

NOVEMBER 2011 REPORT OF TASK GROUP TO REDEFINE THE DEVONIAN-CARBONIFEROUS BOUNDARY

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Introduction

Members of the Devonian-Carboniferous Boundary task group are currently conducting research at several locations in Europe, North Africa, Russia, Asia and North America. The current work focuses on several aims, which have been defined in previous years (Richards and task group, 2010) and at the task-group workshop held during the 2010 Third International Palaeontological Congress (IPC3) in London, United Kingdom (Aretz and task group, 2011).

General activities

Following the IPC3 workshop in London, the task-group members are actively collecting data and a first synthesis of these data should be presented at a workshop in Morocco (March 25th to April 1st, 2013). Until this date no formal meeting is planned, and news and progress are presented in the usual forums (newsletters, congresses, and publications). Several members of the task group attended "The SCCS Workshop on GSSPs of the Carboniferous System - "Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China" from November 22nd - 29th, 2010. The SCCS Workshop, held in Nanjing China from November 22nd to 24th 2010 was organized by Xiangdong, Wang, Yuping, Qi, Yue, Wang and their colleagues and held at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS) in Nanjing. Of particular interest to the task-group members at the workshop was a talk given by Y. Gatovsky and L. Kononova: "Devonian-Carboniferous boundary in the FSU (former Soviet Union)" and a field trip led by Ji Qiang to examine a well-studied Devonian/Carboniferous Boundary section (Ji *et al.*, 1989) situated by the town of Dapoushang in Guizhou province. Few task-group members attended the ICCP in Perth Australia, but three contributions related to the D/C boundary were made (keynote by the task-group leader (Aretz, 2011a), poster on brachiopods by (Brice and Mottequin, 2011) and a poster on the D/C boundary in Czech Republic.

Boundary criterion

The group is currently searching for a suitable criterion for the redefinition of the D/C Boundary, currently defined (Paproth and Streel, 1984) by the first evolutionary occurrence of the conodont *Siphonodella sulcata* (Huddle, 1934) in the lineage *Siphonodella praesulcata* Sandberg 1972 to *S. sulcata*. The task group favors a position that does not change the current base of the Carboniferous too much, because stratigraphic stability is required. However, the search for a criterion is not focused on a specific fossil group or technique. During the IPC3 workshop in London, the multi-phase Hangenberg Event (Kaiser, 2005; Kaiser *et al.*, 2008) was identified as a potential level of interest. However, more data on the precise timing of phases of the Hangenberg and the correlation of the biostratigraphical, geochemical, sedimentological and sequence stratigraphical patterns within it are needed to evaluate the potential of the event for boundary definition on a global scale. In order to properly understand the Hangenberg Event, the interval to be studied should include strata below and above the event level, which can be associated with black shales in specific facies realms.

Since the problems with the conodont lineage *S. praesulcata* – *S. sulcata* and the FAD of *S. sulcata* that are used to define the D/C Boundary GSSP at La Serre were recognized (Kaiser 2005, 2009), the clarification of the lineage has been a prime task for the conodont workers (e.g. Spalletta *et al.*, 2010). Results have been published for siphonodellids (Kaiser and Corradini,

2011) and protognathodids (Corradini *et al.*, 2011). Their papers indicate that the two conodont groups probably do not contain potential index fossils for the D/C boundary. The currently used lineage represents a series of taxonomic problems and instability, which result from the diverging identification and naming of transitional forms between *S. praesulcata* and *S. sulcata*. Thus the identification of *S. sulcata* is subjective and the species is not a suitable marker for the base of the Carboniferous.

The second conodont group, which is often used as an alternative index to the siphonodellids, is the protognathodids and they show a variety of problems. They suffer from: a general rarity in many sections, regional variation in the position of the first occurrence datum, and restricted stratigraphic ranges and global distribution; in addition, their relationship to lithofacies is poorly understood. Thus, none of the four species of *Protognathodus* [*Protognathodus meischneri* Ziegler 1969, *Protognathodus collinsoni* Ziegler 1969, *Protognathodus kockeli* (Bischoff, 1957) and *Protognathodus kuehni* Ziegler & Leuteritze 1970] within the boundary interval have a high potential as an index for redefinition of the boundary.

Because the conodonts most frequently used to locate the D/C Boundary do not provide a good candidate for defining that boundary, other fossil groups need to be considered and require comprehensive analysis. Additionally, new results from the restudy of the conodonts in the La Serre section (Kaiser, 2009) show that current global correlations at the D/C Boundary level may be wrong because they rely on conodont datums, which have been identified as being problematic. Consequently, the task group has to establish new tools for correlation of the D-C Boundary and revise the global correlations.

