https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

The Phanerozoic paleoclimate archive in Svalbard: a data synthesis

Simon M. Schad[1,2], Denise K. Kulhanek[3], Jiří Bárta[4], Stella Z. Buchwald[5], Sten-Andreas Grundvåg[6], William J. Foster[7], Mads E. Jelby[8], Morgan T. Jones[9,10], Luke Marsden[11,1], Sverre Planke[10,12], Kasia K. Śliwińska[13,10], Aleksandra Smyrak-Sikora[14], Lidya G. Tarhan[15], Madeleine L. Vickers[9], Valentin Zuchuat[16], Kim Senger[1]

[1]Department of Arctic Geology, The University Centre in Svalbard, Longyearbyen, 9171, Norway
[2]Faculty of Geosciences, University of Bremen, Bremen, 28359, Germany
[3]Institute of Geosciences, Kiel University, Kiel, 24118, Germany
[4]Centre for Polar Ecology, Faculty of Science, University of South Bohemia, České Budějovice, 370 05, Czech Republic
[5]IHPE Laboratory, University of Perpignan Via Domitia, CNRS, IFREMER, University of Montpellier, Montpellier, 34090, France
[6]Department of Geosciences, UiT The Arctic University of Norway, Tromsø, 9037, Norway
[7]Department of Earth System Sciences, University of Hamburg, Hamburg, 20146, Germany
[8]Department of Geoscience, Aarhus University, Aarhus, 8000, Denmark
[9]Department of Ecology, Environment and Geoscience, Umeå University, Umeå, 901 87, Sweden
[10]Department of Geosciences, University of Oslo, Oslo, 0371, Norway
[11]Ocean Department, Norwegian Meteorological Institute, Oslo, 0371, Norway
[12]Volcanic Basin Energy Research AS, Oslo, 0361, Norway
[13]Geological Survey of Denmark and Greenland, Copenhagen, 1350, Denmark
[14]Department of Geosciences, Norwegian University of Science and Technology, Trondheim 7031, Norway
[15]Department of Earth and Planetary Sciences, Yale University, New Haven, CT 06511, United States of America
[16]CSIRO Mineral Resources, Kensington, WA 6151, Australia

Correspondence to: Kim Senger (kims@unis.no)

Abstract. Understanding ancient climate dynamics is crucial to accurately forecast future changes to Earth's climate system. The Norwegian High-Arctic archipelago of Svalbard experiences higher-magnitude warming than the lower latitudes. Its sedimentary succession provides an important climate archive spanning much of the Phanerozoic, including several hyperthermal events and mass extinctions of global importance. These include the End-Permian Mass Extinction (EPME) and the Paleocene–Eocene Thermal Maximum (PETM). In addition, the High Arctic Large Igneous Province (HALIP) provides an opportunity to study how igneous sills interact with organic-rich shales to generate greenhouse gases during contact metamorphism. The ongoing multidisciplinary international project SvalCLIME aims to systematically study these hyperthermal events and their relationships to Phanerozoic climate evolution. SvalCLIME seeks to drill multiple shallow boreholes at four sites in Spitsbergen that will provide a semi-continuous record of Phanerozoic stratigraphy from an underexplored region. The drill cores, in conjunction with outcrops, will provide a Permian–Eocene climate record of unprecedented continuity.

Here, we synthesise existing pre-Quaternary Phanerozoic (540–2.58 Ma) paleoclimate and paleoenvironmental data from Svalbard in curated data packages to complement a recently published comprehensive review article. The data packages are organised by proxy, facilitating the addition of future data sets. We present composite data coverage plots of key proxies (stable carbon isotopes [$\delta^{13}C$], oxygen isotopes [$\delta^{18}O$], pyrolysis, mercury) that illustrate data availability and current data gaps. Further, we give an overview of available geochronological constraints for Svalbard's pre-Quaternary Phanerozoic rock record, likewise curated into two data collections of 1) various methods that provide age constraints and 2) biostratigraphy. We also discuss the integration of various data sets in four case studies to illustrate the benefit of compiling such data for both drill cores (Longyearbyen CO_2 lab and Deltadalen) and outcrops (Festningen, Lusitaniadalen, Munindalen and Billefjorden).

1 Introduction

The Norwegian High-Arctic archipelago of Svalbard constitutes a remarkably continuous sedimentary rock record spanning from the Neoproterozoic to the Paleogene (Olaussen et al., 2025; Smelror et al., 2025; Smyrak-Sikora et al., 2025). This archive enables detailed reconstruction of deep-time paleoclimate evolution and paleoenvironmental change. Recently, Smyrak-Sikora et al. (2025) reviewed 148 that utilised Svalbard's high-quality outcrops and available drill cores to constrain regional climate evolution. While these datasets capture key processes such as tectonics, including Svalbard's northward drift, volcanism, basin evolution, and climate perturbations throughout the Phanerozoic, they remain fragmented and largely un-synthesised. Most studies focus on selected short intervals, leaving broader temporal trends underexplored. This highlights a critical question: How can Svalbard's diverse paleoclimate records be integrated to uncover long-term climate patterns and their driving mechanisms? Addressing this issue is crucial for advancing our understanding of Earth's climate history.

Deciphering past climate is fundamental to understanding what factors and processes have shaped the evolution of life and the planet, and to better elucidate Earth's current and future climate states (Figure 1). Tierney et al. (2020) discuss how emerging methods (e.g., development of new proxies and refinement of existing ones), the generation of many high-resolution marine and terrestrial paleoclimate records, and the direct assimilation of proxy data into Earth system models will contribute to reaching this goal. Understanding past Earth-system responses to short-lived perturbations is also pivotal to further developing robust future climate scenarios. The Intergovernmental Panel on Climate Change (IPCC, 2023) specifically highlights the need for deep-time climate archives across specific intervals where the magnitude of temperature increase was large and rapid (i.e., hyperthermals; Figure 1b) to improve our understanding of warmer-than-present climates and rapid climate change. The most rapid and pronounced hyperthermal of the last 60 Ma was the Paleocene–Eocene Thermal Maximum (PETM; 55.9–55.7 Ma). The PETM is identified by the IPCC as a reference interval for understanding the consequences of high rate and magnitude climate change. High latitude records across the PETM are scarce; therefore, the Svalbard record provides an important perspective.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

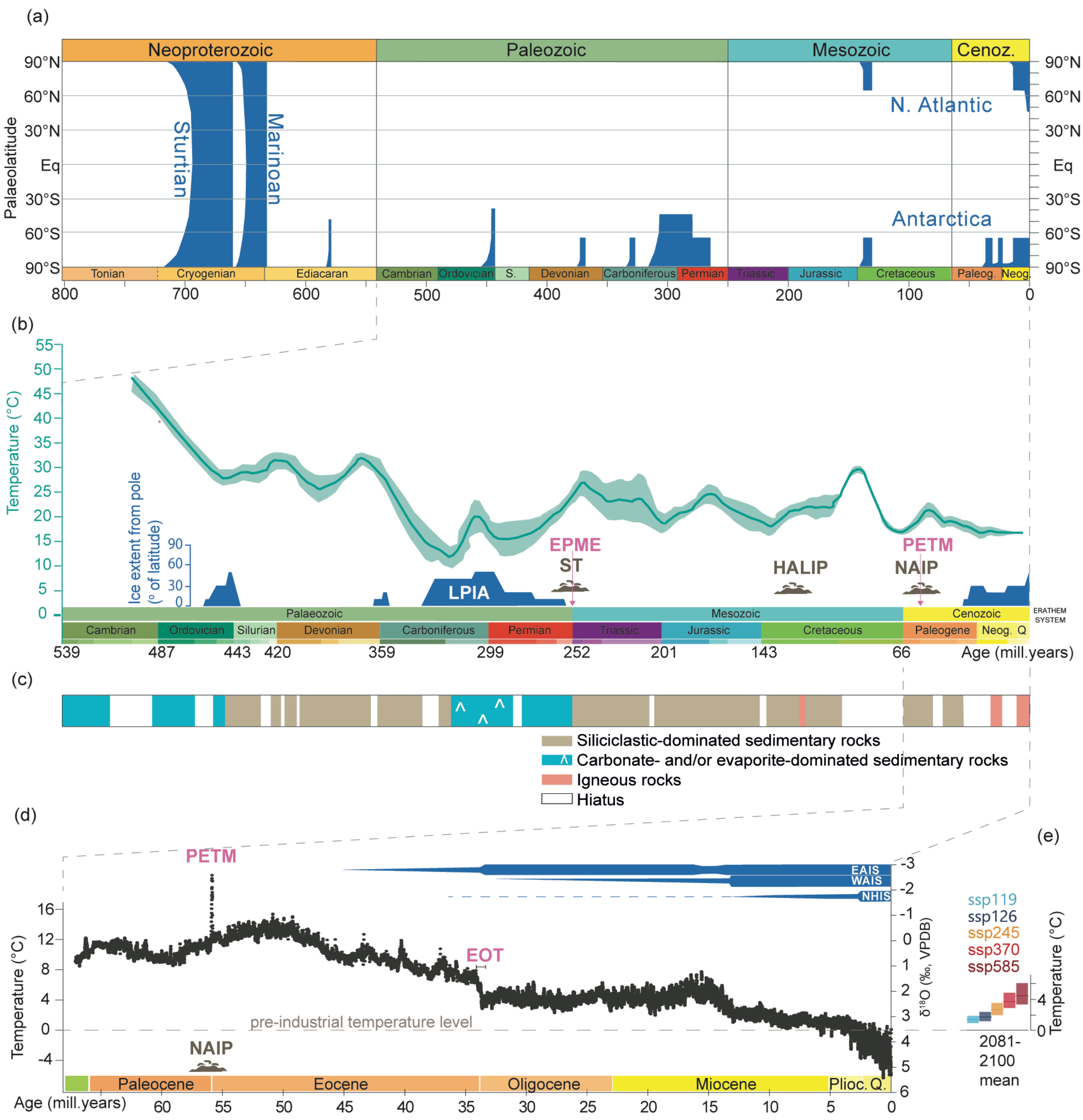


Figure 1: (a) Extent of glaciations globally over the past 800 Ma. Figure adapted from Hoffman (www.snowballearth.org). (b) Global mean values of tropical sea surface temperatures over the last 540 Ma from Scotese et al. (2021; green curve, with shaded area 95% confidence intervals, based on oxygen isotopes from phosphatic and carbonate fossils), glaciations from Macdonald (2020); major Large Igneous Provinces (LIPs) recorded in Svalbard: Siberian Traps (ST), High Arctic Large Igneous Province (HALIP), North Atlantic Igneous Province (NAIP). (c) Broad Phanerozoic lithostratigraphic records in Svalbard. (d) Global temperature over the last 60 Ma (modified from Westerhold et al. 2020). (e) Global surface air temperature projections (mean for years 2081–2100) relative to 1850–1900 according to the Shared Socioeconomic Pathways (SSP; modified from Figure 4.35 in IPCC (2023)). Other abbreviations: Late Paleozoic Ice Age (LPIA), End-Permian Mass Extinction (EPME), Paleocene–Eocene Thermal Maximum (PETM), Eocene–Oligocene Transition (EOT), East Antarctic Ice Sheet (EAIS), West Antarctic Ice Sheet (WAIS), and Northern Hemisphere Ice Sheet (NHIS). Figure adapted from Senger et al. (2025a).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Climate archives from globally distributed sites spanning paleolatitudinal gradients are crucial to understanding wider patterns in past climate evolution in a broader Earth system context. As such, Svalbard has been located near the northern margin of various (super)continents for much of its Phanerozoic history and provides high-latitude records since the Late Triassic that complement better-studied lower latitude records. Climate archives from higher latitudes such as the modern Arctic provide crucial insights into polar amplification and latitudinal gradients, where climate system feedback processes facilitate responses faster and in greater magnitude than at lower latitudes (Holland and Bitz, 2003). Over the past 100 Myr, Svalbard has been located above the Arctic circle and is thus ideally suited to provide insights into late Mesozoic and Cenozoic polar paleoclimate evolution. Moreover, Svalbard's mid-paleolatitude position during previous late Paleozoic and Mesozoic hyperthermals, such as that accompanying the End-Permian Mass Extinction (EPME), may offer critical insights into broader paleolatitudinal patterns in climate–biotic coevolution across these episodes, given that existing records are concentrated largely in paleotropical and paleo-subtropical regions (e.g., Reolid et al., 2020). Furthermore, records from the northern margin of the supercontinent Pangaea are limited both in terms of size and published research compared to Tethyan records.

