger Tal near Ulm (latest Kimmeridgian). Meyer got his material mostly from amateur collectors, such as August Wetzler (1821–1881), a pharmacist and fossil trader. Unfortunately, a part of the original type material must be considered as lost. A statistical analysis about the relative abundance of taxa is therefore impossible for his material. Moreover, in many cases we do not even know the exact localities nor the stratigraphic horizons, from which the material was collected. Some historical localities are not accessible any more. Only the scientific excavation of a single site in Franconia (Biburg; early Kimmeridgian = late Oxfordian in Mediterranean biozonation) by the 'Bayerische Staatssammlung für Paläontologie und Geologie' (Munich) in 1980 has provided statistically sufficient data concerning the abundance and diversity of crustaceans within spongiolithic lithologies. This material was already included in the doctoral thesis of Gabriele Wehner in 1988 (see Müller et al. 2000). Rich brachyuran material from the Upper Kimmeridgian site of Nusplingen comes from an allochthoneous mudflow and is thus not representative for a true palaeocommunity, because taxa from neighboring environments could become mixed during transport. According to the rock matrix of some survived specimens, the same is true for the historical site of Oerlinger Tal.

The exact topographic and stratigraphic positions of the historical crab localities near Geislingen an der Steige are unknown. However, there exists a natural outcrop of bedded sponge-microbial limestones near the village Oberböhringen (ca. 2 km SW of Geislingen an der Steige). One of us (H.K.) has extensively sampled this site, with a thickness of ca. 2.5 m and a lateral expansion of ca. 25 m, for several years. The lithology of the rock matrix is a poorly sorted peloidal packstone, strikingly similar to the Franconian 'Treuchtlingen Marble'. The rich and diverse ammonite fauna yields e.g. *Taramelliceras compsum* (Oppel), *Taramelliceras pseudoflexuosum* (Favre), *Streblites weinlandi* (Oppel), *Ochetoceras canaliferum* (Oppel), *Physodoceras acanthicum* (Oppel), *Sutneria hoelderi* Zeiss, *Orthaspidoceras lallierianum* (Orbigny), and *Nebrodites* cf. *planicyclum* (Gemmellaro), among others. This assemblage recalls an ammonite fauna reported from the early late Kimmeridgian of Mt. Crussol near Valence (Ardèche Mts., France; Baudouin et

al. 2011). Some differences in its composition, however, point to a slightly older age of the fauna from Oberböhringen, undoubtedly located within the Acanthicum Zone. The majority of the ammonite taxa is of Tethyan origin thus indicating warm seawater conditions. Other macrofossils associated with the ammonites and crustaceans comprise small-sized bivalves, gastropods, belemnite guards, brachiopods, calcareous sponges and rare echinoderms. Siliceous sponges are abundant but cannot be extracted from the solid rock.

The studied sample of decapod crustaceans from Oberböhringen comprises 758 specimens (701 of which are brachyurans). 14 taxa of brachyurans could be identified (total number of specimens in brackets): *Goniodromites serratus* (Beurlen) (497), *Eodromites aequilatus* (v. Meyer) (65), *Laeviprosopon sublaeve* (v. Meyer) (41), *Planoprosopon thiedeae* Schweigert & Koppka (30), *Nodoprosopon ornatum* (v. Meyer) (21), *Planoprosopon heydeni* (v. Meyer) (15), *Planoprosopon dumosum* (Wehner) (14), '*Abyssophthalmus*' *mirus* (Moericke) (7), *Laeviprosopon punctatum* (v. Meyer) (3), *Prosopon aculeatum* v. Meyer (3), *Bucculentum bucculentum* (Wehner) (2), *Tanidromites sculptus* (Quenstedt) (1), *Verrucarcinus torosus* (v. Meyer) (1), *Lecythocaris* sp. (1).

Most of these brachyurans, except for the rarest taxa, are represented by both juveniles and adults, thus indicating that they had spent their whole lifetime in this spongiolithic environment. Some of the carapaces are incompletely preserved due to fragmentation during transport prior to burial or due to predator activities. Especially the very fragile shells of *Laeviprosopon sublaeve* are fragmented. Bopyrid infections are generally rare. They occur only in *Goniodromites serratus*, *Planoprosopon thiedeae* and *Planoprosopon dumosum*.

Further decapod crustaceans of this locality are anomurans such as *Gastrosacus wetzleri* v. Meyer (52), *Gastrodorus neuhausense* v. Meyer (4), the lobster *Glyphea dietleni* Schütze (1), and a few isolated chelae and remains of articles of uncertain affinity.

