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Revision of the Devonian-Carboniferous Boundary in Belgium and surrounding areas: a scenario

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The Devonian-Carboniferous Boundary (DCB) was the first chronostratigraphic boundary to be officially and globally defined in the Heerlen Congress in 1935. It was soon acknowledged that the definition was not suitable and a new definition was proposed 50 years later. The DCB therefore was placed at the first appearance of the conodont *Siphonodella sulcata* in the stratotype section “La Serre E” in S France (PAPROTH et al. 1991). Again, it was soon agreed that the definition and stratotype were not sustainable for taxonomic issue about siphonodellids and because the guide marker was found in older strata (KAISER 2009). Hence the DCB working group suggested to revise the definition and currently tests as new criterion a depositional event bracketed by biostratigraphy: the end of the reworking caused by the Hangenberg Sandstone regressive event immediately before the entry of the conodont *Protognathodus kockeli*.

The DCB is associated with a major extinction event caused by a rapid but short-lasting change in deposition and eustasy called Hangenberg Event. In the Namur-Dinant Basin the latest Devonian (“Strunian”) deposits recorded a 3rd-order transgression that produced a progressive change from coastal siliciclastic to proximal mixed deposits with an increase of the carbonate content on the ramp. Hence the Comblain-au-Pont and lower Hastière formations are regarded as the transgressive systems tract whereas the middle member of the Hastière Fm is interpreted as the highstand systems tract, capped by an erosion surface corresponding to this 3rd-order sequence boundary (top of sequence 1 in HANCE et al. 2001). Superimposed to the 3rd-order sequences are well-marked orbitally-forced precession cycles (wet-dry climate alternations) of c. 18.6 ka, appearing as irregular c. 40 cm thick couplets of limestone and calcareous shale beds (POTY 2016). A holistic revision of classical and less classical sections exposing the DCB in southern Belgium was recently performed in order to test the new criterion for the redefinition of the DCB.

The Hangenberg Black Shale Event is locally recorded as dark shale that likely spread on the shelf and marks the maximum flooding surface of sequence 1. Before and after this event, carbonate facies rich in benthic macro- and microfauna continued to develop. The Hangenberg Sandstone Event, recorded as a sandstone bed in pelagic sections, is variously recorded at the base of the Hastière Fm, either as a sandy siltstone bed in proximal sections, or as a horizon with limestone clasts and reworked fossils in more distal ones. The Hangenberg Sandstone event beds occur sharply in the stratigraphic record and do not correspond to the long sea-level fall of a 3rd-order sequence boundary, but most probably to a short out-of-sequence event (POTY 2016).

The revision of the stratigraphic distribution of major fossil groups led to the demonstration of a continuous biostratigraphic succession of foraminifers and palynomorphs with no obvious hiatus in neritic settings. The variable development of some micropalaeontological biozones that were often described as evidence for depositional hiatuses (e.g., VAN STEENWINKEL 1990) are nowadays regarded as the environmental signature of stratigraphy (eco-biostratigraphy). The LN palynozone has been demonstrated to be an ecozone based on occurrence of strongly environment-related markers and consequently included in the LE zone (PRESTIANNI et al. 2016). The DFZ8 foraminifer zone is re-interpreted as a facies-related variation of the basal Tournaisian MFZ1 (POTY 2016) and is clearly post-Hangenberg Sandstone Event according to the contemporaneous fauna (rugose corals, conodonts) and correlated by sequence stratigraphy above the DCB.

The base of the Carboniferous is marked by extinctions of Devonian taxa, concomitantly with the end of the reworking produced by the Hangenberg Sandstone Event just below the entry of the conodont *P. kockeli*. It is also coincident with the boundary between the foraminifer zones DFZ7–MFZ1 and palynozones LE–VI that both see the extinction of Devonian taxa. After the short-lasting regressive phase of the Hangenberg Sandstone Event, normal settings returned with the deposition of the Hastière Fm. Hence it is proposed as the most natural Devonian-Carboniferous Boundary.

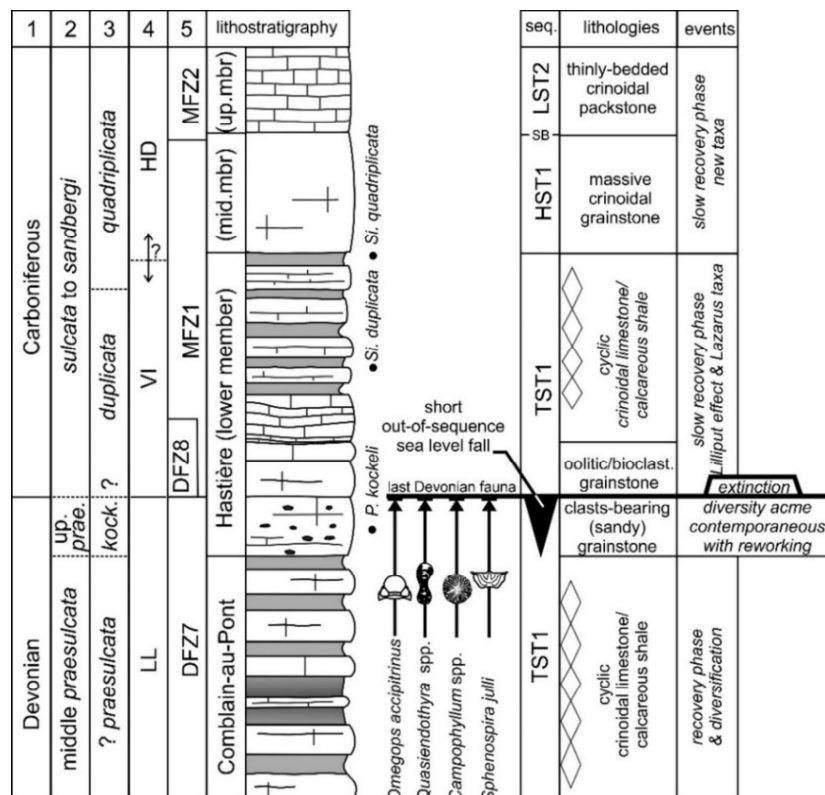


Fig. 1: Synoptic succession of depositional and biotic events across the Devonian-Carboniferous Boundary in S Belgium. 1. Chronostratigraphy. 2. Standard conodont zones. 3. Revised conodont zones sensu KAISER (2009). 4. Miospore palynozones emended by PRESTIANNI et al. (2016). 5. Foraminifer zones emended by POTY (2016), seq.: 3rd-order sequence systems tracts (HST: highstand systems tract, LST: lowstand systems tract, TST: transgressive systems tract, SB: sequence boundary).

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