The Drumian Isotopic Carbon Excursion (DICE) in Scania, southern Sweden : a mirror of the onset of the Marjumiid Biomere at a time of increased primary production?

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Foreword and acknowledgements

This abstract volume has been prepared for the 3rd annual meeting of the IUGS/UNESCO International Geoscience Programme Project 591 *The Early to Middle Palaeozoic Revolution*. The meeting was hosted by the Department of Geology, Lund University, in June 9–19 2013 and followed the successful annual meetings held in Madrid/Ludlow (2011) and Cincinnati (2012). The Lund conference was arranged jointly with the annual meetings of the Cambrian, Ordovician and Silurian subcommissions on stratigraphy, and included a post-conference excursion to key geological localities in Skåne, Västergötland and the Oslo Region. The conference was a focus for cutting-edge research in Lower and Middle Palaeozoic geology and palaeontology, and the presentations covered a wide range of topics from morphology and taxonomy of various fossil groups through advances in geochemistry and stratigraphy to biogeography, palaeoecology and palaeoclimatology. We would like to express our sincere gratitude to Anders Lindskog and Kristina Mehlqvist for their meticulous editing of the meeting proceedings. We are also grateful for valuable input from the organization and scientific committee associated with the meeting. We acknowledge financial support from the Swedish Research Council (grant D0013001 to MC), the Geological Survey of Sweden, the Geological Society of Sweden, the Department of Geology at Lund University, and the municipality of Lund.

Lund on 8 May 2013

Mikael Calner (meeting chair)
Oliver Lehnert (vice chair)
Per Ahlberg

The Drumian Isotopic Carbon Excursion (DICE) in Scania, southern Sweden – a mirror of the onset of the Marjumiid Biomere at a time of increased primary production?

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Only one prominent $\delta^{13}C_{org}$ excursion, the Steptoean positive carbon isotope excursion (SPICE) from the Andrarum 3 drillcore in Scania (Skåne), has been documented in detail from the provisional Cambrian Series 3 through Lower Ordovician (Tremadocian) Alum Shale Formation of Scandinavia (Ahlberg et al. 2009). Here we report on the Drumian carbon isotope excursion (DICE) from Cambrian Series 3 outer shelf deposits in the biostratigraphically well-controlled Almbacken drillcore from south-central Scania.

The DICE is a prominent negative $\delta^{13}C$ excursion that is well-known from the Great Basin, western United States (Montañez et al. 2000; Howley & Jiang 2010), and South China (e.g., Zhu et al. 2004). In the Almbacken drillcore, a study on the $\delta^{13}C_{org}$ chemostratigraphy has been performed in an interval ranging from the ?*Ptychagnostus praecurrens* Zone or lower *Ptychagnostus gibbus* agnostoid Zone (upper part of provisional Cambrian Stage 5; corresponding to the Topazan regional Stage of Laurentia) through the *Lejopyge laevigata* agnostoid Zone (lower Guzhangian Stage; upper Marjuman regional Stage of Laurentia). A detailed zonation in the core section was provided by Axheimer & Ahlberg (2003). The shift in the biofacies of the trilobite and agnostoid assemblages reflects a first order sea-level change. In the Almbacken drillcore, a prominent negative excursion has been recorded within an interval of dark grey to black mudstones and shales in the lowermost part of the Alum Shale Formation, i.e., between the top of the Gislöv Formation and the base of the *Exsulans* Limestone Bed. The macrofauna in this interval is largely restricted to linguliformean brachiopods and cannot be biostratigraphically constrained. However, in terms of the global agnostoid zonation, it probably represents the *P. praecurrens* Zone or the lower *P. gibbus* Zone. The prominent negative excursion in this trilobite- and agnostoid-barren interval (lingulid biofacies) can be correlated wih the DICE in the *Ehmaniella* Zone in the Great Basin (Montañez et al. 2000). The appearance of an open-marine assemblage with polymerids and agnostoids in the overlying *Exsulans* Limestone Bed (25.08–25.47 m) reflects a

sudden shift in water depth. This sea-level rise is accompanied by a positive shift of more than 1.5‰ (rising upper limb of the DICE). Most of the remaining part of the succession in the core is dominated by agnostoid trilobites that reflect deeper-water, open-shelf conditions. These deeper water conditions are associated with more positive $\delta^{13}C_{org}$ values (ca. 0.5‰ higher) following the rising upper limb of the DICE.

The Guzhangian Andrarum Limestone Bed (4.10–5.65 m) has yielded polymerids and linguliformean brachiopods, reflecting shallower water depth and a regressive trend in the youngest part of the Alum Shale succession where stable $\delta^{13}C_{org}$ values between -31.5 and -31.0‰ have been recorded.

The increase of $\delta^{13}C_{org}$ values after the negative peak of the DICE roughly coincides with the base of the Marjumiid Biomere. The base of this biomere, however, does not coincide with the base of the Marjuman Stage (base of *Ptychagnostus atavus* Zone; Ludvigson & Westrop 1985 emend. Palmer 1998) in the biomere concept of Palmer (1998). In Laurentia, the base of the Marjumiid Biomere is placed at the base of the *Proehmaniella* Subzone of the *Ehmaniella* Zone (*Ptychagnostus praecurrens* agnostoid Zone; see Babcock et al. 2011).

The record of the DICE in the *Ehmaniella* Zone of Laurentia suggests that a substantial part of the lowermost part of Alum Shale Formation in the Almbacken core, i.e., the interval below the first occurrence of trilobites and agnostoids of the *Ptychagnostus gibbus* Zone, may be correlated with at least part of the *P. praecurrens* Zone. The increase in $\delta^{13}C_{org}$ values after the $\delta^{13}C_{org}$ minimum of the DICE may represent a time of increased primary productivity, which could have triggered the radiations observed within the Marjumiid Biomere.

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