The great predominance of *Goniodromites serratus* within the association from Oberböhringen – 65.6 % of the crustacean fauna – is shared with Biburg in Franconia, where this species makes up 57 % of the fauna. It is evident that *Goniodromites serratus*, which is the morphologically best-known Late Jurassic crab (Feldmann et al. 2016), was a generalist and had the broadest ecological tolerance of all taxa. However, the relative abundance and occurrence of taxa within the fauna from Oberböhringen is fairly distinct from the Biburg fauna, probably due to differences both in stratigraphic age and palaeoenvironment. There was a shallowing trend in the Upper Jurassic of SW Germany, which is possibly expressed in the association from Oberböhringen by the appearance of taxa, which are otherwise mainly known from Late Jurassic coraliferous limestones (e.g. *Laeviprosopon sublaeve*, *Prosopon aculeatum*, *Gastrosacus wetzleri*). ⬢

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TALK

Brachyura during the Cretaceous: Niche partitioning, evolution, and diversity

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Diversity analysis of fossil Decapoda, based upon the compilation of Schweitzer et al. (2010) and updated through March, 2014, has shown that Brachyura experienced faunal turnover at the level of evolutionary grade beginning in the Late Cretaceous. Heterotreme crabs replaced podotreme crabs and dominated the decapod fauna into the Holocene (Schweitzer and Feldmann, 2015). Updating the database through December, 2015, indicates that similar faunal turnovers occurred within the podotreme crabs and the heterotreme crabs as families replaced one another through time and within environments. Environmental analysis follows methods of Schweitzer and Feldmann (2014, 2015).

The least derived crabs, the so-called podotrematous crabs, reached their peak in generic level diversity in the early Late Cretaceous (Schweitzer and Feldmann, 2015). This polyphyletic group reached its highest proportion of the decapod fauna at nearly the same time, in the late Early to Late Cretaceous (Albian-Cenomanian), when they dominated the entire decapod fauna by percentage. Each clade within the podotreme crabs displays distinctive environmental preferences as inferred from the enclosing rock.

Homolodromioidea is the earliest occurring group within Brachyura and among the podotremes. It is found almost entirely in carbonates, often associated with corals and sponges in Jurassic rocks. Notably, the sole extant family, Homolodromiidae, embraces the earliest known brachyuran, from the Pliensbachian, which is known from siliciclastics.

As the homolodromioids declined in abundance through the Early Cretaceous, the dromioids increased in abundance. Among the dromioids, the extant Dynomenidae and Dromiidae inhabited carbonate and reef environments beginning in the Early Cretaceous. It seems possible that these two families replaced homolodromioids in carbonate environments during the late Early Cretaceous.

The two extinct podotreme groups Dakoticancrida and Torynommida are almost exclusively recovered from Late Cretaceous siliciclastics. Of Homolida, most of which are extant, most inhabited siliciclastic environments during the Cretaceous, although the solely Jurassic Tithonohomolidae is known only from carbonates, usually associated with coral. The largely Cretaceous Etyoida has been recovered from both carbonate and siliciclastic environments but is rarely associated with coral.

The extant podotreme clade, Raninoida, exhibits strong evidence for niche partitioning within its included families. All of the raninoidan families with an equidimensional bauplan (Karasawa et al., 2014) and Palaeocorystidae inhabited mainly siliciclastic environments of all energy levels but also with a marked presence in carbonate environments. They did not inhabit reefs, and most were extinct by the end of the Cretaceous or had minor occurrences in the Paleogene. The extant Lyreididae first occurred in the late Early Cretaceous (Albian) and is almost exclusively known from siliciclastics. The extant Raninidae is known from every possible environment since its appearance in the Late Cretaceous (Cenomanian).

It appears from the current data that podotrematous Brachyura radiated early in carbonate and reef environments, although this hypothesis is heavily biased by collecting and rock exposure in Europe. During the Cretaceous, brachyurans rapidly radiated into all types of environments and niche partitioning seems to have led to yet another radiation in the late Early and early Late Cretaceous (Albian-Cenomanian), as the various sections occurring during the Cretaceous are recovered predominantly from certain types of environments. Extant groups primarily appeared during the Cretaceous.

Heterotreme groups began to appear during the late Early and early Late Cretaceous (Albian-Cenomanian). Dorippidae appeared at this time, and occurs in siliciclastic sediments. The extinct majoid family Prisinachidae is known from coral and high energy siliciclastics. Retroplumidae is well-represented in the Late Cretaceous, primarily in siliciclastic rocks with a few occurrences in carbonates. Portunoids occurring in the Late Cretaceous inhabited siliciclastics. Palaeoxanthopsidae in the Late Cretaceous inhabited both siliciclastics and carbonates, with only one occurrence in coral, whereas Tumidocarcinidae inhabited exclusively carbonates, but not in corals. Goneplacidae, and the sole occurrences of Panopeidae and Hexapodidae are known from siliciclastic sediments.