Data from outcrops and existing drill cores provide a solid foundation of Svalbard's pre-Quaternary Phanerozoic climate evolution as documented in numerous publications (Smyrak-Sikora et al., 2025 and references therein). However, the datasets published in these studies are rarely truly "Findable, Accessible, Interoperable and Reusable" (i.e., the FAIR principles; Wilkinson et al., 2016). Several fully cored boreholes are available on Svalbard, covering large parts of the Paleogene succession (Sysselmannbreen borehole; Johannessen et al., 2021), including the PETM (recorded in coal exploration borehole BH-09/2005; Charles et al., 2011), the Upper Triassic to Lower Cretaceous successions (Longyearbyen CO_2 lab Project; Braathen et al., 2012b; Olaussen et al., 2019; Senger et al., 2025b), as well as the Permian–Triassic transition (Deltadalen boreholes; Zuchuat et al., 2020). However, the two Deltadalen boreholes, which targeted the EPME, are the only ones drilled explicitly for deep-time paleoclimate research and accompanied by a dedicated, multidisciplinary high-resolution analytical program. As such, complementary fully cored boreholes, with full suites of wireline logs and systematic data acquisition plans are needed. Thus, an ongoing initiative, the SvalCLIME project (Kulhanek et al., 2024; Senger et al., 2023), aims to drill and fully core six scientific research boreholes to specifically study the link between hyperthermals and mass extinctions from the Permian to the Paleogene (c. 260–50 Ma).

The geoscientific community benefits from standardised data packages and associated metadata to facilitate comparison of deep-time paleoclimate data across various sites and time intervals, and to refine the outputs of global deep-time biogeochemical and climate models. Furthermore, scrutiny of paleoclimate data in the context of a region's geological evolution is critical to disentangle local variability from global trends. In addition, robust reconstruction of deep-time paleoclimatological evolution requires the integration of various heterogeneous data types. For most of these, there are no widely adopted data and metadata standards, hampering data synthesis and full data usage.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Here, we synthesise available pre-Quaternary Phanerozoic paleoclimatic and paleoenvironmental data from Svalbard. Furthermore, the existing geochronological information used to date sedimentary successions investigated for paleoclimatological studies is integrated into two data packages. The data are formatted in curated, openly accessible data packages with associated metadata information and are organised by different proxy (stable carbon isotopes [$\delta^{13}C$], oxygen isotopes [$\delta^{18}O$], pyrolysis, mercury) and geochronological (biostratigraphy, age constraints) methods. In addition, we use a multidisciplinary approach to integrate quantitative proxy data into a broader geological context of four well-studied sites in Svalbard; The Longyearbyen CO_2 lab, Deltadalen and Lusitaniadalen, Festningen, and Munindalen and Billefjorden.

2 Geological setting of Svalbard

The pre-Quaternary Phanerozoic geological evolution of Svalbard has been extensively described in recent reviews (Olaussen et al., 2025; Smelror et al., 2025; Smyrak-Sikora et al., 2025 and references therein) and is therefore only briefly outlined here. This largely sedimentary to locally metamorphosed succession records Phanerozoic global climate change, Svalbard's progressive northward movement (Figure 2) and numerous tectono-magmatic events that include three large igneous provinces (the Siberian Traps, the High Arctic Large Igneous Province [HALIP] and the North Atlantic Igneous Province [NAIP]), influencing global climate and regional sedimentation patterns (Figures 1 and 2).

Structurally, Svalbard is dominated by three pre-Devonian basement provinces exposed in the southwest, northwest and northeast (e.g., Harland, 1997). These terranes were likely brought together along a series of regional, long-lived N-S trending fault zones (e.g., McCann and Dallmann, 1996) during the Caledonian Orogeny. These terrane-bounding fault zones were also instrumental in later basin development, defining the Devonian basins of northern Spitsbergen and Carboniferous rift basins from Hornsund in the south to Lomfjorden in the north. The post-Devonian Paleozoic–Mesozoic sedimentary cover was tilted gently towards the south during the Early Cretaceous, likely in response to HALIP emplacement and opening of the Canada Basin. Paleogene compressional to transpressional tectonism related to Eurekan deformation and its later transtensional phase, which led to the sheared continental margin development off west Spitsbergen, are perhaps the most important regionally extensive structuring events (Piepjohn et al., 2016). Since the Neogene, the archipelago has experienced several phases of uplift induced by thermo-tectonics, including Miocene and Quaternary volcanism, and post-glacial isostatic rebound.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

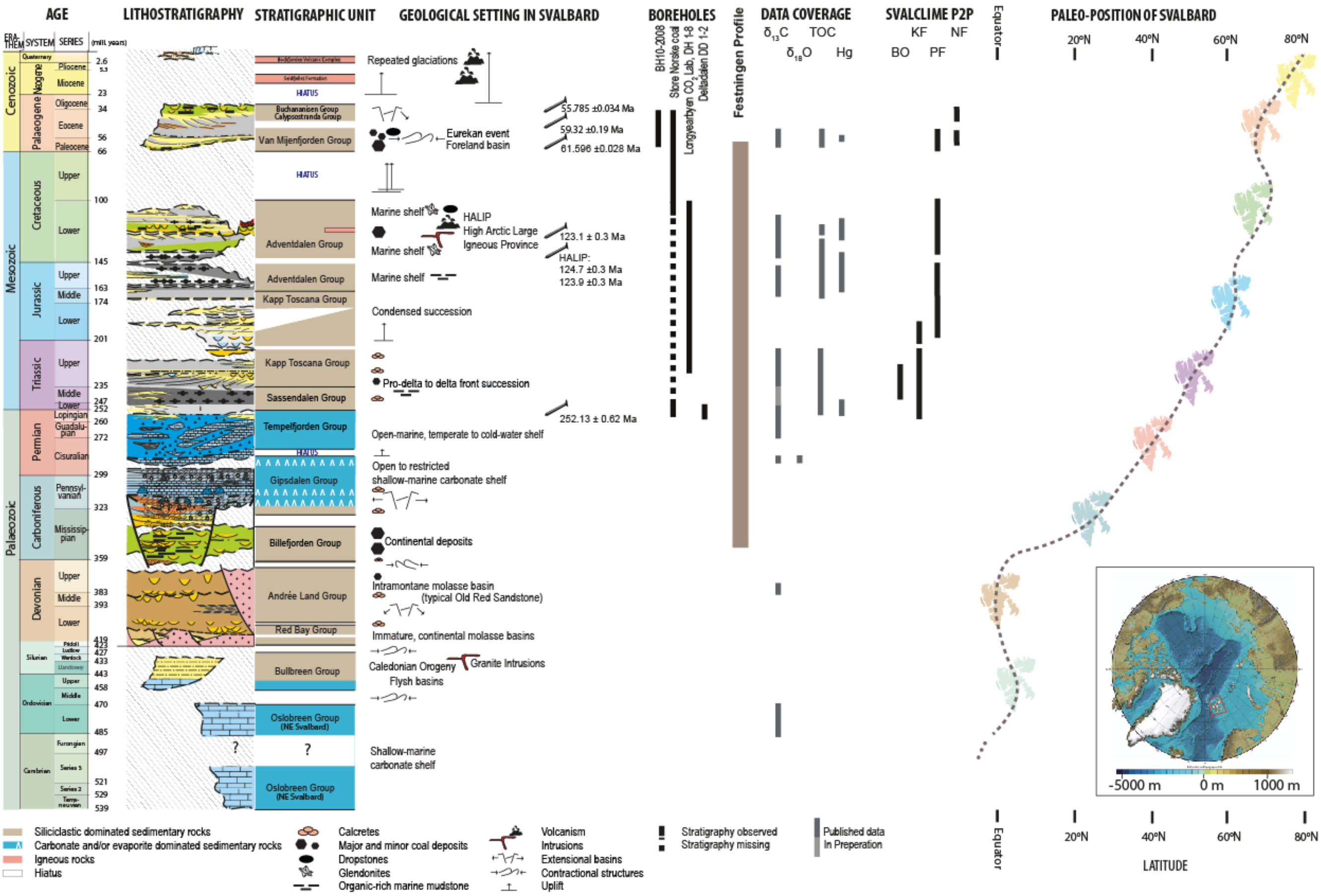


Figure 2: Phanerozoic stratigraphic column of Svalbard highlighting the data and research borehole coverage (modified from Smyrak-Sikora at al., 2025). Lithostratigraphy after Smelror et al. (2025) and Olaussen et al. (2025). Data coverage based on the data packages provided in this study (Stable carbon isotopes [δ^{13}C], oxygen isotopes [δ^{18}O], total organic carbon [TOC] and mercury [Hg]) and the targeted SvalCLIME drilling record (Botneheia [BO], Kropotkinfjellet [KF], Platåfjellet [PF], Nordenskiöldfjellet [NF]). Paleogeographic position of Svalbard from Senger et al. (2025a).

Pre-Devonian basement provinces include Cryogenian to Ediacaran diamictites and potentially 'slushy' "Snowball Earth" deposits formed in a shallow-marine carbonate shelf (e.g., Halverson et al., 2018). During the early Paleozoic, Svalbard occupied a near-equatorial position, during which carbonate and sandy sediments were deposited along Laurentia's margin prior to and during the early phase of the Caledonian Orogeny (Smelror et al., 2025). The Devonian was marked by the deposition of the Old Red Sandstone succession in extensional basins in the wake of the Caledonian collapse (Smelror et al., 2025), notably preserving some of the world's first forests under tropical monsoonal conditions (Berry and Marshall, 2015). In the Carboniferous, coal-bearing deposits that formed under humid and tropical conditions transitioned into arid-climate evaporites and warm-water carbonates as the Late Paleozoic Ice Age (LPIA; 360–255 Ma, Figure 1) began to influence regional and global sea level. The Permian saw a shift from warm-water carbonates to cold-water spiculitic ramps (Beauchamp and

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Baud, 2002) and was concluded by the EPME (e.g., Zuchuat et al., 2020), a catastrophic event tied to the Siberian Traps LIP, which brought a prolonged period of chert and spiculitic mudstone sedimentation to a halt.

The Mesozoic was characterised by the development of a siliciclastic platform succession, influenced by a major deltaic system (postulated to be the largest in Earth's history; Klausen et al., 2019), which reached Svalbard during the Late Triassic after prograding across the Barents Shelf from the Urals. In addition, the background greenhouse climate, which prevailed throughout the era, was punctuated by several cold snaps. In the Early Cretaceous, the HALIP (Senger and Galland, 2022) caused significant regional uplift and southward platform tilting. This epoch also recorded major global carbon-cycle perturbations, including the Volgian Isotopic Carbon Excursion (VOICE) and the Weissert Event (Hammer et al., 2012; Jelby et al., 2020b, 2025 and references therein).

