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Devonian-Carboniferous boundary in Europe - a multidisciplinary approach

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Elemental geochemistry of fourteen carbonate-dominated strata proved to be an excellent correlative tool in shallow- to deep-water marine settings close to the D/C boundary. Particularly useful correlative proxies included detrital elements as Al, Rb, K and Zr, their ratios as well as computed gamma-ray values (based on K and Th concentrations) from field gamma-ray spectrometry. Magnetic susceptibility doesn't show clear correlative patterns. The most distinct correlative horizon is the Hangenberg event *sensu lato* (HBE; including the Hangenberg black shales, gray shales and sandstones of the *costatus-kockeli* interregnum), which was associated with increased detrital influx into oceans inferred from the detrital element proxies. Sediment accumulation rates (normalized to terrigenous Al_2O_3) substantially increased even in the most distal pelagic depositional settings indicating a strong continental influence on marine realms during the entire HBE. The black shales including associated positive geochemical anomalies ($\delta^{13}C$, U_{GRS}) sometimes overlap with the entire HBE s.l. interval (Kronhofgraben section of Carnic Alps) but more often develop at its base (Rhenish Massif) or they are not present at all (Pyrenees - Saubette, Grüne Schneid of Carnic Alps, Montagne Noire, Moravia). We therefore assume that the deposition of the black shales represented only a local manifestation of the global detrital HBE event. Contrary to previous interpretations, the Hangenberg black shales did not develop due to sediment starvation during peak sea-level rise and they should not be regarded as a stratigraphic unit with isochronous top surface. The geochemical correlations between shallow-water sections with distinct facies stacking patterns and their deep-water counterparts indicate that the HBE was associated with a rapid sea-level drop (FSST to LST) followed by a sea-level still stand or minor rise and renewal of carbonate production in the *kockeli* to *sandbergi* zones (latest Famennian to early Tournaisian). No distinct sea-level rise probably occurred before the Lower Alum Shale Event in the middle Tournaisian times.

Several D/C boundary sections in the Moravian Karst shown the joint occurrence of foraminiferal and conodont fauna in earliest Tournaisian, which have important implications in tracing the extinction pattern of typical foraminiferal Famennian genus *Quasiendothyra*, crossing the D-C boundary and extending to *Siphonodella jii* conodont zone. The latest Famennian foraminiferal fauna from the Moravia compares well with the associations described in Belgium, the Timano-Pechora region and the Urals. In the early Tournaisian, the sections exhibit a unique fauna of quasiendothyrs and tournayellids (chernyshinellids, *Neoseptaglomospiranella*, *Uviella*), the representation of which

gradually increases over the course of the early Tournaisian. The Moravian conodont succession reveals a good correlation with other European areas. The *Siphonodella sulcata* morphotype (close to Group 1 sensu Kaiser and Corradini or to "nov. gen. nov. sp. 1" sensu Tragelehn) enters prior to the Hangenberg Events, which correlates well with Uppermost Famennian conodont successions from F ranconia, Bavaria and Morocco.

New position of the D/C boundary proposed by our working group is FAD of conodont *Protognathodus kockeli* (in lineage from *Pr. collinsoni*) in the first limestone bed just above the HE horizon, coinciding with a sudden drop in concentrations of K, Al, Th, Rb and other detrital proxies (CGR) and change in their ratios.

Original project title

Devonian-Carboniferous boundary in Europe - a multidisciplinary approach.

Project leaders, funding agency, duration

Kalvoda, J., Czech Science Fundation (project code P210/11/1891), 2011-2015.

Scientific background

The major aim of this project was the correlation of evolutionary changes in foraminifer and conodont faunas within the Devonian/Carboniferous (D/C) boundary interval in Europe, with a multiproxy stratigraphic analysis comprising carbon isotope geochemistry, element geochemistry and petrophysical logging (gamma-ray spectrometry and magnetic susceptibility). The studied sections included both basinal and more shallow-water depositional settings of Czech Republic (Moravian Karst), Austria (Carnic Alps), France (Pyrenees, Montagne Noire, Avesnois), Belgium (Ardennes) and Germany (Rheinische Schiefergebirge). The D/C boundary is perceived as an important step on the passage from the Devonian greenhouse to the Carboniferous icehouse global climatic regime. The high-resolution stratigraphic model will be used to better correlation between the basinal and shallow-water sequences at the D/C boundary. The project was a part of broader international effort within the IGCP 596, IGCP 580 and International Working Group on the Devonian Carboniferous Boundary (IUGS) aimed at redefinition of the boundary and reevaluation of the D/C boundary GSSP.

Output:

Published papers

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