Overall patterns.—Heterotreme crabs first occurred primarily in siliciclastic rocks. Reefs were less widespread in the Late Cretaceous, but they were abundant in the Albian-Cenomanian when many of the heterotreme families first occurred. During the Albian-Cenomanian, many podotremes still inhabited coral reef environments. Did heterotremes evolve and radiate in the siliclastic environments, as did some later appearing podotreme groups, at the expense of lobsters, which were declining during Cretaceous time? ⬢

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TALK

Phylogenetic analysis of Jurassic Tanidromitidae and Goniodromitidae

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Numerous recent studies have focused on the phylogeny of extant Brachyura (Ahyong et al. 2007; Brösing et al. 2006; Guinot & Tavares 2001; Jamieson et al. 1995; Scholtz & McLay 2009). Studying phylogeny of the oldest, Jurassic Brachyurans is especially difficult due to the state of preservation of specimens. Although the features considered in extant Brachyurans are mostly not preserved in the fossil material, studies on phylogeny of all podotrematous crabs have been undertaken (Karasawa et al. 2011).

The present study contains all Jurassic representatives of Goniodromitidae Beurlen, 1932 and Tanidromitidae Schweitzer & Feldmann, 2008.

Goniodromitidae consist of 14 genera (Klompmaker et al. 2012) of which 6 appeared in the Jurassic. They are known from the Late Jurassic (*Cyclothyreus* – Tithonian, *Distefania* – Tithonian, *Eodromites* – Oxfordian, *Goniodromites* – Oxfordian and *Cycloprosopon* - Tithonian), except species included in *Pithonoton* sensu lato; *Pithonoton moutieri* Hée, 1924 which was found in the Middle Jurassic deposits (Schweitzer & Feldmann 2008).

There are two genera representing Tanidromitidae, both with Jurassic roots. First known representatives of both tanidromitid genera; *Tanidromites* and *Gabriella*, come from deposits dated on Bajocian: *Tanidromites richardsoni* Woodward, 1907 – latest Bajocian; *Gabriella lugobaensis* Förster, 1985 – Bajocian/Bathonian (Schweitzer & Feldmann 2009).

A relationship between families Tanidromitidae and Goniodromitidae was discussed before (Schweigert & Koppka 2011; Starzyk 2015). The present phylogenetic analysis is based on the features of the dorsal surface of the carapace, diagnostic for these families as: hepatic pits and tubercles, outer orbital spine (Starzyk 2013, 2015) and on shape and proportions of the carapace, augenrest and rostrum.

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TALK

Phylogenetic analysis of the shrimp-like decapods (Dendrobranchiata, Caridea & Stenopodidea) using fossil and extant representatives

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The highest number of documented fossil shrimp species come from the world famous Solnhofen Limestone that is Upper Jurassic in age (Tithonian, 150 M.A.). This deposit is a *Lagerstätte* in which eexceptional preservation of various animal groups can be observed, including the famous dragonfly *Protolindenia* and *Archaeopteryx*, the earliest known bird.

The two main groups of decapod shrimp are the dendrobranchiates and the carideans. Dendrobranchiates are a suborder composed entirely of shrimp-like forms that are usually recovered as the sister group to the rest of the decapods, the pleocyemates, which include true crabs, lobsters. The pleocyemates also include the carideans, an infraorder also composed entirely of shrimp-like forms, but in this case more closely related to crabs and lobsters than to dendrobranchiates. A second infraorder within Pleocyemata is also composed of shrimp like forms, the stenopodideans, though it is much less abundant and diverse than the other decapod shrimp groups for both extant and fossil forms.

Though some phylogenetic work has been done for several decapod shrimp taxa, no phylogenetic study of shrimp has included fossil forms, which can potentially offer insight for phylogenetic queries like the polarization of various characters, such as appendage formula, or carapace ornamentation. It is the intent of this study to analyze as many extinct and extant decapod shrimp species as possible in order to develop a phylogeny testing the evolutionary relationships between and among extant and extinct shrimp as well as within each of these groups. Thus far, around 60% of the fossil shrimp species from the Solnhofen *Lagerstätte* as well as at least one member of all but the rarest of the extant decapod shrimp families have been coded.

