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## **Review on some European, North African and North American Devonian Ostracods**

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### **Introduction on the scientific background of the project**

Ostracodes are important elements of many marine faunas throughout the entire Phanerozoic. As many beds without conodonts turned out to be rich in ostracodes, the ostracodes are a vital source of auxiliary information on palaeoecology, biostratigraphy, and palaeogeography. Due to their strong facies dependence, ostracode assemblages and diversity change with the change of water depths and sediment input which can be interpreted in terms of climate change.

During the middle of the 20<sup>th</sup> century oil exploration motivated many research project on ostracodes, but since then, the interest shifted to other microfossils such as conodonts. Thus, nowadays only few researchers are specialised on Devonian ostracodes and several important Devonian sections are known to content ostracodes, but are only little studied so far. E.g., the Middle and Late Devonian ostracodes of the Ardennes (France) are well known due to the extended studies of J.-G. Casier, B. Milhau and S. Maillet. Also well-known are the Early and Middle Devonian ostracodes from Cantabria, which have been studied during years by late G. Becker. Other areas have not been that much in the focus of Devonian ostracode research such as the Pyrenees (e.g. Sanchez de Posada et al., 2008, Dojen et al., 2009a) or the Carnic Alps (only one succession described by Bandel & Becker, 1975). Therefore, the taxonomically, geographically and stratigraphically crossovers are still small.

The aim of this long-term project is to gather extensive data on early Devonian ostracode successions from both Laurussia and (Peri)-Gondwana as well as the in-between situated microcontinents. The comparison and correlation of these successions should provide us with a conodont-correlated ostracode zonation with interbasinal application potential, which is crucial for interpretation of a mid-palaeozoic climate change with ostracodes in a global sense.

### **Original project title**

Change in biodiversity patterns of Devonian ostracodes from Europe, North America and North Africa as indicators for the mid-palaeozoic climate change.

### **Project leaders, funding, duration**

Dojen, C., none, long-termed (various projects are included; some have been finished respectively are about to be finished).

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## Research results

For this purpose faunas have (and will be) studied especially from sections which have already been delivered ostracodes as a by-product of conodont work. Ostracodes have been provided from the Spanish Pyrenees by the J.I. Valenzuela Rios (University of Valencia), from Nevada by M. Murphy (University of California) and from Morocco by R.T. Becker (University of Münster) and by E. Schindler (Senckenberg Research Group). Further assemblages from SE Turkey have been provided by U. Mann (Research Center Jülich). Additional samples for ostracodes from the Carnic Alps have been taken, as the area has been between Gondwana and Laurussia in the Early Devonian.

### ***Dra Valley (Anti-Atlas, S Morocco)***

Within the last 5 years the research has been focussed on the Dra-Valley, where the Devonian is world-famous for its extensive outcrops incredible rich in well-preserved faunas. Early Devonian to early Middle Devonian ostracodes from various samples from sections Bou Tserfine, Rich Tamelougou and Hassi Mouf South have been studied by H. Groos-Uffenorde and C. Dojen. The results will be published soon as a joined paper with the research teams of the University of Münster and the Senckenberg Institute Frankfurt.

As one incredible rich sample has been found at an important position near the Emsian/Eifelian boundary, it is in the centre of our interest. In the literature the boundary is assumed to be within or at the top of the Rich 4 Sandstone Member, but due to the lack of macrofossils it cannot be pinpointed. A newly found occurrence of large beyrichiids (*Zygobeyrichia subcylindrica*) within the overlying crinoid marls and the studied ostracode faunas favour the Early/Middle Devonian boundary the overlying Yeraifia Formation and not in or on top of the Rich 4 sandstone. The late Emsian ostracode faunas belong to the shallow water Eifelian Mega-Assemblage, whereas the Early Eifelian ostracode faunas delivered more spinose species characterising a deepening.

As regards Devonian events and their effect on ostracodes both the Kellwasser-Event and the Hangenberg-Event are studied thoroughly. However, the smaller-scale events such as the Daleje, Choteč or Kačák Event have not been studied in detail so far. Without covering the event horizons in detail, our study gives nonetheless preliminary information on the possible influence of these events on benthic ostracodes faunas in the W Dra Valley, where the Kačák-Event seems to be the most effective one. However, further studies have to include more material covering the event horizons in detail.

