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Zooming in on the GOBE

2020 Virtual Annual Meeting of IGCP 653

Christian Mac Ørum Rasmussen, Alycia L. Stigall, Arne Thorshøj Nielsen,
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International Geoscience Programme Project 653: The onset of the Great Ordovician Biodiversification Event

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G E U S

Paired carbonate and organic carbon isotope records from the Ordovician of Estonia: Local, regional or global drivers?

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Carbon stable isotope excursions are widely used as correlation tool in Ordovician stratigraphy as well as for reconstructing climatic and environmental history. The mechanisms behind individual carbon isotopic excursions are, however, not fully understood and their geographic scope, facies dependence and synchroneity need further assessing. The Baltic region has been a reference area for studying Ordovician carbon isotope records for several decades. Most previous works in the region are based on data from bulk carbonate rocks ($\delta^{13}C_{carb}$), whereas the stratigraphic variability of the isotopic composition of organic matter ($\delta^{13}C_{org}$) has remained poorly studied.

Here we document paired carbonate and organic carbon isotope records from the Middle Ordovician to basal Silurian from Estonia. The primary aims of this work were to: (1) assess the variability and stratigraphic usefulness of the $\delta^{13}C_{org}$ curves, in comparison with $\delta^{13}C_{carb}$ data from the same sections and records from other regions; (2) examine the offset between the carbonate and organic matter isotope curves ($\Delta^{13}C$) in order to reveal any temporal trends; (3) test the spatial variation of paired isotope data within the Baltoscandian basin. For this 470 samples at *c.* 1 m resolution were analysed from the Lelle, Viki and Tartu cores, each characterising somewhat different facies within the Baltoscandian basin.

The $\delta^{13}C_{carb}$ curves from the three sections reveal the isotopic excursions well-known globally and/or from the region: MDICE, LSNICE (Kukruse low), GICE, Rakvere, Saunja, Moe and the prominent HICE. The $\delta^{13}C_{org}$ data show more varying patterns than $\delta^{13}C_{carb}$, ranging between *c.* -33‰ and -26‰. Compared to data from other regions, however, the new Estonian $\delta^{13}C_{org}$ data sets stand out by relatively small scatter. The main $\delta^{13}C_{carb}$ events can usually be identified in the $\delta^{13}C_{org}$ curves; the agreement between the two curves is particularly good in the Darriwilian and Sandbian. Starting from the Katian, the paired curves tend to show different magnitudes, and occasionally slightly diachronous nature or even opposite trends. Few $\delta^{13}C_{org}$ anomalies observed in one section only are likely related to specific facies conditions, restricted biota, or early diagenetic effects. On a basinal scale, the average $\delta^{13}C_{org}$ (as well as $\delta^{13}C_{carb}$) values increase towards deeper-water settings. The $\Delta^{13}C$ curves show an overall increasing trend by 1–2‰ in the Viki and Lelle sections, which agrees with the global data compilation and may suggest a global driver, such as change in pCO_2 and pO_2. However, a more pronounced $\Delta^{13}C$ increase occurs in the early Katian post-dating GOBE, and in places the broader trend is masked by stratigraphically constrained local/regional shifts of up to 5‰.

In summary, the new paired carbon isotope records reveal mixed signatures from global changes in carbon sequestration and environments, as well as basinal trends and locally induced shifts. The latter two have limited value for stratigraphy, but may aid understanding facies changes and diagenetic environments.