Our overarching hypotheses is that many of the currently accepted groups within the decapod shrimp, particularly to a superfamily level, will be challenged by our resulting phylogenies. We also predict that the characters related to the pereiopods will be the most significant in explaining the divergence of mayor clades.

Preliminary results do not support the status of several taxa, including most caridean superfamilies as well as the family Penaeidae. They indicate that carapace groove and spine characters are not phylogenetically significant for the fossil groups, possibly due to their poor preservation. For extant forms, however, some carapace ornamentation characters exhibit a phylogenetic signal. The appendage characters, on the other hand, seem to exhibit a high degree of consistency for most groups which could be useful for developing hypotheses of group divergence based on adaptative physiology. The results also seem to indicate that the dendrobranch general model is indeed the plesiomorphic form for the shrimp-like decapods.

Thus far, fossil specimens have been observed from various US Collections: The United States National Museum, Smithsonian Institution; the Carnegie Museum; and The Lauer Collection (a private collection in Chicago, IL). Importantly, many holotypes and additional specimens of Solnhofen shrimp taxa were examined at the Bayerische Staatssammlung für Paläontologie und Geologie in Munich. Extant forms observed belong to the United States National Museum, Smithsonian Institution. ⬢

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POSTER

Ferroranina fritschi (Brachyura, Palaeocorystoidea) from the Coniacian claystones of Březno locality in the Bohemian Cretaceous Basin, Czech Republic

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The Coniacian sediments of the Březno Formation are comparatively rich in decapod crustaceans, and represent the most diverse assemblage reported from the Bohemian Cretaceous Basin. Well-preserved material is slightly flattened in very fine-grained calcareous claystones, allowing preservation of poorly calcified exoskeleton parts (Hyžný et al. 2014). The occurrence of palaeocorystid crabs in the Bohemian Cretaceous Basin is restricted to the Coniacian claystones of Březno locality. The material is represented only by a single, well-preserved dorsal carapace preserving cuticle but lacking chelipeds or other appendages. The first report was by Fritsch (1893) who illustrated and named the specimen as *Palaeocorystes*? sp. Later, Glaessner (1929) redescribed this original as *Notopocorystes fritschi*, transferred by Mertin (1941) to *Notopocorystes* (*Cretacoranina*) *fritschi*. Since Tucker (1998) considered the generic status of *Cretacoranina*, the designation of *Cretacoranina fritschi* has been adopted by several authors (Waugh et al. 2009, Klompmaker 2013, Hyžný et al. 2014, Karasawa et al. 2014). However, based on

Figure 1. *Ferroranina fritschi* (Glaessner, 1929) from the Coniacian claystones of Březno locality.

a revision of Palaeocorystidae (Van Bakel et al. 2012), the studied specimen shows the affinity to *Ferroranina* Van Bakel, Guinot, Artal, Fraaije, & Jagt, 2012, rather than to *Cretacoranina* Mertin, 1941 or any other palaeocorystid genus: frontal furrows on rostrum that slightly extended onto carapace, presence of distinct trilobate post-frontal terrace and medially defined cervical groove with V-shaped medial portion. These carapace details clearly point to an identification of the material as a member of *Ferroranina*. Van Bakel et al. (2012) recognized three species of the genus: *F. dichrous* (Stenzel, 1945) from the upper Cenomanian of Texas and Mexico, *F. tamilnadu* Van Bakel, Guinot, Artal, Fraaije, & Jagt, 2012 from the middle Cenomanian of India and *F. australis* (Secretan, 1964) from the Campanian of Madagascar. *F. fritschi* (Glaessner, 1929) from the Bohemian Cretaceous Basin differs clearly from others in its small size (at least three times smaller), having broader and less prominent elements of orbitofrontal margin (fissures are shorter), longer spine on the third element of orbitofrontal margin, different course of jagged line on carapace, more concave posterolateral margin and in absence of a medial carina. *F. fritschi* constitutes the fourth known member of the genus and simultaneously the first fossil record of *Ferroranina* for Europe and thus extends the previously known distribution of the genus during the Cretaceous period. ⬢

