

# Evolution of Rhenish faunal communities during the Late Emsian and Early Eifelian: three reviews on sedimentation, brachiopods and bioevents

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**ABSTRACT.** Uppermost Emsian of southern Eifel Hills (Western Rhenish Massif, Germany) is recorded by the Heisdorf Formation (mudstones, siltstones, sandstones and crinoidal limestones), which shows a trend of increasing carbonate content upward. The overlying Lower Eifelian Lauch Formation (thickness ca 55 m) exhibits conformable relations. Very important guide fossils of the Emsian of the Rhenish Massif are species successions of spiriferid genera like *Acrospirifer*, *Euryspirifer*, *Brachyspirifer* etc., which all can be traced back to the Pragian (Siegenian). A remarkable innovation is the origination of *Paraspirifer* from *Brachyspirifer* in the lower Upper Emsian cancellata-elegans/Daleje Event. With *Paraspirifer cultrijugatus* and related forms, this genus has an acme in the upper Upper Emsian and Lower Eifelian. In Europe and Northern Africa, *Paraspirifer* became extinct at the end of the Lower Eifelian, but in Northern America it did not die out before the Upper Eifelian. The Emsian/Eifelian boundary can be recognised by evolutionary transition between closely related species [e.g. spiriferids of the subgenus *Acrospirifer* (*Arduspirifer*)]. There is no remarkable break or abrupt change in the fauna at this boundary, rather slightly increased background origination/extinction is shown. Three brachiopod species *Uncinulus orbignyianus* – *Paraspirifer cultrijugatus* – *Alatiformia alatiformis* indicate a very remarkable fauna called OCA Fauna. This OCA Fauna, known from many parts of the world, has well developed roots in the lower parts of the Emsian and the Pragian, but becomes abruptly extinct at the end of the Lower Eifelian. This remarkable break (end of the OCA Fauna) at the boundary between the Lauch Formation and the Nohn Formation is the most likely place for equivalents of the jugleri/Choteč Event.

Data concerning the influence of the jugleri Event on reef building organisms in the western Sauerland (Eastern Rhenish Massif, Germany) includes: *Cultrijugatus* Beds are Upper Emsian to Lower Eifelian and consists mainly of sandy silt- and mudstones with shallow marine fauna. It is proved by brachiopods, that the upper part of the *Cultrijugatus* Beds is of Lower Eifelian age. With no break, fossiliferous, marly beds of the Hobrücke Formation (without *Paraspirifer*) follows above.

The upper part of the *Cultrijugatus* Beds contains very fossiliferous coral limestones. The majority of coral and brachiopod species continued to overlying beds with no visible mass extinction by the jugleri/Choteč Event. Probably, this event was not very important for corals and stromatoporoids.

**KEYWORDS:** Emsian, Eifelian, Devonian, sedimentology, brachiopods, fauna, bioevents.

## 1. Sedimentary evolution of the Emsian and Eifelian in the southern Eifel Hills (Western Rhenish Massif, Germany)

Beds of the Pragian (~ Siegenian) and Emsian are represented in the Eifel area by terrigenous shallow water sediments of a peritidal to subtidal shelf sea. The total succession can be well subdivided following brachiopod development. With no break to the Pragian, the ca 3000 m thick Lower Emsian consists mainly of siltstones and sandstones with subordinate mudstones. The rock colour is mainly grey, with locally red beds in the basal part.

The ca 100 – 200 m thick Upper Emsian beds contain a shallow marine fauna. The Upper Emsian starts with the Emsquarzit. This quartzite marks a transgression which may be synchronous with the cancellata-elegans / Daleje Event. Sandstones, siltstones and mudstones follow above.

The upper part of the Upper Emsian consists of the Heisdorf Formation (comprising mudstones, siltstones, sandstones and crinoidal limestones), which shows a trend of increasing carbonate content to the top. With no break, the Lower Eifelian Lauch Formation (thickness ca 55 m) follows above, which can be subdivided into a lower part (= Wolfenbach Member) and an upper part (= Dorsel Member). The Wolfenbach Member is a sequence of alternating limestones, mudstones, and marls, with

rare calcareous sandstones. Beds of marls and mudstones increase in thickness towards the top. At the boundary Wolfenbach / Dorsel Member, the lithologies change distinctly from crinoidal limestones to silty sandy marls with deeply weathered ferriferous crinoidal limestones at the top. The boundary between the Lauch Formation and the overlying Nohn Formation is marked by another remarkable lithological change: The Nohn Formation starts with marls interbedded with limestones containing stromatoporoids and corals. Furthermore at the top of the Dorsel Member of the Lauch Fm. the characteristic OCA Fauna of the Heisdorf Fm. and the Lauch Fm. abruptly becomes extinct. Therefore the jugleri / Choteč Event can be correlated with the total Dorsel Member (Weddige 1988: 105–106) or with the upper boundary (Struve 1990: 261).

Generally, the Eifelian series consists of limestones and marls with subordinate calcareous sandstones and sandy marls. The total thickness is 450 – 520 m. In some parts of the Eifel Hills exists a continuous record of (± shallow) marine fauna and sediments. In other parts, there a small to big gap occurs (Struve 1982). Remarkable is the Klausbach-Event, the start of the sand sedimentation at the base of the Junkerberg Formation in the upper Middle Eifelian (Struve 1992: 503, 509–510). The Klausbach Event is interpreted as a transgression. Probably this event can be correlated with the base of the Unnenberg Sandstone in the Eastern Rhenish Massif (May 1993: 116).

