state thought to be most similar to that predicted for our own future due to global warming. This has two implications: 1) if future global climates were to warm substantially beyond those levels thought to correlate to early Pliocene values, equilibrium diversity of diatoms in the oceans might be significantly lower than today, suggesting the risk of extinctions. 2) Models of ocean plankton response based on living species-ocean temperature relationships may not be valid if climate warming exceeds the early Pliocene level.

Our results are preliminary, and need better data. Past ocean environments are imperfect analogs for future ones, and thus may not be good predictors of future response. We particularly need a better understanding of the actual ocean parameters that regulated past ocean diversity, rather than generalized proxies such as global isotopic oxygen. Our results nonetheless suggest that the marine diatom plankton, and thus possibly the ocean's carbon pump, may be seriously adversely affected by future climate change, and in ways that are not easy to predict.

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ICDP

The Siljan impact structure of central Sweden: an unique window into the geologic history of western Baltoscandia

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Siljan is Europe's largest impact structure and preserves unique Lower Palaeozoic sedimentary successions in its ring-like depression around the central uplift. Outcrops are limited, but the Lower Palaeozoic stratigraphy investigated in three core sections provides new information revolutionizing the knowledge of the development of this area located at the western margin of Baltica. Effects of the Ordovician/Silurian foreland basin development and several facies belts can be observed in the sedimentary record of the area some 100 km away from the Caledonian front in the west (Fig. 1A). The Mora 001, Stumsnäs 1 and Solberga 1 cores (Fig. 1B) provided by the Swedish company Igrene AB comprise more than 1500 m of strata ranging from the late Tremadocian to Wenlock in age. The cores provide a complex dataset which is the basis for reconstructing shifts in palaeoclimate, sea-level, and changes in ecosystems. The volcanic record, expressed by Ordovician and Silurian K-bentonites, may be compared to occurrences of ash layers in other parts of Baltoscandia which serve as time-lines in a detailed stratigraphic framework including litho-, bio-, chemo- and sequence stratigraphic parameters. Well-defined carbon isotope excursions are additional pin-points within this framework.

The erosional unconformity and the hiatus spanning about 30 Ma between the Middle Ordovician Holen Limestone and early Silurian shales in the western Siljan Ring (i.e. Mora area) reflect the passage of the Caledonian peripheral forebulge due to tectonic loading by thrust sheets to the west (Lehnert et al. 2012b; Fig. 2).