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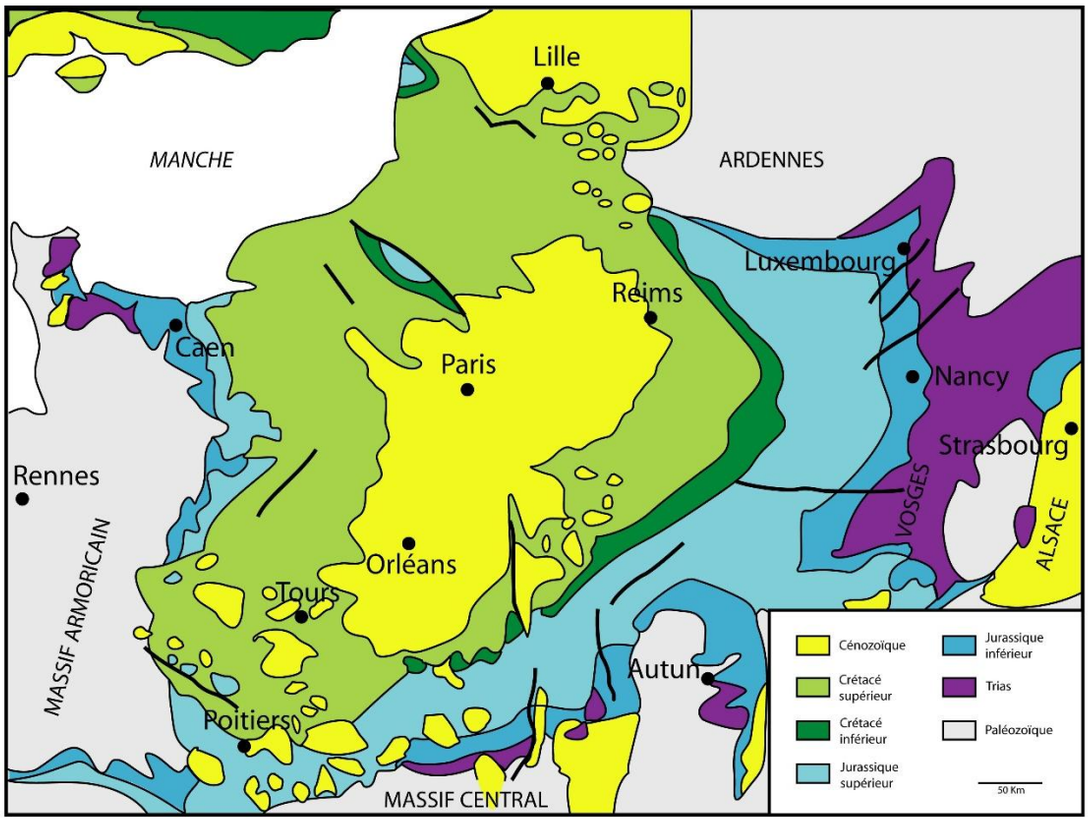
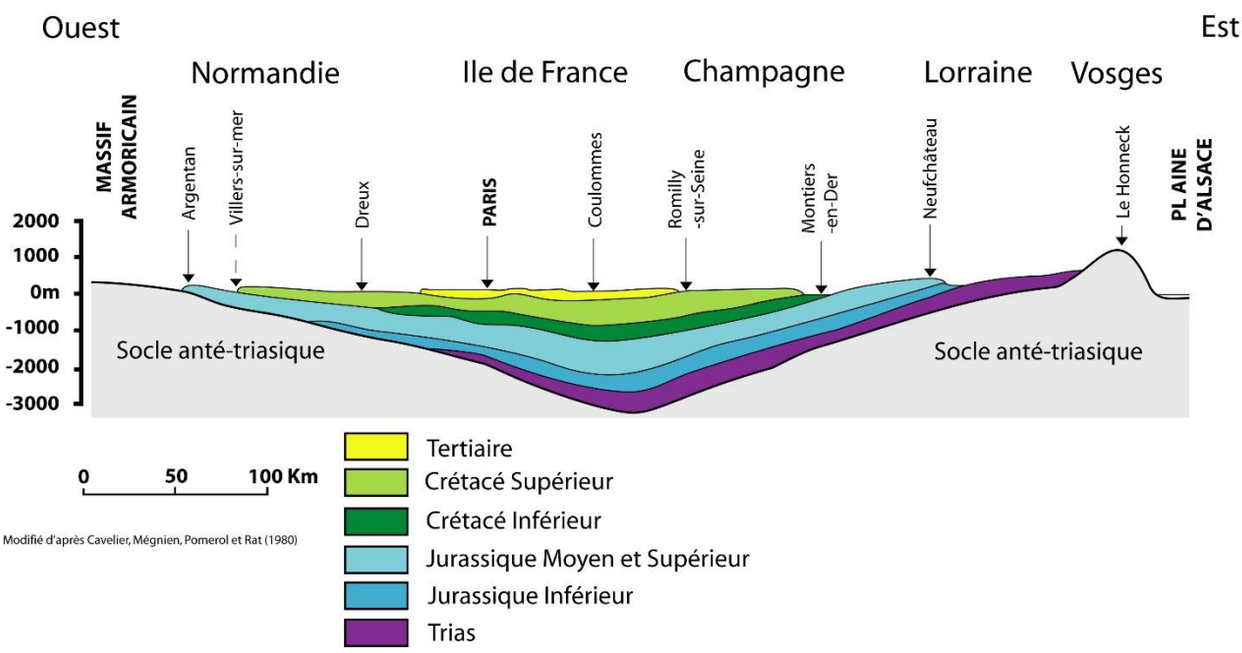