In the Paleogene, Eurekan deformation resulting from compression between Greenland and Svalbard formed the West Spitsbergen Fold-and-Thrust Belt and its associated foredeep, the Central Spitsbergen Basin (Braathen et al., 1999; Helland-Hansen and Grundvåg, 2020). The foreland basin fill succession hosts a highly expanded record of the PETM hyperthermal (Dypvik et al., 2011). In agreement with global records, following the Early Eocene Climatic Optimum, Svalbard experienced gradual cooling towards the modern icehouse state. Finally, massive Neogene uplift and erosion, accompanied by Miocene volcanism in the north, removed up to 3 km of strata, resulting in the archipelago's present-day exhumation and a substantial stratigraphic hiatus. Quaternary glaciations shaped the present-day landscape and exposed many high-quality outcrops.

3 Methods and their data products

Herein, we provide a Svalbard-based overview of deep-time paleoclimate and paleoenvironmental methods, associated data products and examples of studies employing these approaches (Table 1).

Table 1: Summary of thematically grouped data sets relevant to deep-time paleoclimate research with selected published examples from Svalbard.

Data set	Data format	Comment/location	Example references
Non-destructive core scanning			
Hyperspectral imaging	Images	Deltadalen, Linnévatnet	Van Exem et al. (2019); Zuchuat et al. (2020)
In-site physical properties (MSCL)	Text file	Not conducted onshore yet, marine cores routinely scanned	Forwick and Vorren (2007)
XRF core scanning	Text file	Deltadalen	Zuchuat et al. (2020)

Downhole logging measurements			
Downhole wireline logs	Text file	Longyearbyen CO_2 lab project, selected petroleum exploration boreholes	Nuus et al. (2026); Senger et al. (2025b)
Core-log-outcrop integration	Images, data files, reports	Longyearbyen CO_2 lab project, Deltadalen	Grundvåg et al. (2017, 2019, 2021); Jelby et al. (2020a, b, 2025); Koevoets et al. (2019); Rismyhr et al. (2019); Olaussen et al. (2019); Zuchuat et al. (2020)
Lithological and structural characterisation			
Structural analysis	Text file	Longyearbyen CO_2 lab project	Ogata et al. (2014)
Lithological description (e.g., grain size and other textural properties, mineralogy, depositional environments)	Images, descriptions	Longyearbyen CO_2 lab project, Deltadalen	Grundvåg et al. (2017, 2019, 2021); Jelby et al. (2020a, b, 2025); Koevoets et al. (2019); Rismyhr et al. (2019); Olaussen et al. (2019); Zuchuat et al. (2020)
Magmatism, thermal maturity and burial history			
Pyrolysis (/Rock-Eval) (e.g., TOC, T_{max}, SI, HI)	Text file	Longyearbyen CO_2 lab project, Deltadalen and Lusitaniadalen, other outcrops	Buchwald et al. (2026); Jelby et al. (2020b, 2025); Koevoets et al. (2016); Schad and Senger (2025d) and references therein; Zuchuat et al. (2020)
Mercury	Text file	Longyearbyen CO_2 lab project, other outcrops	Grasby et al. (2015, 2016); Jones et al. (2019); Schad and Senger (2025c) and references therein
Petrophysics (porosity, permeability)	Text file	Longyearbyen CO_2 lab project	Mørk (2013)
Age model			
Radiometric dating (U-Pb)	Text file	Dolerites in outcrop, tephra layers in Deltadalen	Corfu et al. (2013); Grasby et al. (2015); Sartell et al. (2025); Zuchuat et al. (2020)
Radiometric dating (Re-Os)	Text files	Longyearbyen CO_2 lab project	Park et al. (2024); Xu et al. (2009)

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

Tephrochronology	Text file	Coal exploration boreholes, Longyearbyen CO_2 lab project	Corfu et al. (2013); Jones et al. (2016, 2017); Midtkandal et al. (2016)
Thermochronology	Text file	Northern Svalbard outcrops	Dörr et al. (2012, 2019a)
Magnetostratigraphy	Text file	Longyearbyen CO_2 lab project, Permian and Triassic outcrops	Hounslow and Nawrocki (2008); Hounslow et al. (1996, 2008a, b); Zhang et al. (2021)
Chemostratigraphy	Text file	Longyearbyen CO_2 lab project, Triassic outcrops	Jelby et al. (2020b, 2025); Koevoets et al. (2016); Wesenlund et al. (2022)
Cyclostratigraphy	Text file	Permian outcrops	Jafarian et al. (2017)
Biostratigraphy	Text file, images	Longyearbyen CO_2 lab project, Svalbard-wide	Alsen et al. (2020); Grundvåg et al. (2017, 2019); Schad et al. (2026) and references therein; Śliwińska et al. (2020)
Environment and climate			
Macrofossils (e.g., molluscs)	Darwin Core Archive, images		Alsen et al., (2020); Jelby et al. (2020b, 2025); Nakrem and Mørk (1991); Zuchuat et al. (2026)
Microfossils (e.g., foraminifera, radiolarians, conodonts)	Darwin Core Archive, images	Deltadalen, Lusitaniadalen	Nagy and Naoroz (2018); Nagy et al. (2025); Nakrem et al. (2008); Ozsvárt et al. (2026); Zuchuat et al. (2026)
Palynomorphs and palynofacies	Text file, images		Mørk et al. (1990); Vigran et al. (2014)
Trace fossils and ichnofabrics	Darwin Core Archive, images	Lusitaniadalen, Deltadalen, Reinodden, Festningen and Marmierfjellet	Beaty et al. (2025); Mørk and Bromley (2008); Rodriguez-Tovar et al. (2021); Uchman et al. (2016); Wignall et al. (1998, 2016); Worsley and Mørk (2001)
Biomarkers	Text file	Lusitaniadalen	Buchwald et al. (2025, 2026); Nabbefeld et al. (2010b)
Weathering ($^{86}Sr/^{87}Sr$, $^{187}Os/^{188}Os$, δ^7Li)	Text file	Lusitaniadalen, Festningen; PETM from borehole 09/2005	Bond et al. (2015); Ehrenberg et al. (2010); Gruszczynski et al. (1992); Pogge von Strandmann et al. (2021); Rauzi et al. (2024); Wieczorek et al. (2013)

Open Access Earth System Science Data Discussions

Iron speciation	Text file	Festningen outcrop and Deltadalen core	Schobben et al. (2020)
Major and trace elements	Text file	Permian–Triassic of Lusitaniadalen, Deltadalen, Festningen and Reinodden	Beaty et al. (2025); Buchwald et al. (2026); Grasby et al. (2015); Koevoets et al. (2019)
Stable carbon isotopes ($\delta^{13}C$)	Text file	Outcrops and drill cores Svalbard-wide	Schad and Senger (2025a) and references therein
Oxygen isotopes ($\delta^{18}O$)	Text file	Central and northern Spitsbergen	Schad and Senger (2025b) and references therein
Productivity and nutrients (P, N)	Text file	Permian–Triassic outcrops (Festningen, Reinodden, Lusitanadalen, Sassendalen area) and drill cores (Deltadalen)	Beaty et al. (2025); Blattmann et al. (2024); Grasby et al. (2019a); Schobben et al. (2020)
Glendonites	Text files, images	Localities around Adventdalen; Festningen (Cretaceous); Heerodden and Hollendarbukta (Paleocene)	Spielhagen and Tripati (2009); Vickers et al. (2018, 2025)
Pore fluids and the deep biosphere			
Gas composition with depth	CF-NetCDF (featureType “profile”),		Huq et al. (2017)
Deep biosphere			No study in Svalbard thus far

3.1 Non-destructive core scanning

Core scanning generates high-resolution quantitative data sets that allow targeted physical sampling and correlation with other continuous data sets (e.g., wireline logs, sedimentary logs).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

3.1.1 Hyperspectral imaging

Hyperspectral imaging of drill cores provides quantitative information on mineralogy and is routinely used in the mining industry (e.g., Thiele et al., 2024). In Svalbard, thus far only the Deltadalen cores have been imaged with a hyperspectral scanner and these data are available in a data package (Zuchuat et al., 2026b).

3.1.2 In-site physical properties (multisensor core logger)

A multisensor core logger (MSCL) measures physical properties on full or split drill cores. Depending on the instrument set-up, P-wave velocity, gamma ray attenuation bulk density, magnetic susceptibility and electrical resistivity can be measured. MSCL data have so far only been collected on recent marine cores from around Svalbard, but future use is planned for the SvalCLIME project.

3.1.3 X-ray fluorescence core scanning

X-ray fluorescence (XRF) analysis provides information on the elemental composition of the studied intervals and can be acquired both through core scanners (e.g., Croudace et al., 2019) or handheld units. XRF core-scan data were collected for the Deltadalen DD1 core (Zuchuat et al., 2020) and handheld XRF was applied regularly especially for Upper Jurassic–Lower Cretaceous successions (Koevoets et al., 2019).

3.2 Downhole logging measurements

3.2.1 Downhole wireline logs

The majority of boreholes drilled in Svalbard were slimhole coal exploration wells that were fully cored were not wireline logged. Thirteen of the 18 petroleum exploration wells have some wireline logs (Senger and Jochmann, 2025), which Nuus et al. (2026) recently used to calculate the thermal properties of these largely sedimentary successions. Fully cored research wells in Adventdalen (Senger et al., 2025b) and Sysselmannbreen (Johannessen et al., 2011) have a relatively good coverage of wireline logs, although with some limitations due to the narrow borehole diameters.

3.2.2 Core-log-outcrop integration

Integrating drill cores with wireline logs (e.g., Grundvåg et al., 2019; Koevoets et al., 2019; Mulrooney et al., 2019; Rismyhr et al., 2019) facilitates greater understanding of lithological variation and facilitates correlation between boreholes. In addition, integrating borehole and outcrop data provides important insights into regional basin-scale architecture and thereby aids in distinguishing between global and regional paleoenvironmental responses to past climate perturbations or climate-state shifts.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

3.3 Lithological and structural characterization

3.3.1 Structural analysis

Characterising faults and fracture systems in drill cores and outcrops (e.g., Ogata et al., 2012, 2014) is important both to decipher the tectonic evolution of the study area as well as to identify stratigraphic intervals that are missing or duplicated due to tectonism.

3.3.2 Lithological description

Standard lithological descriptions (e.g., grain size and other textural properties, sedimentary structures, mineralogy) constrain the depositional environment and the suitability of various proxies for reconstructing paleoenvironment and paleoclimate (e.g., Zuchuat et al., 2026a). Employment of quantitative non-destructive data collection methods such as XRF (see above; Jelby et al 2025; Koevoets et al., 2019; Zuchuat et al., 2020) may provide additional information on the depositional environment.

3.4 Magmatism, thermal maturity and burial history

3.4.1 Pyrolysis (Rock-Eval)

Pyrolysis generates data on the organic richness of the investigated rocks and their maturity (e.g., total organic carbon [TOC], hydrogen index [HI]), thus providing additional constraints on a basin's thermal evolution. Pyrolysis is also used to quantify contact metamorphic aureoles around igneous intrusions (e.g., Senger et al., 2014). Some paleoclimate proxies, notably mercury concentrations and isotopes, need to be interpreted in conjunction with the organic content of the investigated sediments, and pyrolysis data are therefore routinely acquired. We provide an update to a specific curated data package with all openly available pyrolysis data generated from Svalbard successions (Schad and Senger, 2025d; Table 3; Figure 1).