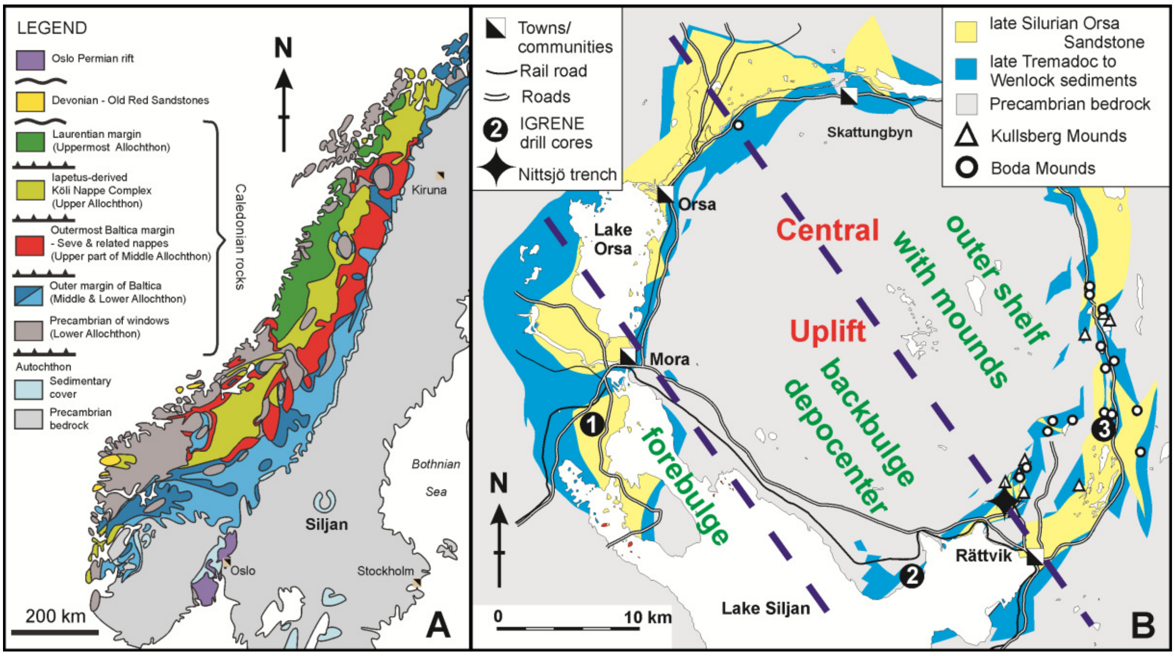

Figure 1: A- Location of the Siljan impact structure in relation to the Caledonian nappe system (modified from Gee et al. 2010); B - Simplified geological map of the Siljan district (modified from Ebbestad & Högström 2007) with locations of the Igrene AB drill sites (1 – Mora 001; 2 – Stumsnäs 1; 3 – Solberga 1) and the tentative position of late Ordovician facies belts.

In the Ordovician succession of the Stumsnäs 1 core (Fig. 1B), a previously unknown marly deeper water facies, time-equivalent to the uppermost Holen Limestone through upper Dalby Formation is observed (Fig. 2). The sediments display deposition in an area where backbulge basin and outer platform environments are interfingering (Fig. 1B). This backbulge depocenter presumably developed during late Middle Ordovician times when erosion started at the peripheral forebulge to the west (Lehnert et al. 2012b). During the time when erosion continued at the forebulge, large mud mounds developed on the outer shelf through the shelf to basin transition in the Upper Ordovician carbonate shelf succession (Kullsberg and Boda mounds). These ecosystems are characteristic for the eastern part of the impact structure (Fig. 1B). Due to westward movement of the forebulge during continuous crustal loading by the Caledonian nappes in the Silurian, the depocenter of an evolving shale basin also moved to the west where a thick siliciclastic succession was deposited in the western Siljan Ring (i.e. Mora and Orsa areas). The substantial thickness of the shale succession in the Orsa region can be deduced from two seismic lines studied in the northwestern part of the ring structure (Juhlin et al. 2012).

Within the upper part of the Silurian clastic succession in the Mora 001 core (Fig. 2) we observe the progradation of a delta system. The high influx of silt ('tricolor member') and proximal delta sands ('sandstone member') reflects a regression in an overall subsiding basin likely due to global sea-level drop during the Sheinwoodian (early Wenlock) glaciation.

The thick Silurian siliciclastic succession in the Mora 001 core as well as the shales of the early Silurian Kallholn Formation, the late Ordovician Fjäcka Shale and the early Ordovician Tøyen Formation have geochemically been investigated to support the view of a biotic origin of the oil and gas occurrences in the Siljan region (Fig. 2 – GC marked levels). This was necessary since some recent models favour an 'abiotic deep source" in the mantle to explain the origin of the bulk of the hydrocarbons in that area. An interesting aspect of shale studies in the Siljan ring structure is that the Silurian 'graptolitic shales', usually interpreted as being fully marine deposits, show a deposition in lacustrine to brackish and marine environments (Berner et al., this volume). The data can explain the absence of marine fossils in large parts of the siliciclastic successions showing up only in periods of fully marine conditions. Similar geochemical data reflecting times of lacustrine to brackish conditions were obtained from one of the best source rocks of the Baltoscandian Basin, the late Ordovician Fjäcka Shale, showing intervals of reworked or land-plant derived hydrogen-lean organic matter in a basin flooded after the Katian 'Slandrom Glaciation'. The geochemical data suggesting 'lacustrine' to brackish and marine palaeoenvironmental conditions are supported by biomarker studies from samples of crude oil and bitumen from the eastern Siljan Ring (i.e. Solberga area) (Ahmed et al. 2012).