Modifié d'après http://ww.mnhn.fr
D'après la synthèse géologique du Bassin de Paris (1980) et la carte géologique de France au 1/1 000 000 ème (6ème ed., 1996)



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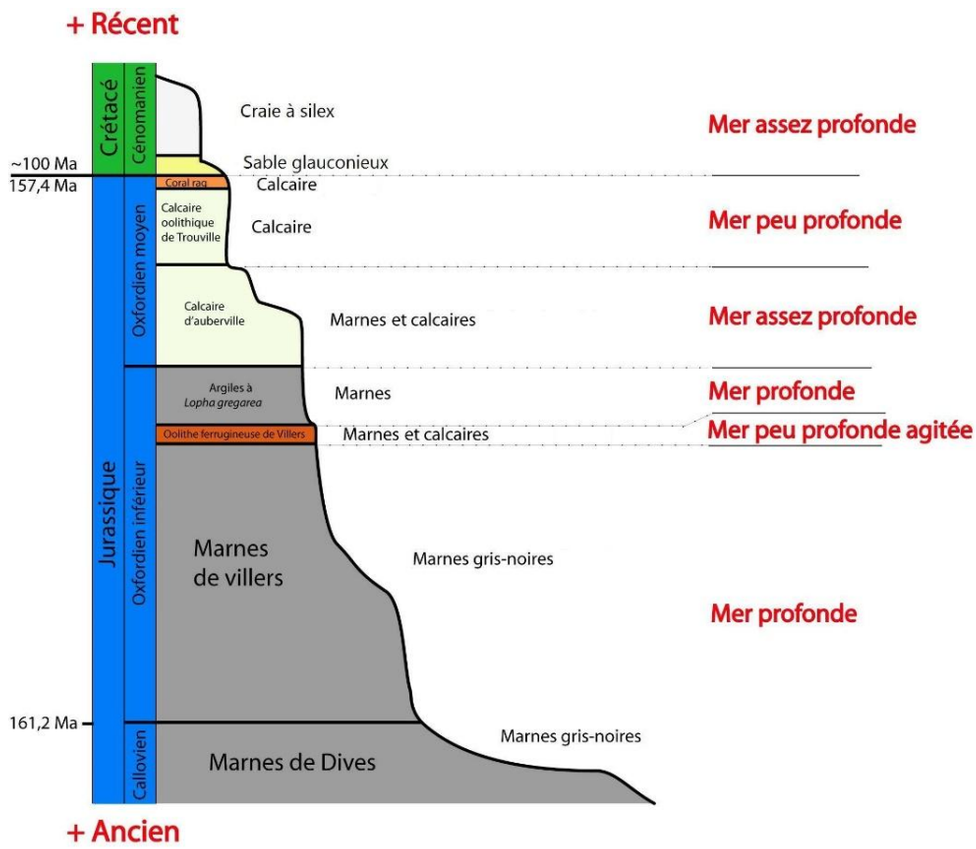

+ Récent
Crétacé
Cénomanien
Craie à silex
Mer assez profonde
~100 Ma
157,4 Ma
Sable glauconieux
Coral rag
Calcaire
Calcaire oolithique de Trouville
Calcaire
Mer peu profonde
Oxfordien moyen
Calcaire d'auberville
Marnes et calcaires
Mer assez profonde
Argiles à Lopha gregarea
Marnes
Mer profonde
Oolithe ferrugineuse de Villers
Marnes et calcaires
Mer peu profonde agitée
Jurassique
Oxfordien inférieur
Marnes de villers
Marnes gris-noires
Mer profonde
161,2 Ma
Marnes gris-noires
Callovien
Marnes de Dives
+ Ancien


8
7
6
5
4
3
2
1
Cénomanien
Craie à silex
Sable Glauconieux
Coral-Rag
Oxfordien moyen
Calcaire Oolithique de Trouville
Calcaire d'Auberville
Argiles à Lopha gregarea
Oolithe Ferrugineuse de Villers
Oxfordien inférieur
Marnes de Villers
Callovien
Marnes de Dives
Eponge (8)
Thecosmilia (7)
Isastrea (7)
Nucleolites scutatus (6)
Gastéropode (7)
Paracidaris florigemma (7)
Actinostreon (Lopha) gregareum (4)
Gryphaea (Bilobissa) dilatata (1, 2, 3, 5)
Modiolus bipartitus (3)
Rhynconelle (1)
Myophorella (5)
Euaspidoceras (ammonite) (1)