The conodont workers of the task group continue their studies on various late Famennian-early Tournaisian sections. Data arising from their work will be incorporated into correlation charts planned at the IPC3 workshop in London.

Progress reports from members

Europe. A team of researchers from the Czech Republic is currently using a multidisciplinary approach to study the D-C boundary interval (Babek- geophysical methods, sedimentology, and sequence stratigraphy; Fryda- C isotopes; Grygar- element geochemistry; Kalvoda- foraminifers, and conodonts; and Kumpan- conodonts, geophysical logging, and C isotopes). This team is working intensively on Devonian – Carboniferous sections in the southern part of the Moravia – Silesian Basin (Central Europe, Czech Republic) ranging from the late Famennian *expansa* to the early Tournaisian *sandbergi* zones. Protognathodid faunas are rather abundant in the calciturbidite succession in the Lesni lom quarry, where the Hangenberg Event facies are developed. The specimen of *Siphonodella* found in 1986 below the Hangenberg event facies can be assigned to the *sulcata* morphotype, which underlines the problems of the biostratigraphic definition of the D/C boundary. The foraminiferal studies confirm the presence of the genus *Quasiendothyra* up to the *duplicata* Zone. Petrophysical measurements (gamma-ray spectrometry, bulk magnetic susceptibility and colour parameters /spectral reflectance in visible light) show a relatively good correlation potential within the carbonate turbiditic facies but the correlation with the nodular facies is limited. First results of carbon isotopic studies show a positive peak of $\delta^{13}\text{C}_{\text{carb}}$ in the middle to upper? *praesulcata* zones in the Lesni lom quarry. Preliminary results were presented in a poster at the International Congress on the Carboniferous and Permian in Perth. The Czech workers have extended their work to sections in Austria (Carnic Alps and Graz Palaeozoic).

Task-group member Hanna Matyja continues to work with colleagues from Poland and Germany (T. Becker, S. Kaiser) on two projects related to the D/C boundary in the subsurface of northwest Poland and in the Tian-Shan Range of central Asia. Short-term objectives of their work are the establishment of a high-resolution biostratigraphic scheme and geochemical profiles

using stable- carbon and oxygen isotopes. A longer term goal is to identify the signatures of the Hangenberg Event. Results of a multidisciplinary study of the Pomeranian Basin will be published in a Special Volume of the Geological Society of London. Task-group member D. Brice and B. Mottequin continue to study brachiopods from the boundary interval in Europe and Northern Africa.

Morocco. The working group of Thomas Becker continues their research in central and southern Morocco. Their new results and sections will be presented at a 2013 task-group workshop in Morocco.

Pre-Caspian region. Task-group member P. Brenckle continues his investigations of foraminifera in shallow-water facies of the North Caspian Basin.

North America. Task-group member Barry Richards continues his ongoing studies of the latest Famennian to early Tournaisian Exshaw Formation (Richards *et al.*, 2002) in the southern Canadian Rocky Mountains and Foothills to see if the main events in the multi-phase Hangenberg Event Interval (Kaiser, 2005), can be more precisely located in the formation with a multidisciplinary approach using stable-carbon isotope geochemistry combined with U-Pb geochronology, biostratigraphy and sedimentology. Conodont data indicate the contact between Devonian and Carboniferous strata lies in the upper part of the black shale member of the Exshaw Formation at its type section and at several other localities. The position of the D/C boundary has not been precisely located in the Exshaw Formation and it is hoped evidence from stable-isotope geochemistry will more tightly constrain the position of the boundary.

China. Task-group members E. Poty and M. Aretz and co-workers continue their work on the correlation of latest Devonian to Mississippian third-order sequences in Southern China with those in Europe. The studied sections are all in shallow-water facies. First results, indicating a high correlation potential of many sequence boundaries, were presented at the International Congress on the Carboniferous and Permian in Perth (Poty *et al.*, 2011). Work on the correlations will facilitate correlations to other regions in shallow water facies.

Outlook

The work of the task group starts to become more organized. The lack of data on many fossils groups and especially the correlation of the “old” data with the new conodonts results are a constant problem and will strongly influence the future work of the task group. First of all, the task group has to continue gathering biostratigraphical, sedimentological, geochemical and petrophysical data in the next years. These data have to come from different facies and different fossil groups to insure good correlations in various facies realms and regions.

As decided at the IPC3 workshop in London, one focus should be the compilation of correlation charts for the different phases of the Hangenberg Event. However, that must not exclude or slow the work on stratigraphic ranges of latest Famennian and earliest Carboniferous taxa, because the level of the Hangenberg Event is only one possibility.

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