The Katian 'Slandrom Glaciation' is reflected on Baltoscandia by a widespread palaeokarst surface (Calner et al. 2010a), and its prominent palaeokarst development is observed in cores (e.g. Solberga 1) and in outcrops (Calner et al. 2010b) in the eastern Siljan Ring. There, palaeokarst is developed in different Ordovician units in the shallower environments. Together with multiple karst horizons in the Cambrian–Silurian of other parts of Sweden widespread subaerial exposure surfaces are recognized at times of major regressions. These together with other sedimentary and biotic proxies of extremely shallow-water conditions challenge earlier ideas suggesting a tranquil, deep and stable basin (Lehnert et al. 2012a). However, the strata preserved in the Siljan impact structure provide not only the unique possibility to study sea-level changes but also shifts in palaeoclimate, and changes in

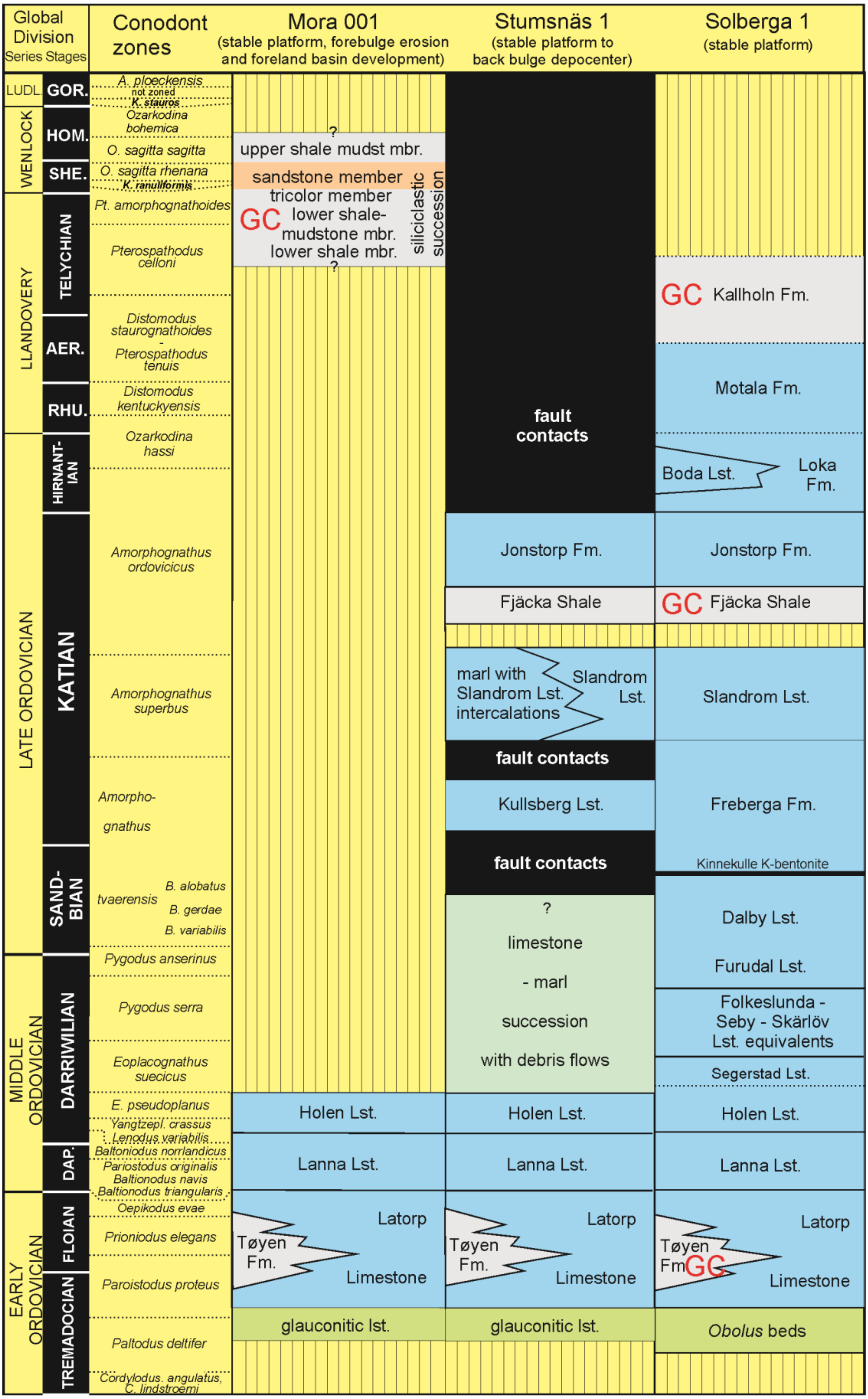

Figure 2: Preliminary lithostratigraphic correlation of the units recovered in the sedimentary successions of the Mora 001, Stumsnäs 1 and Solberga 1 core sections (Lehnert et al. submitted). The gaps shown in black are caused by faulting. The nomenclature follows Ebbestad & Högström (2007); GC marks shale units geochemically investigated for characterizing their potential for hydrocarbon generation.

palaeoenvironments and faunal communities in western Baltica where otherwise across long distances erosion cut down into the Precambrian basement rocks.

