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Multiple palaeokarst horizons in the Lower Palaeozoic of Baltoscandia challenging the dogma of a deep epicontinental sea

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Several prominent palaeokarst surfaces have recently been detected in the Cambro-Ordovician sedimentary succession of Sweden. The oldest palaeokarst was found in autumn 2011 in Västergötland. An irregular palaeokarst cave with a breccia fill yielding large, angular Orsten clasts in a dark mud- to wackestone matrix is exposed beneath a karstic surface in the Cambrian Alum Shale Formation at Kakeled Quarry, Kinnekulle. The karstic surface occurs near the top of the Kakeled Limestone Bed that ranges from the upper Agnostus pisiformis into the Ctenopyge tumida Zone. The base of the cave is more than 1.4 m below this unconformity. A mass occurrence of Orusia lenticularis, a shallow-water brachiopod originally settling on hard substrates, in the karst pockets reflects deposition of the conglomeratic cover in extremely shallow marine environments. We interpret the widespread Orusia occurrences together with a brecciated or conglomeratic interval above an irregular surface in various Swedish locations as evidence for transgression after a major regression, regionally exposing the sea-floors of the Alum Shale Basin.

A slightly younger karst surface is exposed in Tomten Quarry at Torbjörntorp, Västergötland. This resembles "Schrattenkalk" in the quarry wall but rock slabs cut vertical and parallel to bedding display a karren system, which reconstructed in 3D resembles "Napfkarren" or cockling features. Trilobites of the Ctenopyge bisulcata and C. linnarssoni zones have been recovered from the orsten bed just below the base of a 1–2 cm thick and irregular glauconitic packstone layer of the Bjørkåsholmen Formation (upper P. deltifer conodont Zone). The huge 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 point to yet another substantial gap in the succession.

In the new Tingskullen core from northeastern Öland a karstic surface with grikes and evidence of repeated exposure occurs on the top of the upper Djupvik Formation (equivalent to the Bjørkåsholmen Formation). This palaeokarst is covered by the Töyen Formation and represents erosion and karstification during the global Ceratopyge Regressive Event (CRE).

Higher up in the Ordovician of Öland, the lower Dapingian Blommiga Bladet hardground complex (Flowery Sheet) preserves karst morphologies. It can be correlated by means of the typical large borings of Gastrochaenolites oelandicus across most of Baltoscandia, including the Siljan district (new observations). An unconformity has recently been identified on top of the Skagen Formation in the Röstånga core from Scania (Skåne). This surface yield solution features possibly of subaerial origin and correlates with a conglomerate at the upper boundary of the same formation in the Borenshult core (Östergötland). Lastly, a prominent, basin-wide palaeokarst horizon in the Upper Ordovician Slandrom Limestone has been recently documented in detail.

The multiple karst horizons in the Cambro-Silurian of Sweden imply subaerial exposure, and even locally soil-forming processes, during major regressions. Their preservation implies rapid burial and transgression. The common evidence for palaeokarst together with other sedimentary and biotic proxies of extremely shallow-water, challenge earlier models favouring a stable and deep basin.