3.4.2 Mercury

Mercury (Hg) is an important indicator of past volcanic eruptions (Grasby et al., 2019b), as volcanoes are a key source of atmospheric Hg that leads to global dispersal. Variations in Hg contents and Hg/TOC ratios are used as a proxy for enhanced volcanic activity in the rock record. Thus far, only a handful of studies have utilised this proxy from Svalbard strata (Grasby et al., 2016; Hammer et al., 2019; Jones et al., 2019). We provide a specific curated data package with all mercury data from Svalbard (Schad and Senger, 2025c; Table 3; Figure 1).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

3.4.3 Petrophysics (porosity, permeability)

Quantitative data on reservoir properties (notably porosity, permeability and net-to-gross ratio) are crucial parameters for applied subsurface work, including CO_2 storage (Olaussen et al., 2019; Senger et al., 2015). However, they are also important in the context of deep-time paleoclimate research as they constrain past fluid migration. Petrophysical datasets may include either point sets from laboratory measurements (e.g., Mørk, 2013) or curves calculated from wireline logs (e.g., Nuus et al., 2026).

3.5 Age model

Obtaining a robust age model is crucial in any paleoclimate study because it constrains the timing and duration of events, including biotic responses to past climatic and environmental perturbations. Svalbard's stratigraphy is relatively well constrained biostratigraphically in some intervals (Schad et al., 2026), but independent absolute ages provided by, for example, radiometric dating or magnetostratigraphy are still limited (Smyrak-Sikora et al., 2025). They would allow for more precise correlation of Svalbard's successions to global stratigraphic frameworks and a better quantification of rates and durations of past climatic and environmental change.

We provide an age-constraint data package for Svalbard (Schad and Senger, 2026) to give a geographical, geological and geochronological overview of published literature on radiometric (U-Pb, Re-Os), tephrochronologic, thermochronologic, magnetostratigraphic, cyclostratigraphic and chemostratigraphic data across Svalbard's stratigraphy (Schad and Senger, 2026; Figure 2). Further, a similar data package is provided herein as an overview to Svalbard's biostratigraphic literature (Schad et al., 2026; Figure 3).

3.5.1 Radiometric dating

Absolute ages of certain geologic events are highly valuable to constrain age models. These are not only applicable to the dated sample itself, but they can also be applied to undated strata via correlation using other geochronologic or chronostratigraphic methods, e.g., tephrochronology or magnetostratigraphy (see Sect. 3.5.2, 3.5.4). Furthermore, uranium-lead (U-Pb) and argon-argon ($^{40}Ar/^{39}Ar$) radiometric dating has been used to constrain the emplacement of HALIP sills in Svalbard (Corfu et al., 2013; Polteau et al., 2016; Sartell et al., 2025).

Rhenium-osmium (Re-Os) radiometric dating relies on the beta decay of the isotope ^{187}Re to ^{187}Os and is especially useful in obtaining absolute depositional ages of organic-rich sediments (Yin et al., 2023). In Svalbard, Re-Os has been applied to constrain the age of the Agardhfjellet (Park et al., 2024) and Botneheia (Xu et al., 2009) formations.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

3.5.2 Tephrochronology

Ash layers (i.e., bentonites) provide very useful absolute geochronological constraints. In Svalbard, U-Pb dating of bentonites has provided absolute age constraints for the Paleocene and Paleocene/Eocene boundary (Charles et al., 2011; Jones et al., 2017, 2025), the Barremian/Aptian boundary (Midtkandal et al., 2016; Zhang et al., 2021) and the Permian/Triassic boundary (Zuchuat et al., 2020). Bentonites have also been reported from the lowermost Triassic around the EPME interval (Zuchuat et al., 2020, 2026a) and the Upper Triassic (Chlebowski and Wierzbowski, 2010).

3.5.3 Thermochronology

Thermochronology uses apatite fission track (AFT) and apatite/zircon (U-Th-Sm)/He(A_{He}/Z_{He}) methods to constrain uplift and exhumation phases by characterising their thermal history. This approach has been applied, for instance, to characterise uplift along Svalbard's northern coast (Dörr et al., 2012, 2019a, b) and to better constrain tectonic evolution along western Spitsbergen (Schaaf et al., 2021; Meier et al., 2024). A data compilation of thermochronological data from Svalbard has recently been published (Data package ADP3 in Senger et al., 2025b).

3.5.4 Magnetostratigraphy

Magnetostratigraphy allows for the correlation and dating of sedimentary successions. In Svalbard, magnetostratigraphy has been applied to the Permian–Triassic succession (Hounslow et al., 2007, 2008a, 2008b; Nawrocki, 1999). A review of these data is provided by Hounslow and Nawrocki (2008). Further, Hounslow et al. (2022) used magnetostratigraphy and organic carbon isotopic changes to better constrain the base of the Norian in Svalbard. Zhang et al. (2021) used magnetostratigraphy and tephrochronology to refine the Barremian/Aptian boundary in drill cores in Adventdalen.

3.5.5 Chemostratigraphy

Chemostratigraphy uses chemical "fingerprinting" of the variation of inorganic and organic chemical variations to characterise trends in the studied rocks, using, for instance, elemental or isotopic compositions. Chemostratigraphy also facilitates regional to global correlation of key sedimentary sections. In Svalbard, chemostratigraphy has been applied, amongst others, to organic-rich shales such as the Middle Triassic Botneheia Formation (Wesenlund et al., 2022), the Upper Jurassic–Lower Cretaceous Agardhfjellet Formation (Koevoets et al., 2016), the Lower Cretaceous Rurikfjellet, Helvetiafjellet and Carolinefjellet formations (Vickers et al., 2016, 2019), and the PETM-hosting Paleogene Frysjaodden Formation (Charles et al., 2011).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

3.5.6 Cyclostratigraphy

Cyclostratigraphy studies the imprint of high-frequency astronomical cycles (i.e., Milankovitch cycles) in the sedimentary record. Cyclical changes in the eccentricity of the Earth's orbit and the degree of obliquity (axial tilt) both have a strong influence on the strength of the seasons. The precession (rotation) of the tilt axis modulates which hemisphere is most affected by eccentricity and/or obliquity forcing, which is critical if there is a large difference in the dispersal of land masses between the two hemispheres as there is today. Thus, these orbital variations create rhythmic patterns in sediments on timescales of thousands to hundreds of thousands of years. Cyclostratigraphic studies in Svalbard are concentrated on the Paleogene Frysjaodden Formation (Charles et al., 2011; Dypvik et al., 2011; Harding et al., 2011), the Permian Kapp Starostin Formation (Jafarian et al., 2017) and the Late Carboniferous Wordiekammen Formation (Blomeier et al., 2009).

3.5.7 Biostratigraphy

Fossilised fauna, flora and protists can be used to determine the relative age of sedimentary successions because the first and last appearances of specific taxa can be used to constrain the age of sedimentary successions. Although age-deterministic fossils can be scarce in some of Svalbard's Phanerozoic succession, the range of time intervals and fossil groups that have been investigated to-date is considerable (Figure 4). Here we provide a data package summarising a selection of biostratigraphic studies from Svalbard (Schad et al., 2026).

3.6 Environment and climate

3.6.1 Macrofossils

Macrofossils can be studied to reconstruct paleo-communities and patterns of origination, evolution and extinction, as well as paleoenvironmental conditions such as the depositional environment and climatic conditions. In Svalbard, fossil leaves and wood from terrestrial plants are preserved in, for instance, Paleogene strata. Marine macrofossils recovered from Svalbard include diverse invertebrates such as brachiopods, bivalves, ammonoids and bryozoans (e.g., Buchan et al., 1965; Nakrem and Mørk, 1991; Nakrem et al., 2009). Furthermore, Lower Triassic ichthyosaur fossils from Svalbard represent the earliest report globally of marine reptiles to-date (Roberts et al., 2025).

3.6.2 Microfossils

Changes in microfossil assemblages can be used for paleoenvironmental and paleoclimatic reconstructions. In addition, geochemical properties of microfossils, for example, $\delta^{18}O$ composition of calcareous shells, can provide insights into past seawater temperatures and the $\delta^{18}O$ of seawater, both of which are influenced by the extent of global ice sheets. Several marine microfossil groups are abundantly reported across Svalbard's sedimentary succession, such as conodonts (e.g., Leu et al., 2024;

Nakrem et al., 2008; Zuchuat et al., 2020), foraminifera (Hjálmarsdóttir et al., 2022; Nagy et al., 2011, 2026), ostracods (Nagy et al., 2011; Olempska and Blaszyk, 1996; Weitschat, 1983), and radiolarians (Foster et al., 2023; Maletz and Bruton, 2007; Nakrem and Kiesling, 2012; Osvárt et al., 2026), as well as minute bivalves, brachiopods, gastropods (Foster et al., 2017), sponge spicules (Foster et al., 2023), crinoid fragments (Salamon et al., 2015), and fish teeth (Błażejowski et al., 2013; Scharling et al., 2025).

3.6.3 Palynomorphs and palynofacies

Palynomorphs comprise microscopic, organic-walled microfossils. This group includes spores and pollen (reproductive cells of land plants), dinoflagellate cysts (resting cysts of marine or freshwater dinoflagellates), acritarchs (resting cysts of marine phytoplankton) and a diverse group of non-pollen palynomorphs. Palynofacies is the assemblage of acid-resistant, microscopic particulate organic matter in a sedimentary package, including palynomorphs (e.g., Batten, 1982). Palynofacies analysis is a powerful tool for reconstructing past depositional environmental changes and assessing proximal–distal trends (Tyson, 1990), including in Svalbard (e.g., Smelror, 2016). Marine palynomorphs have proven very useful in providing a stratigraphic framework (e.g. Pross et al., 2026) and were succefully applied to several successions in Svalbard (e.g., Manum and Throndsen, 1986; Mørk et al., 1990, Smelror and Dypvik, 2005; Sliwinska et al., 2020). Terrestrial pollen and spores are particularly useful in reconstructing vegetation changes and the response of land plants to climatic events (e.g. Daniau et al., 2019) and have also provided insight into the past vegetation of Svalbard (e.g., Bjærke and Manum, 1977; Vigran et al., 2014).

3.6.4 Trace fossils and ichnofabrics

Trace fossils and characterisation of ichnofabrics (sedimentary fabrics caused by burrowing and sediment-mixing activities) provide valuable and *in situ* records of the behaviours of past burrowing animals (infauna). In conjunction with sedimentary and lithostratigraphic, geochemical and body fossil data, they can also help refine interpretations of the depositional environments in which trace-making organisms (and associated epifauna) lived (e.g., Seilacher, 1967), as well as documenting biotic responses to paleoenvironmental changes and the nature and pace of ecosystem recovery from such perturbations (e.g., Twitchett and Barras, 2004; Zuchuat et al., 2020; Rodriguez-Tovar et al., 2021; Beaty et al., 2025). As such, the integration of trace-fossil analysis in geological research in Svalbard has provided additional insights into local paleoenvironmental evolution and elucidated infaunal responses to regional and global-scale climatic shifts and biotic crises. Uchman and Hanken (2024) studied the Cambrian–Ordovician at Basissletta. The EPME and its aftermath were characterised by Beaty et al. (2025; DD1 core, Lusitaniadalen, Reinodden, Festningen), Rodriguez-Tovar et al. (2021; Deltadalen DD1 core), Uchman et al. (2016; Marmierfjellet and Belvederdalen), and Wignall et al. (1998; Festningen). Worsley and Mork (2001) documented the ichnodiversity of trace fossil assemblages throughout the Triassic at Festningen.