The most recently studied core is structurally highly complex and comes from the Stumsnäs 1 borehole (Arslan et al., this volume; Lehnert et al. submitted) (number 2 in Fig. 1B). Large parts of the Ordovician succession are cut out by faults. In the Stumsnäs 1 section and in other places of the southeastern ring structure, large slabs of granitic basement (up to 200 m in thickness) are lying on top of the Palaeozoic sedimentary succession. The impact-related thrusting of basement slivers over sedimentary strata caused folding and faulting of the underlying sediments and cutting out of weaker units such as the late Ordovician K-bentonites intercalated in marly limestones. An important goal of our future research is to relate the structural data from the core to the outcrop situation in the southern and southeastern part of the Siljan Ring. It is essential to determine transport directions in order to evaluate published impact models. The data collected so far are already in contradiction with these models and show the potential of a better understanding of impact dynamics by basic structural studies in the field in combination with high resolution shallow seismic research.

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ICDP

Tectono-stratigraphic interpretation of sediments within Lake Ohrid (Albania/Macedonia) for the SCOPSCO ICDP campaign

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Ancient Lake Ohrid is probably the oldest existing lake in Europe. It is located on the Balkan Peninsula within the Dinaride-Albanide-Hellenide mountain belt, and is often referred to as a hotspot of endemic biodiversity (Albrecht and Wilke, 2008). This study sheds light on the tectonic and sedimentary evolution of Lake Ohrid based on newly-acquired hydro-acoustic and seismic data sets. It testifies the importance of Lake Ohrid as a valuable archive susceptible to provide a continuous sediment record within the scope of the SCOPSCO project within the International Continental Drilling Program (ICDP) campaign. Drilling is now scheduled for April 2013.

Intensive work has been done in the last couple of years resulting in a better understanding with respect to the

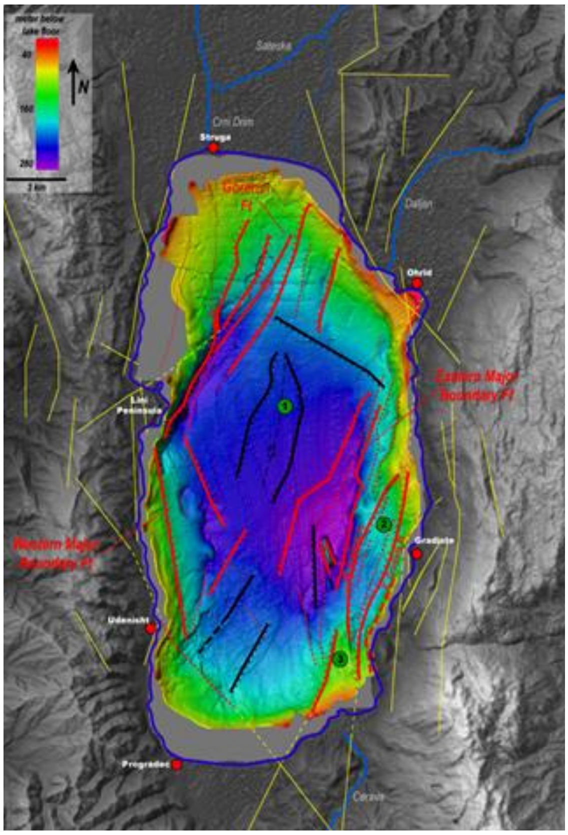

Figure 1: Compilation of bathymetric map and topography of the surrounding area at Lake Ohrid. Red lines are major active normal faults. Thick black lines are inactive faults. Dashed lines are inferred faults. Yellow lines are faults described onshore (Hoffmann et al. 2010). Green dots are proposed drill sites (1: DEEP, 2: Gradiste, 3: Cerava).