In the geologic timescale, the Bajocian is an age or stage in the Middle Jurassic. It lasted from approximately 170.3 Ma to around 168.3 Ma (million years ago).
The Bajocian stage takes its name from the Latin name (Bajocae) of the town of Bayeux, in the region of Normandy in France. The stage was named and introduced in scientific literature by French palaeontologist Alcide d'Orbigny in 1842.
The base of the Bajocian stage is defined as the place in the stratigraphic column where fossils of the ammonite genus *Hyperlioceras* first appear. A global reference profile (a GSSP) for the base is located at Murtinheira, close to Cabo Mondego in Portugal. The top of the Bajocian (the base of the Bathonian) is at the first appearance of ammonite species *Parkinsonia convergens*.

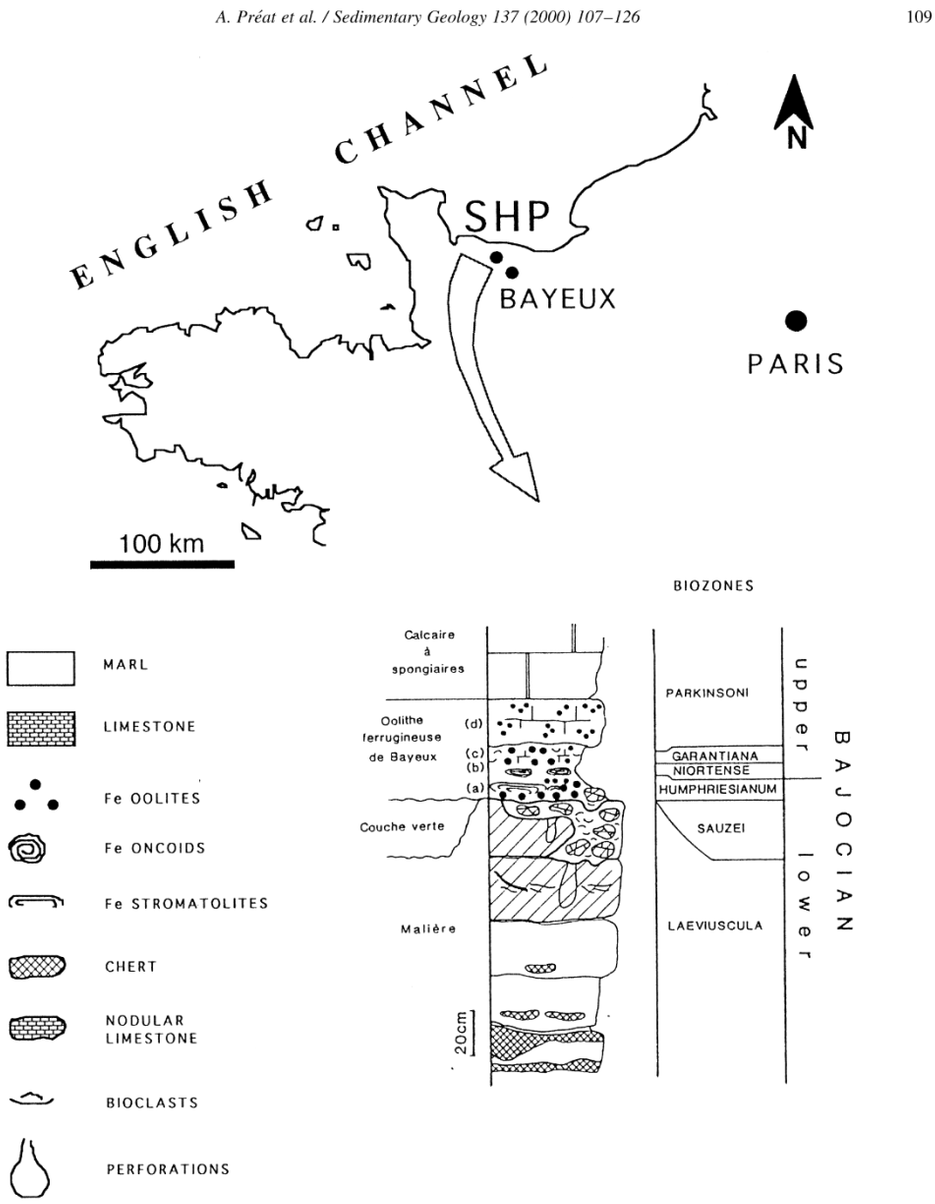
