# Palaeokarst formation in the early Palaeozoic of Baltoscandia : evidence for significant sea-level changes in a shallow epicontinental sea

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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

# Palaeokarst formation in the early Palaeozoic of Baltoscandia – evidence for significant sea-level changes in a shallow epicontinental sea

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In the Lower Palaeozoic sedimentary succession of Sweden palaeokarsts have been reported from different stratigraphic levels in the Silurian strata of Gotland by Calner (2008; see references therein). Until last year there were no records of Cambrian karsts and in the Ordovician only the basin-wide Katian palaeokarst horizon in the Upper Ordovician Slandrom Limestone has been described in detail (Calner et al. 2010a). The unconformities and disconformities on top of the slightly older Kullsberg mounds in quarries located in the Siljan impact structure (Dalarna) presumably represent an earlier regression and karstic development (Calner et al. 2010b). Beside these reports, there is only the statement by Nielsen (1995) that karst may have formed at the top of the Darriwilian Komstad Limestone. During the last two years, however, several new and significant palaeokarst surfaces have been detected in the Cambrian–Ordovician successions of Sweden (Lehnert et al. 2012).

At Kakeled Quarry (Västergötland), a palaeokarst cave with a breccia fill (large, angular Orsten clasts in a dark limestone matrix) is exposed beneath a 'Middle Cambrian' palaeokarst surface (Jiangshanian Stage) located close to the top of the Kakeled Limestone Bed of the Alum Shale Formation (Lehnert et al., 2012). In the karstic pockets, a mass occurrence of *Orusia lenticularis* occurs. These shallow-water brachiopods originally settled on hard substrates after a major regression exposing, regionally, the sea floors of the alum shale basin. Their reworking and concentration in the conglomeratic bed overlying the irregular palaeokarst surface reflects deposition during transgression in extremely shallow marine environments.

A younger karst surface is exposed in Tomten Quarry at Torbjörntorp (Västergötland). In two dimensions in the quarry wall it resembles the "Schrattenkalk", but rock slabs cut vertically and parallel to bedding planes display a karren system that resembles "Napfkarren" or cockling features. Trilobites of the Furongian *Ctenopyge bisulcata* and *C. linnarssoni* zones occur in the 1–2 cm thick, glauconitic packstone bed that overlies the palaeokarst surface and which represents the upper Tremadocian Bjørkåsholmen Formation. The associated stratigraphic gap comprises the six uppermost trilobite zones of the Furongian plus most of the Tremadocian. Darriwilian conodonts with reworked

older material within a limestone bed slightly above the glauconitic packstone bed indicate yet another substantial gap in the succession.

In the new Tingskullen core from northeastern Öland, another palaeokarst surface with grikes and evidence of repeated exposure marks the top of the upper Tremadocian *Obolus* conglomerate (?) or a lower limestone part of the Djupvik Formation ("Ceratopyge Shale"). This palaeokarst surface is overlain by glauconitic limestone of the Köpingsklint Formation and inferably reflects the global *Ceratopyge* Regressive Event (CRE).

At the base of the Lanna Limestone in the Siljan area, palaeokarst is associated with the Dapingian Blommiga Bladet ('flowery sheet') hardground complex, which can be correlated across most of Baltoscandia.

The basin-wide palaeokarst in the Katian Slandrom Limestone (Calner et al. 2010a) no longer marks the youngest Ordovician karst record. Recently, Hirnantian karst caves and solution cavities filled with greenish marls of the Glisstjärn Formation have been recognized in sections of the Boda Limestone in the Siljan Ring structure (Dalarna). Solution and karst cave formation reflects an interval of the regression during the Hirnantian glaciation and the youngest period of subaerial exposure during the Ordovician.

Some earlier sedimentary models suggesting that Baltoscandia was flooded by a deep epicontinental sea are challenged by the discovery of multiple palaeokarst development together with other shallow-water features. Instead, palaeokarst formation implies subaerial exposure during a number of major regressions.

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