3.6.5 Biomarkers

Lipid biomarkers are molecular fossils that can complement the records provided by micro- and macrofossils. They provide insights into microbial and primary producer ecosystems, with varying specificity for certain taxonomic groups or metabolic pathways (Summons et al., 2022). Furthermore, lipid biomarkers can diagnose certain environmental conditions, for instance photic-zone euxinia (Nabbefeld et al., 2010b). In Svalbard, various biomarkers have been extracted to investigate primary producer and heterotrophic planktonic communities and carbon sources during selected time intervals, including the Ordovician (Lee et al., 2019), the Permian/Triassic boundary (Nabbefeld et al., 2010a; Buchwald et al., 2025, 2026), the Smithian/Spathian boundary (upper Olenekian; Blattmann et al., 2025a, b), the Lower Cretaceous (Vickers et al., 2019) and the PETM (Cui et al., 2021).

3.6.6 Weathering

The radiogenic strontium ($^{87}Sr/^{86}Sr$), neodymium ($^{143}Nd/^{144}Nd$) and osmium ($^{187}Os/^{188}Os$) isotope systems are powerful tracers of seawater mixing and terrestrial weathering. Each isotope system has highly distinct continental and mantle end members, and the ocean residence times of each element vary considerably, from hundreds (Nd) to thousands (Os) to millions (Sr) of years. However, in restricted seaways these elemental residence times may be considerably shorter and may alter rapidly in response to changes in input fluxes (e.g., Peucker-Ehrenbrink and Ravizza, 2000). This makes these isotope systems sensitive to environmental changes such as shifts in continental weathering (e.g., Cohen et al., 2004), LIP volcanism, and seaway connectivity to epicontinental seas due to tectonic/endogenic processes (e.g., Jones et al., 2023). Wieczorek et al. (2013) present evidence of both LIP activity and enhanced weathering from PETM strata in Svalbard using $^{187}Os/^{188}Os$ data, underlining the strength of this paleoenvironmental proxy.

Lithium isotopes (δ^7Li) are another powerful tool for understanding changes to weathering and the hydrological cycle. Lithium isotopes are strongly fractionated during clay formation. Therefore, changes to δ^7Li provide a key proxy for silicate weathering intensity or congruency (e.g., Dellinger et al., 2017), which is one of the most important atmospheric CO_2 sinks on >10 kyr timescales, as well as for reverse weathering (marine authigenic clay formation) that can serve as a CO_2 source (e.g., Rauzi et al., 2024). Together with other proxies, Li isotopes can inform regional changes in surface temperatures, the strength of the hydrological cycle and extent of authigenic clay production, as shown from Lower Triassic (Rauzi et al., 2024) and PETM strata in Svalbard (Pogge von Strandmann et al., 2021).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

3.6.7 Iron speciation

Iron speciation data are used for redox reconstructions (i.e., oxic, anoxic, ferruginous, or euxinic conditions) based on the availability and reactivity of iron phases. This proxy has been applied to both the Deltadalen core (Schobben et al., 2020) and outcrop samples from Festningen (Schobben et al., 2020).

3.6.8 Major and trace elements

Major and trace elements provide insights both into chemostratigraphy (Sect. 3.5.5) and reconstruction of local to global seawater and seafloor chemistry. Handheld XRF scanners provide a quick and relatively inexpensive way of acquiring large data sets and have been used to characterise the Cenozoic (in the Sysselmannbreen drill cores; Doerner et al., 2020) and the Mesozoic (in the Longyearbyen CO_2 lab drill cores; Koevoets et al., 2016) successions. Mass spectrometry (including inductively coupled plasma–mass spectrometry [ICP-MS] and inductively coupled plasma-optical emission spectroscopy [ICP-OES]) analyses of bulk rock samples can also provide more accurate and higher-resolution measurements of trace and major elements. ICP-MS major and trace element (in particular, redox-sensitive trace element) data are reported from the Permian–Triassic transition at Reinodden, Festningen, Lusitanianadalen (outcrop samples) and Deltadalen (core samples) by Beaty et al. (2025).

3.6.9 Stable carbon isotopes

The ratio of the stable isotopes of carbon (^{13}C and ^{12}C, expressed as $\delta^{13}C$) measured in organic matter or carbonates may reflect global-scale perturbations in the carbon cycle; i.e., injection of sources of isotopically depleted carbon such as carbon dioxide or methane, or changes in the extent of production and burial of organic carbon. Large perturbations (i.e., beyond those associated with changes in local carbon source) are often associated with major global environmental and/or climatic changes, such as the EPME (Schobben et al., 2020; Zuchuat et al., 2020, 2026a), the Early Cretaceous Weissert Event (Jelby et al., 2020b), Ocean Anoxic Event 1a (Vickers et al., 2016, 2019), or the PETM (Cui et al., 2011). As such, perturbations in $\delta^{13}C$ that reflect shifts in the global dissolved inorganic carbon (DIC) reservoir are interpreted as global indicators and distinctive isotope excursions are therefore widely used as chemostratigraphic markers, to correlate sections that are poor in stratigraphically useful index fossils or radiometrically datable material. Across Svalbard, a number of studies have examined the organic carbon $\delta^{13}C$ record mostly for use as a stratigraphic tool, but also in order to understand the extent and environmental impact of associated events. We provide an update to the specific curated data package of all to us available $\delta^{13}C$ data for Svalbard (Schad and Senger, 2025a; Table 2; Figure 1).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

3.6.10 Oxygen isotopes

The oxygen isotope composition of a variety of minerals (particularly carbonate, bioapatite and silica) as the ratio of ^{18}O and ^{16}O, expressed as $\delta^{18}O$, can be used to reconstruct seawater temperatures or changes in climatic conditions (e.g., extents of ice sheet development), as well as salinity variations (e.g., through evaporation or influx of freshwater or other meteoric fluids). In Svalbard, $\delta^{18}O$ has been measured across several time intervals, for instance, in strata recording Early Cretaceous transient cooling and interruption of Cretaceous greenhouse conditions (Price and Nunn, 2010), and in Permian strata in which inferred seasonal temperature variation has been recorded (Mii et al., 1997; Nielsen et al., 2013). Furthermore, when combined with $\delta^{13}C$ measurements and fossil occurrences, $\delta^{18}O$ analysis of carbonate strata from the Sassenfjorden area has revealed hydrothermal seep activity during the latest Jurassic (Hammer et al., 2011). A specific curated data package of $\delta^{18}O$ data openly available from Svalbard is provided (Schad and Senger, 2025b; Table 3; Figure 1).

3.6.11 Productivity and nutrients

Nutrients such as nitrogen (N) and phosphorus (P) play a major role in regulating the productivity of biological communities. The availability of these macronutrients can be assessed through phosphorus speciation, determined through sequential extractions of distinct sedimentary phosphorus pools, and calculating the C:P ratio or nitrogen concentrations (Beaty et al., 2025; Blattmann et al., 2024; Schobben et al., 2020), thereby providing insights into the impact of past seafloor burrowing animal communities on seafloor nutrient regeneration (Beaty et al., 2025). Nitrogen isotopes ($\delta^{15}N$) can, when compared to $\delta^{13}C$ and coupled with elemental C/N ratios, inform interpretations about the balance between continental and marine sources of organic matter (Blattmann et al., 2024).

3.6.12 Glendonites

Glendonites are pseudomorphs after the metastable mineral ikaite (calcium carbonate hexahydrate, $CaCO_3 \cdot 6H_2O$) (Suess et al., 1982), the formation of which is favoured by low temperature conditions and the presence of an inhibitor of the more stable anhydrous polymorphs (e.g., calcite and aragonite) (Purgstaller et al., 2017; Zhou et al., 2015). Due to near-freezing temperatures favouring ikaite precipitation, and their frequent occurrence with glacial deposits, the presence of glendonites in the geological record is often used as a semi-quantitative indicator of prevailing low-temperature conditions in the waters from which they grew (Rogov et al., 2023; Scotese et al., 2021). Glendonites have been found across Svalbard in Cryogenian (Fairchild et al., 2016; Halverson et al., 2004; Halverson, 2011), Lower Cretaceous (Mikhailova et al., 2021; Price and Nunn, 2010; Vickers et al., 2018, 2019) and Paleogene (Spielhagen and Tripati, 2009) strata.

3.7 Pore fluids and the deep biosphere

3.7.1 Gas composition with depth

Huq et al. (2017) systematically extracted and analysed gas from various depths of the fully cored Longyearbyen CO_2 lab boreholes in Adventdalen in order to investigate subsurface fluid flow systems. The same data were also utilised to characterise multi-layered natural gas accumulations (Ohm et al., 2019) and abnormal pressure regimes (Birchall et al., 2020).

3.7.2 Deep biosphere

As far as we are aware, no deep biosphere research has yet been conducted in Svalbard. Elsewhere, including Arctic regions (Table 2), deep biosphere research demonstrates that subsurface microbial communities are highly diverse, metabolically active, and strongly shaped by pore fluid geochemistry (Bradley et al. 2019, Lever et al., 2015). High-throughput DNA and RNA sequencing, including metagenomics and metatranscriptomics, have enabled genome-resolved reconstruction of microbial metabolisms in deep aquifers and sediments (Gittins et al., 2018), identifying dominant functional guilds involved in major elemental cycling (e.g., C, N, P, S), such as methanogens, sulphate reducers, fermenters and chemolithotrophs (Dutta et al., 2018; Kadnikov et al., 2020; Magnabosco et al. 2019). These microbial processes are tightly linked to pore fluid chemical composition, where specific electron acceptors (e.g., Fe^{3+}, SO_4^{2-}, NO_3^-) and donors such as dissolved organic carbon and inorganic compounds are used to maintain microbial metabolisms (Gittins et al., 2018; Parkes et al., 2014; Soares et al., 2023). Studies have further shown the coexistence of active and preserved records of past microbial communities, where RNA-based approaches help distinguish viable populations from ancient DNA pools (D´Hondt et al., 2002; Long et al., 2016; Orcut et al., 2013; Willerslev et al., 2003, 2007). Together, these studies highlight the deep biosphere as globally distributed ecosystems that are still understudied, especially in relation to global biogeochemical cycles, and are characterised by extreme energy limitation and long-term microbial dominance and persistence.

Table 2: Summary of key deep biosphere studies. The studies encompass a range of terrestrial and marine subsurface environments, including crystalline bedrock aquifers, basalt-hosted ecosystems, deep-sea sediments, ferruginous lake sediments, and high-latitude ancient DNA archives.

Author/Year	Title	Study area	Study location
Bradley et al. (2019)	Survival of the fewest: microbial dormancy and maintenance in marine sediments through deep time	Marine sediment records	Global oceans
D'Hondt et al. (2002)	Metabolic activity of subsurface life in deep-sea sediments	Ocean Drilling Program sites	Global oceans

Dutta et al. (2018)	Exploration of deep terrestrial subsurface microbiome in Late Cretaceous Deccan traps and underlying Archean basement, India	Koyna Scientific Drilling Project, India	17.4°N, 73.8°E
Gittins et al. (2018)	A metagenomic window into the 2-km-deep terrestrial subsurface aquifer revealed multiple pathways of organic matter decomposition	Äspö Hard Rock Laboratory, Sweden	57.43°N, 16.67°E
Gittins et al. (2022)	Geological processes mediate a microbial dispersal loop in the deep biosphere	Marine sediment and hydrocarbon seep systems	Norwegian Margin / North Atlantic, sub-Arctic
Kadnikov et al. (2020)	Microbial life in the deep subsurface aquifer illuminated by metagenomics	Äspö Hard Rock Laboratory, Sweden	57.43°N, 16.67°E
Lever et al. (2015)	Life under extreme energy limitation: a synthesis of laboratory- and field-based investigations	Review article	Global
Long et al. (2016)	Microbial metagenomics reveals climate-relevant subsurface biogeochemical processes	Review article (multiple deep subsurface sites)	Global
Magnabosco et al. (2018)	The biomass and biodiversity of the continental subsurface	Global synthesis	Global
Orcutt et al. (2013)	Microbial activity in the marine deep biosphere: progress and prospects	Review article	Global oceans
Parkes et al. (2014)	A review of prokaryotic populations and processes in sub-seafloor sediments, including biosphere:geosphere interactions	Review of IODP/ODP sites	Global oceans, Arctic sites included
Soares et al. (2023)	A global perspective on bacterial diversity in the terrestrial deep subsurface	Meta-analysis	Global
Willerslev et al. (2003)	Diverse plant and animal genetic records from Holocene and Pleistocene sediments	Permafrost deposits, Siberia	~68°N, 161°E, Arctic
Willerslev et al. (2007)	Ancient biomolecules from deep ice cores reveal a forested Southern Greenland	Southern Greenland ice core	~73°N, 39°W, Arctic

4 Data packages: collections of deep-time data from Svalbard

We have compiled and curated data packages for four important paleoclimate proxies throughout the Phanerozoic in Svalbard, namely $\delta^{13}C$, $\delta^{18}O$, pyrolysis and mercury (Schad and Senger, 2025a, b, c, d; Table 3). Two of these data packages, $\delta^{13}C$ and pyrolysis, were updated with this contribution encompassing more data that was made available to us as well as newly published data. The aim with these collections is to provide a geographical, geological and geochronological overview of these data (Figure 3) to facilitate their re-use by intercomparison and multidisciplinary approaches.