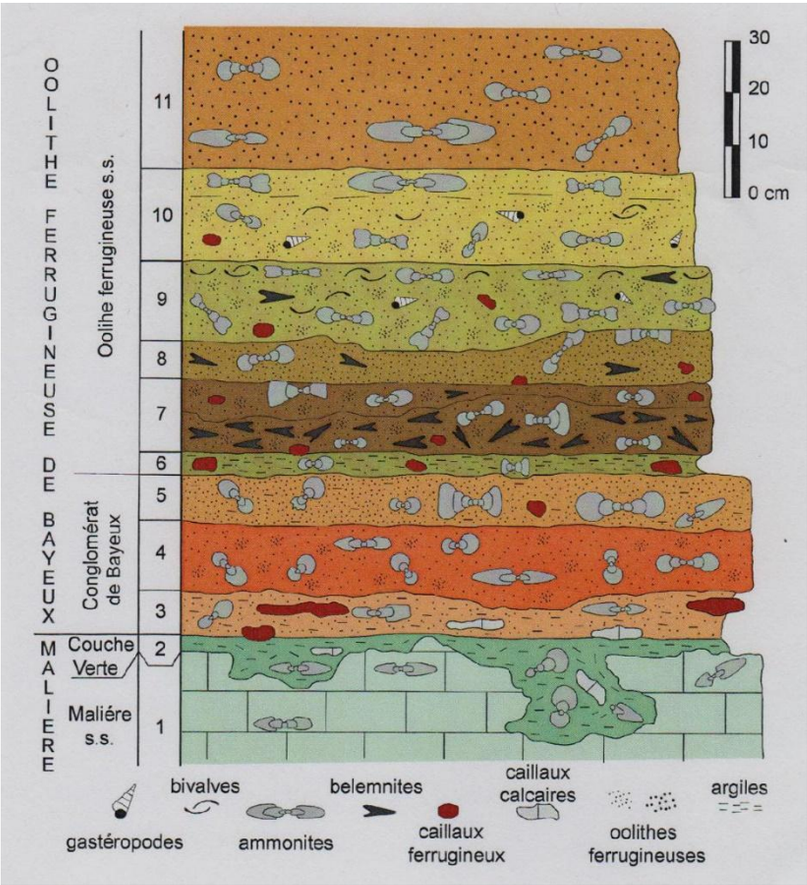
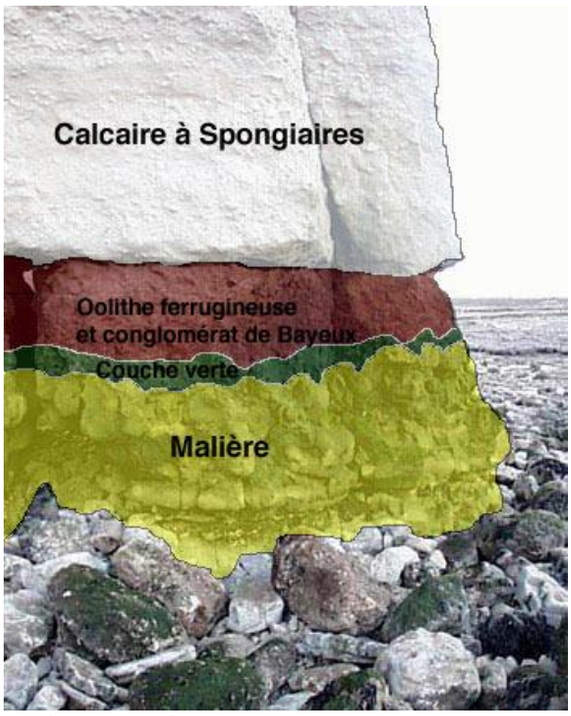


Fig. 1. Geographical location of the stratotype of Sainte-Honorine-des-Pertes (SHP), lithologic log and stratigraphic interpretation based on ammonite zonation (after Rioult et al. (1991)). The Oolithe ferrugineuse de Bayeux Formation is composed of beds a, b, c and d (see text).





http://www.etab.ac-caen.fr/discip/geologie/mesozoi/bajocien/bajocien.htm

Sainte-Honorine-des-Pertes is also known for its karst resurgence area of the Aure river. We will see the re-emergence of the Aure river (fresh water) on the beach of the town of Port-en-Bessin. At this point, the underground Aure river reaches the surface. This curious phenomenon is linked to derived waters at about 3 kilometers from the coast.