The exact position of the *otomari*/Kačák Event in the Eifelian of the Eifel Hills is not known (see, e.g. Struve 1990: 261–262). Weddige (1988: 105–109) assumes a range of the event from the upper part of the Junkerberg Formation up to the top of the Freilingen Formation, but the results of May (1986: 30–33) plead for a position of the event within the middle part of the Junkerberg Formation.

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## 2. Comments on the evolution of brachiopods in the Emsian and Eifelian of the Rhenish Massif (Germany)

The Emsian and Eifelian of the Eifel Hills in the Western Rhenish Massif and the Bergisches Land and western Sauerland in the Eastern Rhenish Massif consist mainly of shallow marine deposits with a more or less large terrigenous influx. In these areas brachiopods are the most common fossil group and the most important index fossils.

Very important guide fossils of the Emsian are species successions of spiriferid genera like *Acrospirifer*, *Euryspirifer*, *Brachyspirifer*, etc., which all can be traced back to the Pragian (~ Siegenian). A remarkable innovation is the origination of *Paraspirifer* from *Brachyspirifer* in the lower Upper Emsian (Solle 1971), possibly furthered by the *cancellata-elegans*/Daleje Event. With *Paraspirifer cultrijugatus* (C.F. Roemer) and related forms, this genus has an acme in the upper Upper Emsian and Lower Eifelian. In Europe and Northern Africa *Paraspirifer* became extinct at the end of the Lower Eifelian, but in Northern America it did not die out before the Upper Eifelian (Solle 1971: 23)!

The Emsian / Eifelian boundary can be recognised by evolutionary transition between closely related species [e.g. spiriferids of the subgenus *Acrospirifer* (*Arduspirifer*)]. Recent investigations (e.g. Weddige et al. 1979; Ziegler and Werner 1982: 13–83) show, that there is no

remarkable break or abrupt change in the fauna at this boundary – only a slight increase in appearances and disappearances of guide fossils. Changes in the fauna are small and are caused, in most cases, by evolutionary transitions between related species (see, e.g. conodonts and brachiopods). In the upper Upper Emsian and Lower Eifelian, *Paraspirifer cultrijugatus* and its variants occur, with the unrelated brachiopods *Uncinulus orbignyianus* (Verneuil) and *Alatiformia alatiformis* (Drevermann), and their variants, building a very remarkable fauna called the OCA Fauna by Struve (1982: 405–406). This OCA Fauna, known from many parts of the world, has well developed roots in the lower parts of the Emsian and the Pragian, but becomes abruptly extinct at the end of the Lower Eifelian [= Lauch Formation]. This remarkable break (end of the OCA Fauna) at the boundary between the Lauch Formation and the Nohn Formation is the most possible place for equivalents of the *jugleri* / Choteč Event.

Brachiopods also give hints for the influence of the *otomari* / Kačák Event in the higher Eifelian. At the time of the boundary between Junkerberg Formation and Freilingen Formation, the spiriferids *Acrospirifer* (*Arduspirifer*) Mittmeyer 1972, *Subcuspidella* Mittmeyer 1965, *Struveina* Boucot 1975, *Vandercammenina* Boucot 1975, and *Rhenothyris* Struve 1970 became extinct (May 1986; 1989). A little bit earlier (upper part of the upper Junkerberg Formation), the *Spinocyrtia* (*Spinocyrtia*) *ostiolata* group and the *Mucrospirifer diluvianus* group appeared in the Rhenish Massif (Struve 1982: 439). These Northern American species groups document the opening of a marine connection to Northern America. Possibly this connection was opened by the transgressive *otomari* / Kačák Event.

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## 3. Data concerning the influence of the *jugleri* Event on reef building organisms in the western Sauerland (Eastern Rhenish Massif, Germany)

In the area of Meinerzhagen (Western Sauerland), Pragian and Lower Emsian continental sediments are covered by the Remscheid Formation. This Remscheid Fm. of the Upper Emsian consists mainly of siltstones and

mudstones, with a fauna showing a development from brackish lagoon to shallow marine conditions. The overlying Cultrijugatus Beds are Upper Emsian to Lower Eifelian and consists mainly of sandy silt- and mudstones with shallow marine fauna. It is proved by brachiopods, that the upper part of the Cultrijugatus Beds is of Lower Eifelian age. The Hobrücke Formation (without *Paraspirifer*) follows above conformably, starting with fossiliferous marly mudstones.

The upper part of the Cultrijugatus Beds contain very fossiliferous coral limestones. In the village of Kierspe are found: (a) Stromatoporoidea: *Schistodictyon amygdaloides subvesiculosum* (Lecompte 1951), *Clathrocoilona curiosa* (Bargatzky 1881); (b) Chaetetida: *Pachythea stellimicans* Schlüter 1885; (c) Tabulata: *Thamnopora angusta* Lecompte 1939, *Alveolites edwardsi* Lecompte 1939, *Alveolites intermedius* Smith 1933, *Squameoalveolites fornicatus* (Schlüter 1889), *Coenites vermicularis* (McCoy 1850), *Platyaxum gradatum* (Lecompte 1939); (d) Rugosa: *Cyathophyllum planum* (Ludwig 1866), *Acanthophyllum heterophyllum* (Milne-Edwards and Haime 1851), *Mesophyllum cylindricum* (Schlüter 1882). Together with the coral limestones occurs *Paraspirifer cultrijugatus*. Therefore, these beds must be older than the *jugleri* /

Choteč Event in the Lower Eifelian. With the exception of *A. intermedius*, all reef builder species are well known from sediments of Middle Eifelian, Upper Eifelian, and/or Givetian age! Possibly *Alveolites intermedius* is the precursor of the Middle Eifelian species *A. megastomus* Steininger 1849. All these species did not become extinct by the *jugleri* / Choteč Event. Probably, this event was not very important for corals and stromatoporoids.

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