- The $\delta^{13}C$ data package consists of 38 publications covering the upper Cambrian–Eocene interval and includes 3528 individual data points.
- The $\delta^{18}O$ data package comprises 10 publications covering the Devonian–Paleocene interval and includes 405 individual data points.
- The pyrolysis data package consists of 24 publications covering the upper Cambrian–Paleocene interval and includes 1010 individual data points.
- The mercury data package comprises 5 publications covering the upper Permian–Eocene interval and includes 893 individual data points.

In addition, we provide two new curated data packages on age constraints and biostratigraphy throughout the pre-Quaternary Phanerozoic in Svalbard (Table 3). The age constraints data package includes radiometric (U-Pb, Re-Os), tephrochronologic, magnetostratigraphic, thermochronologic, chemostratigraphic and cyclostratigraphic data, whereas the biostratigraphy data package deals with various age-distinctive micro- and macrofossil assemblages. The motivation behind this was to provide a multidisciplinary overview of the geochronological and chronostratigraphic constraints on Svalbard's sedimentary succession (Figure 4, 5).

- The age control data package includes 39 publications covering the Pennsylvanian–Eocene (Neogene for thermochronology).
- The biostratigraphy data package includes 56 publications covering the Lower Ordovician–Oligocene.

Table 3: Curated data packages relevant to characterise deep-time paleoclimate and paleoenvironments. S1 = volatile hydrocarbon content, S2 = potential hydrocarbon content, S3 = CO_2 yield from kerogen, T_{max} = temperature at maximum S2 peak, PI = production index, OI = oxygen index.

Data package	Parameter/Method	Period	Location	Access	Dataset provider	Figure
Longyearbyen CO_2 lab	Various	2006–2025	Adventdalen	Senger et al. (2025b); https://doi.org/10.1139/as-2024-0019	UNIS (Kim Senger)	N/A

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

$\delta^{13}C$	$\delta^{13}C_{org}$, $\delta^{13}C_{carb}$, TOC, N, S	1997–2026	Svalbard	Schad and Senger (2025a); https://doi.org/10.11582/2025.m27ev9eu.v2	UNIS (Simon Schad)	Figure 3
$\delta^{18}O$	$\delta^{18}O_{carb}$, $\delta^{13}C_{carb}$	1997–2024	Svalbard	Schad and Senger (2025b); https://doi.org/10.11582/2025.7l4tao47.v2	UNIS (Simon Schad)	Figure 3
Mercury	Hg, TOC, Hg/TOC	2016–2023	Svalbard	Schad and Senger (2025c); https://doi.org/10.11582/2025.9h4pe0bz.v2	UNIS (Simon Schad)	Figure 3
Pyrolysis	S1, S2, S3, TOC, T_{max}, PI, HI, OI	1980–2026	Svalbard	Schad and Senger (2025d); https://doi.org/10.11582/2025.kmemmsdj.v2	UNIS (Simon Schad)	Figure 3
Age constraints	Radiometric dating, tephrochronology, magnetostratigraphy, thermochronology, chemostratigraphy, cyclostratigraphy	1998–2026	Svalbard	Schad and Senger (2026); https://doi.org/10.11582/2026.sb74rnzq	UNIS (Simon Schad)	Figure 4
Biostratigraphy	Various microfossils and macrofossils	1921–2026	Svalbard	Schad et al. (2026); https://doi.org/10.11582/2026.qnrzpfz1	UNIS (Simon Schad)	Figure 5
Deltadalen data package	Sedimentary logs, $\delta^{13}C_{org}$, TOC, HI, mercury, core images, hyperspectral images, XRF core-scan data, X-ray diffraction (XRD), CT-scan images	2014 – 2026	Deltadalen	Zuchuat et al. (2026b); https://doi.org/10.5281/zenodo.20535690	UiO (Valentin Zuchuat)	Figure 8

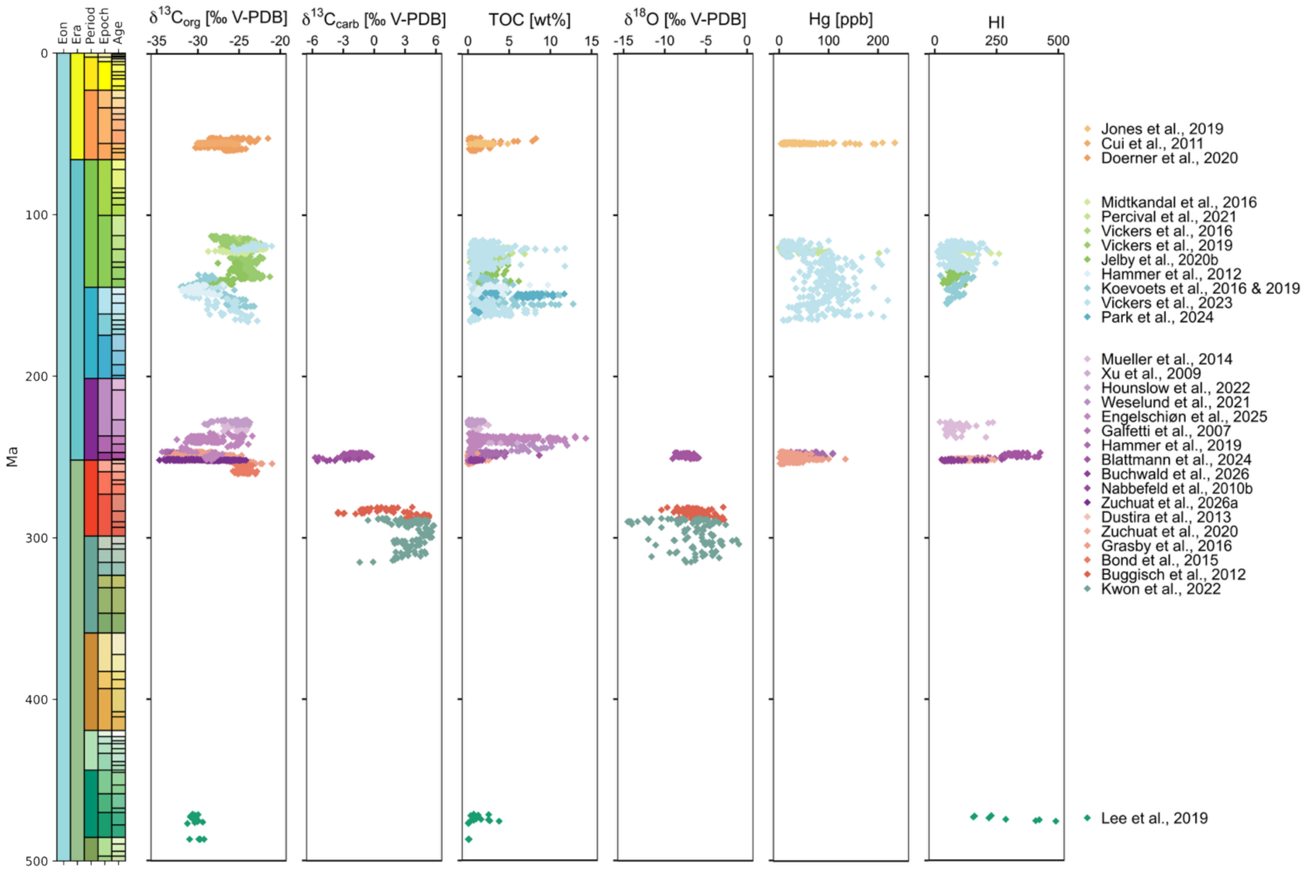
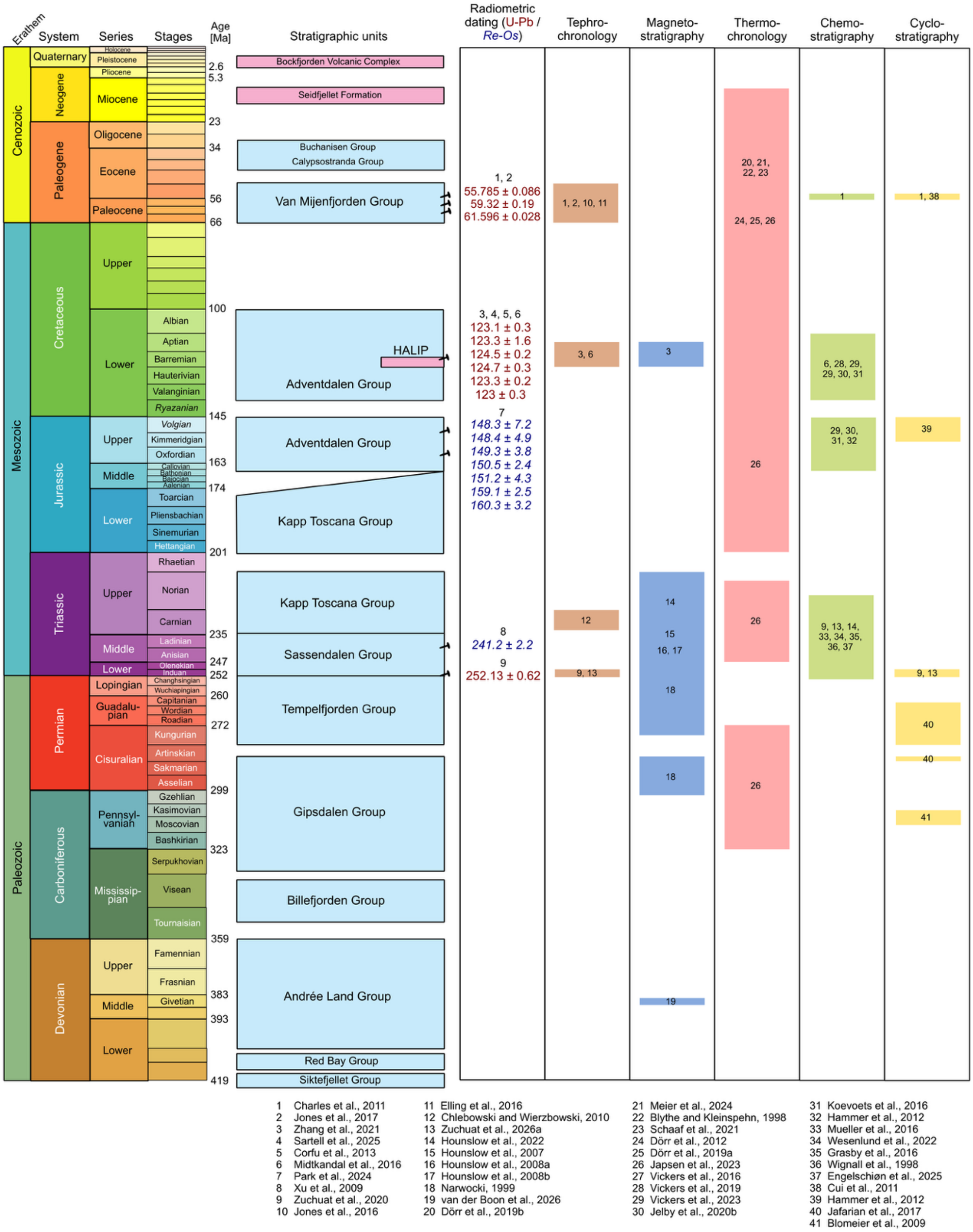