Palaeobiogeographically, most taxa belong the Palaeotethysian Province, but North-American taxa are also present and corroborate migration paths between both areas via N-Africa.

### ***Ardennes***

A second point of interest was focussed on the historical type-area of the Givetian (Givet, Ardennes Department, France). In cooperation with S. Maillet and B. Milhau benthic ostracodes of Middle and Late Givetian age have been studied. The stratigraphical distribution of the highly diverse assemblages shows the installation of a Givetian fauna with many endemic taxa close to the base of the Fromelennes Fm. At the top of the formation, this fauna disappears and is subsequently replaced

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with more cosmopolitan taxa with Frasnian affinities. This distribution is closely related to the major events of the Middle and Late Givetian in the Ardennes: the transgression pulse at the top of the Mont d'Hairs Fm., the global Taghanic Biocrisis and the global Givetian/Frasnian sea level rise. Climate change at the end of the Givetian possibly amplifies the effects of the sea level rise. This pattern of disappearance and replacement as early as the Late Givetian is at least a supraregional phenomenon (Maillet, Dojen & Milhau, 2013).

### **Spain**

In **Celtiberia**, the palaeoecological conditions of most of the ostracode bearing horizons are well known by the wealth of faunas as well as sediment properties. Thus, the T-R-curves are well established and are by no surprise reflected by the ostracode diversity (Dojen, 2005: Text-fig. 9.5).

From the Spanish **Pyrenees** only a first study of Early Devonian hemipelagic ostracodes is published (Dojen et al., 2009a). The study reveals a locally remarkable biostratigraphical succession, although the taxa have been only tentatively identified. Many Lochkovian conodont zones are characterized through the entry of a new ostracode species. However, studies on ostracodes from other Pyrenean sections are needed to establish a stable regional subdivision. Studies on other coeval hemipelagic ostracode faunas will show whether this subdivision can be extended or compared with other basins. Due to a missing funding the project has not been finished up to now.

### **Central Nevada (Coal Canyon Sections, Northern Simpson Park Range)**

Very little data on Silurian and Early Devonian ostracodes of central Nevada have been published in comparison with other groups of fossils. As faunal exchanges between Nevada and the Spanish Pyrenees in Early Devonian times are suggested (Dojen et al., 2009b), the study of the ostracodes discovered during the decades of conodont sampling by M. Murphy (University of California) is highly recommended for the future.

### **Turkey**

Around 2007 ostracode faunas from carbonate sequences in the Hazro area of SE-Anatolia, were discovered and handed over for study. The samples of the Dadas Fm. yield abundant ostracodes, most of them beyrichioideans of the subfamily Amphitoxotidina, which was the first report of beyrichioideans from the Arabian platform (Dojen, 2009). The occurring taxa show strong affinities to *Hemsiella*, *Macrypsilon*, and *Juviella*, which are known from the late Silurian of the Baltic-British Province. Although the samples were considered to be of Early Devonian age, it turns out that according to palynomorphs, conodonts and ostracodes the samples are more likely of late Silurian age. The faunas are of special interest, as SE-Anatolia is situated at the northern margin of the Arabian platform, which belonged to Gondwana in Palaeozoic times and thus, should not yield beyrichioid ostracodes. A proceeding of the studies with F. Luppold is planned for the next year.

Several additional studies on ostracodes from the Istanbul area have been published in the meanwhile by A. Nazik and colleagues.

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### **Carnic Alps**

Ostracodes of the Carnic Alps are of special interest, as the area was located in a key position between Laurussia and Gondwana in the Devonian. But obviously they are not silicified as within conodont samples provided by T. Suttner (Vienna Museum of Natural History) and C. Corradini (University of Cagliari) ostracodes are rare and poorly preserved. As it is highly unlikely that they should not occur in the limestone successions, samples have been taken for (hot) acetolysis and other related methods.

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### **Output:**

#### ***Published papers***

GROOS-UFFENORDE, H., DOJEN, C., ABOUSSALAM, S., BECKER T. & SCHINDLER, E. (in progress): Devonian Ostracodes from Morocco (Dra Valley, southwestern Anti-Atlas) and the Emsian/Eifelian Boundary.

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