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Multi-disciplinary research on long-term Middle to Upper Devonian fore-reef successions from Germany and Austria

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Introduction

Despite the interest for the reconstruction of environmental changes over a long period of time, long-term successions have been relatively poorly investigated, using a multi-disciplinary approach, compared to short-term intervals such as Kačák, Taghanic, punctata, Kellwasser and Hangenberg events. Recently, BOULVAIN et al. (2010) compared two km-thick Eifelian–Frasnian sections from Belgium and Czech Republic using magnetic susceptibility (MS) technique. Despite a very different context regarding palaeogeography, sedimentary rate, facies and local sea-level changes history, a remarkable similarity in the MS trends can be observed between these two sections. Such similarities brought questions on the nature of the long-term forcing parameters that were active at the inter-regional scale.

In order to get a better understanding of the factors responsible for the inter-regional forcing, a detailed records of microfacies analyses, MS measurements, selected trace and major elemental concentrations and conodonts biostratigraphy have been performed on two Middle to Upper Devonian sections from Germany (Sauerland, Burgberg) and Austria (Carnic Alps, Freikofel).

Conodont biostratigraphy

In the Burgberg section, conodont biostratigraphy led us to confirm that the studied section extend from the Middle Givetian to the Lower Carboniferous. In the Freikofel section, it allowed to precisely identify the Eifelian–Givetian and the Frasnian–Famennian boundaries.

Sedimentology

The field and microfacies observations allowed us to reconstruct the sedimentary environment and to highlight several major variations of this environment. In the Middle Devonian, both sections are mainly characterized by fore-reef sediments. In the Burgberg section, those fore-reef sediments mainly correspond to bioclastic grainstone and rudstone related to gravity flow deposits derived from the shallow-water area. In the Freikofel section, the fore-reef area is dominated by breccia sediments suggesting a strong debris flow influence. Through the Upper Devonian, the sedimentary setting evolves towards an off-reef pelagic environment in both sections and even a basinal setting in the Burgberg section. Sediments are then dominated by thin-bedded and nodular limestone. In this Upper Devonian part, debris coming from the shallow-water area are still observed locally in both sections.

Magnetic susceptibility and geochemistry

The mean MS values for the Burgberg and Freikofel sections are respectively $1,88 \times 10^{-8} \text{ m}^3/\text{kg}$ and $7,72 \times 10^{-9} \text{ m}^3/\text{kg}$. Compared to the $MS_{\text{marine standard}}$ of $5.5 \times 10^{-8} \text{ m}^3/\text{kg}$ defined by ELLWOOD et al. (2011) on the basis of ~11,000 marine rocks samples, our values are low, mostly in the Freikofel section. This could indicate a low terrestrial influx seaward during the Middle and Upper Devonian. Regarding the magnetic susceptibility curves from these two sections, several large-scaled trends can be highlighted. The evolution curves of some selected clastic input proxies such as Zr, Si, Al, Ti, Sr display similar large-scaled trends. This indicates that clastic input proxies and MS are inherently linked and MS techniques can then be used here as a proxy for changes in source or amount or type of weathering (RIQUIER et al., 2010).

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Most of the long-term MS variations occurring in both sections are interpreted as being related to second order eustatic variations (T-R Cycles).

Through this multi-disciplinary investigation, we would like to get a better idea about what causes long-term trends in MS variations and to document the sedimentary changes in response to these long-term variations. Further aim is to develop the application of MS techniques as a correlation tool.

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