Figure 3: Overview of the curated data in the paleoclimatic and paleoenvironmental proxy data packages: Stable carbon isotopes [$\delta^{13}C_{org}$, $\delta^{13}C_{carb}$], total organic carbon (TOC), oxygen isotopes [$\delta^{18}O$], mercury (Hg) and hydrogen index (HI). For access to the data please refer to the data packages (Schad and Senger, 2025a, b, c, d) or directly to the studies mentioned therein. To plot these data, a crude linear depth-time relationship was applied for the sole purpose of visualisation if the data had an available depth scale. V-PDB = Vienna Peedee Belemnite.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026



485 **Figure 4: Overview of the stratigraphic age constraints available from Svalbard. For access to the data please refer to the age constraints data package (Schad and Senger, 2026) or directly to the studies mentioned herein. Geologic time is drawn after the International Chronostratigraphic Chart (v2024-12) (Cohen et al., 2025). Stage names are shown when relevant to the data compilation and named in the *Boreal scheme* if applicable. Stratigraphic units are plotted after Dallmann et al. (2015) and Smyrak-Sikora et al. (2025).**

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

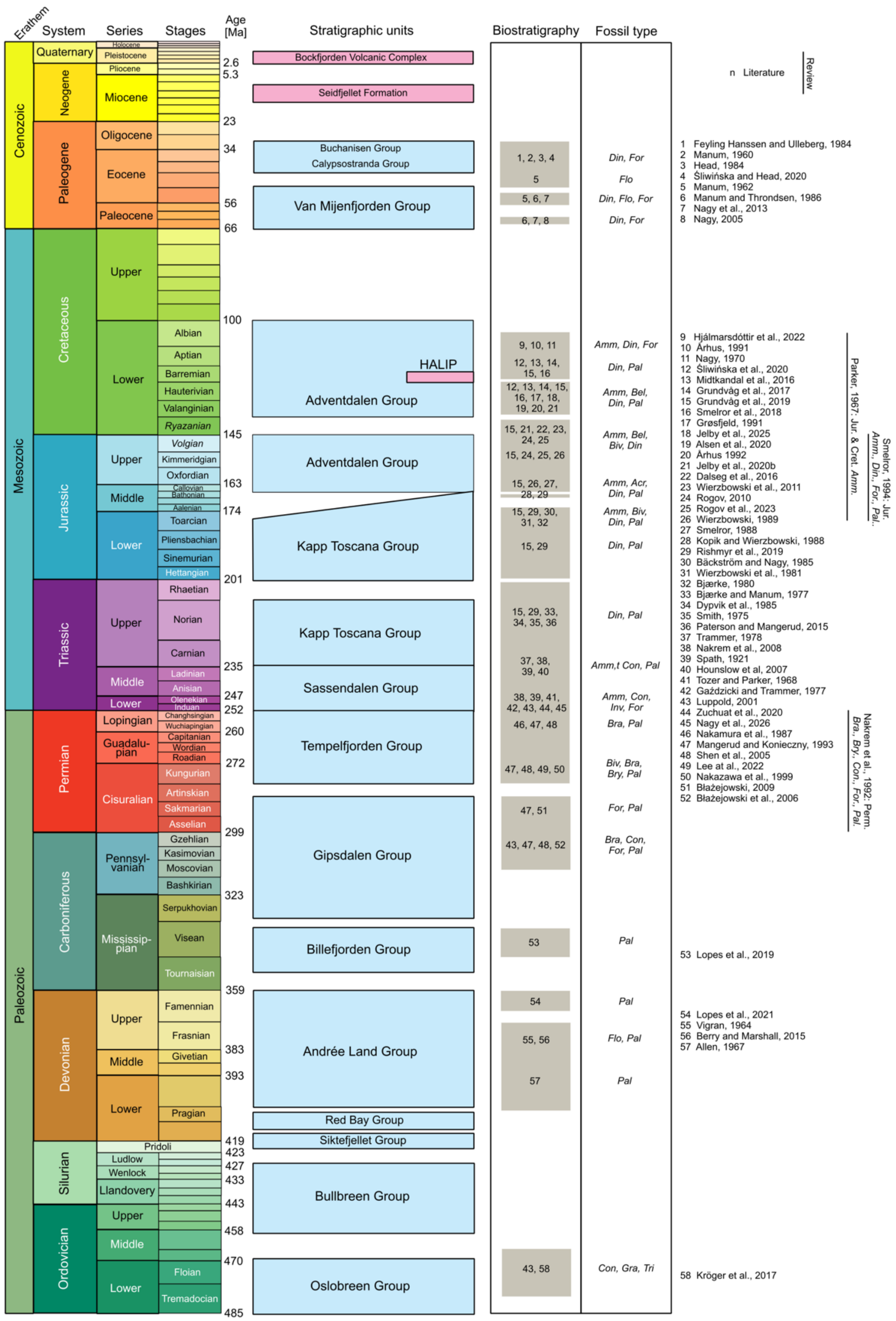
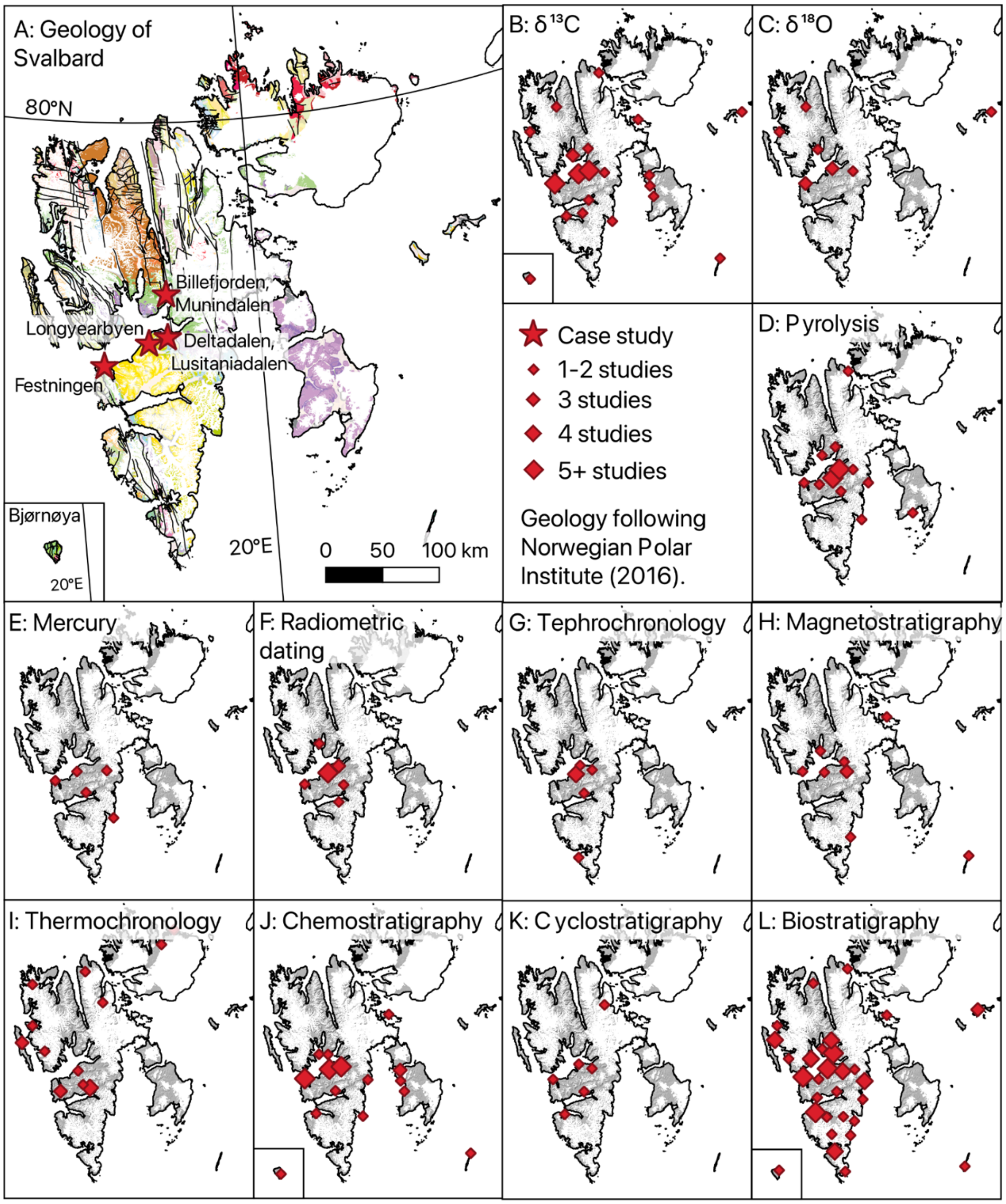


Figure 5: Overview of a selection of biostratigraphic age control available from Svalbard. For access to the data please refer to the age model data package (Schad et al., 2026) or directly to the studies mentioned therein. Fossil types are denoted as acritarchs (*Acr*), ammonites (*Amm*), bivalves (*Biv*), brachiopods (*Bra*), bryozoans (*Bry*), conodonts (*Con*), dinocysts (*Din*), flora (*Flo*), foraminifera (*For*), invertebrates (*Inv*), palynomorphs (*Pal*) and trilobites (*Tri*). Geologic time is drawn after the International Chronostratigraphic Chart (v2024-12) (Cohen et al., 2025). Stage names are shown when relevant to the data compilation and named in the *Boreal scheme* if applicable. Stratigraphic units are plotted after Dallmann et al. (2015) and Smyrak-Sikora et al. (2025).

5 Case studies: putting deep-time data in a regional context

We have selected four case studies to illustrate how the quantitative proxy data provided in our curated data packages (Table 3) can be integrated with descriptive site-specific data to place these in a general geologic context. Such additional data includes sedimentary logs, sample analyses and digital outcrop models. The selection of the case studies is based on the review of Smyrak-Sikora et al. (2025), with the sites corresponding to the areas where most deep-time paleoclimate research in Svalbard has previously focused, as is highlighted by our data collections (Figure 6).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026



505 **Figure 6: Geologic map of Svalbard showcasing the locations of the four case studies (a). Further overview of the geographical range of the studies in the herein presented data packages (Schad and Senger, 2025a, b, c, d, 2026; Schad et al., 2026): (b) $\delta^{13}C$, (c) $\delta^{18}O$, (d) pyrolysis, (e) mercury, (f) radiometric dating, (g) tephrochronology, (h) magnetostratigraphy, (i) thermochronology, (j) chemostratigraphy, (k) cyclostratigraphy, and (l) biostratigraphy. Map data from the Norwegian Polar Institute (2014, 2016).**

5.1 Longyearbyen CO_2 lab, Adventdalen, Deltaneset and Janusfjellet

The Longyearbyen CO_2 lab project was initiated in 2006 to determine whether the subsurface beneath Longyearbyen is suitable for storing CO_2 captured from the local coal-fuelled power plant (Braathen et al., 2012b). Apart from confirming that adequate storage capacity is present for the modest volumes required (Senger et al., 2015), the project also generated an extensive data set, including 4.5 km of fully cored Mesozoic strata in the Longyearbyen area (Olaussen et al., 2019; Senger et al., 2025b). Data generated from these sedimentary cores have been used to characterise the reservoir-cap rock system and facilitate numerous studies focussing on deep-time paleoclimate, paleoenvironments and stratigraphy, listed in Table 4. The Upper Jurassic to Lower Cretaceous succession (Figure 7) was particularly well studied in terms of sedimentology and isotopes. Importantly, the drill cores facilitate correlations to relevant outcrops in Svalbard (Figure 7). Due to the regional dip of the targeted succession, the project facilitated the combination of both drill cores in Adventdalen with outcrop-based work at Deltaneset-Janusfjellet ca 15 km northeast of the drill sites. The project's open data sharing policy has effectively turned the drill cores and associated datasets into a long-term legacy resource, expanding beyond the end of the project's operational phase in 2015. It enabled both core material and data reuse for new scientific projects outside the project's original objectives.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

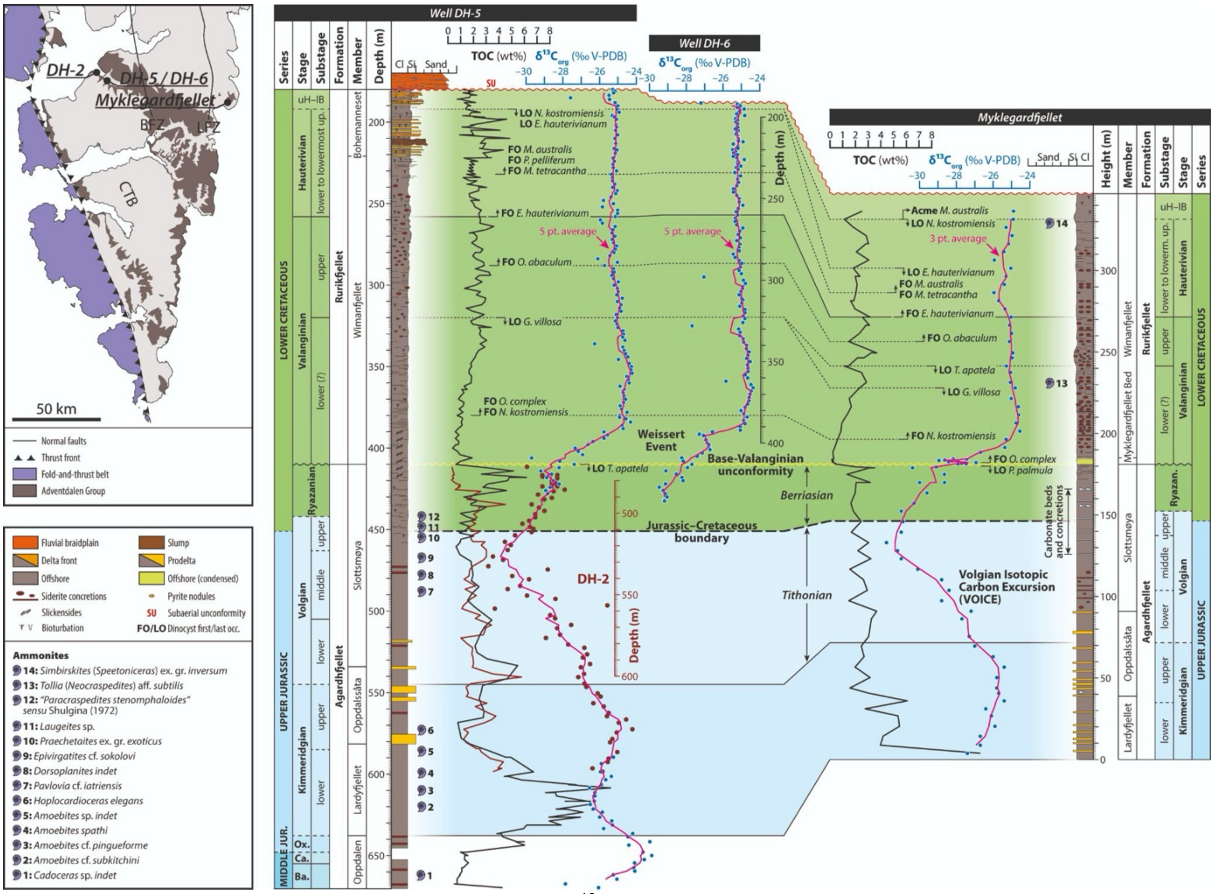


Figure 7: Correlation of organic stable carbon isotope ($\delta^{13}C_{org}$) stratigraphy between representative CO_2 lab well cores (DH-2, DH-5 and DH-6) in the vicinity of Longyearbyen and the Myklegardfjellet outcrop section at the eastern coast of Spitsbergen, calibrated by total organic carbon (TOC) trends, and dinocyst and ammonite biostratigraphy (compiled and modified from Jelby et al., 2020b, 2025; Koevoets et al., 2016, 2019). The correlation illustrates the usefulness of the CO_2 lab wells for understanding stratigraphic architectures and trends that are not readily discerned in outcrop sections. The boundary between the Agardhfjellet and Rurikfjellet formations (conforming to a base-Valanginian unconformity and demarcated by a marked drop in TOC values) is used as a correlation datum. Note the clear expression of the Weissert Event and VOICE in the different sections. For details on the dinocyst bioevents, the reader is referred to Jelby et al. (2020b, 2025) and Śliwińska et al. (2020). uH–lB: upper Hauterivian–lower Barremian. Figure adapted from Jelby et al. (2025).

Table 4: Summary of published studies with relevance for deep-time paleoclimate and paleoenvironment reconstruction conducted on the Longyearbyen CO_2 lab project drill cores. Refer to Senger et al. (2025b) for details on the project's online regularly updated publication database which is available at https://www.zotero.org/groups/5391614/longyearbyencolab/collections/TMN4HRD5.

Reference	Stratigraphy, Formations (Fm.)	Borehole, Outcrop	Chrono-stratigraphy	Data types	No. of samples	Age constraint
Corfu et al. (2013)	Diabasodden suite, Helvetiafjellet Fm.	Dolerite sills in outcrop, DH-3	Barremian	U-Pb dating	2 dolerite sills, 1 bentonite	Absolute U-Pb ages: 124.5 ± 0.2, 124.7 ± 0.3, 123.3 ± 0.2

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Grundvåg et al. (2019)	Rurikfjellet Fm. to lower Caroline-fjellet Fm.	DH-1 to DH-7 (correlation to Festningen, other outcrops)	Valangian–Aptian	TOC, pyrolysis, biostrat., litho-facies	14 pyrolysis, 38 dinocysts	Dinocyst biostratigraphy
Jelby et al. (2020b)	Uppermost Agardhfjellet Fm., Rurikfjellet Fm., lowermost Helvetiafjellet Fm.	DH-5, DH-6 (correlation to Bohemanneset, Myklegardfjellet)	Ryazanian–Hauterivian	TOC, $\delta^{13}C$, lithofacies	389 bulk-rock	Dinocyst biostratigraphy from Śliwińska et al. (2020), age-distinctive ammonite, $\delta^{13}C$ chemostrat.
Jelby et al. (2025)	Rurikfjellet Fm. (formal definition of Adventpynten Mb., Boheman-neset Mb. and Fotografryggen Mb.)	DH-1, DH-2, DH-4, DH-5, DH-6, and Rurikfjellet Fm. Reference and type sections	Valangian–lower Barremian	Lithofacies, and synthesis of latest sedimentiological, biostratigraphic, petrophysical, sequence stratigraphic, che-mostratigraphic and chronostrati-graphic results	5 new sections with lithofacies, other data based on prev. publications	Biostratigraphy (Dinocysts from Śliwińska et al. (2020) and age-distinctive ammonites)
Koevoets et al. (2016)	Agardhfjellet Fm.	DH2, DH-5	Bathonian–Volgian	$\delta^{13}C$, TOC, pyrolysis, ammonites	77 samples DH-2 and 31 samples DH-5	$\delta^{13}C$ chemo-stratigraphy
Koevoets et al. (2019)	Agardhfjellet Fm.	DH2, DH-5	Bathonian–Volgian/ Ryazanian	Lithofacies, wireline logs, XRF geochem-istry, biostratigraphy	-	$\delta^{13}C$ chemo-stratigraphy, ammonite and dinocyst biostratigraphy
Midtkandal et al. (2016)	Upper Helvetia-fjellet Fm. to lower Carolinefjellet Fm.	DH-1, DH-3, DH-7	Hauterivian–Aptian	U-Pb dating, TOC, $\delta^{13}C$, Hg, dinocysts, lithofacies (based on prev. publ.)	1 bentonite (U-Pb), 39 pyrolysis and $\delta^{13}C$, 17 dinocysts	123 ± 0.3 for bentonite, $\delta^{13}C$ chemostratigraphy, biostratigraphy
Rismyhr et al. (2019)	Knorringfjellet Fm. (uppermost De Geerdalen Fm. to lowermost Agardhfjellet Fm.)	DH-2, DH-4, DH-5, DH-7	Carnian–Callovian	Palynology, lithofacies	33 palynology from DH-2, DH-4	Palynomorph biostratigraphy
Senger et al. (2014)	Diabasodden suite contact aureole in lower De Geerdalen Fm.	DH-4	c. 124.5 Ma sill emplacement	TOC, $\delta^{13}C$, elements	33 + 1 from sill	Corfu et al., (2013) U-Pb dating of sill

Śliwińska et al. (2020)	Rurikfjellet Fm. to lower Caroline-fjellet Fm.	Bohemanflya, Myklegardfjellet, Ullaberget, and DH-1, DH-2, DH-5R	Valangian–Aptian	Dinocysts, lithofacies based on prev. publ.	82 outcrop, 40 core samples	Dinocyst biostratigraphy

5.2 Deltadalen and Lusitaniadalen

The 2014 Deltadalen drilling campaign targeted the upper Permian Kapp Starostin Formation and the Lower Triassic Vikinghøgda Formation to provide high-resolution records across the EPME and the subsequent recovery phase. Two "twin" cores were recovered from the drilling site, ca 2 m from each other (78°15.81'N, 16°52.16'E), and are to-date the only boreholes drilled specifically for deep-time paleoclimate studies in Svalbard (Figure 6). The diameter of the core is 3.18 cm. The two boreholes reached ca. 100 meters below surface (mbs), with a core-recovery rate of nearly 100% below the first 10 m of loose Quaternary cover. These cores were correlated to the neighbouring river section (Deltadalen) that allowed for additional sampling of rock for biostratigraphic and geochronologic analyses. The material collected during this campaign has allowed for a series of analyses (Table 5) to improve both regional and global understanding of the EPME and its aftermath (e.g., Beaty et al., 2025; Nagy et al., 2026; Rodriguez-Tovar et al., 2021; Schobben et al., 2020; Zuchuat et al., 2020), as well as identifying longer-term trends across the Triassic stratigraphy of the Barents Shelf (e.g., Lerch et al., 2018). They can also be correlated to the nearby Deltadalen and Lusitaniadalen outcrops at which several studies investigating the microfossil record, bioturbation and geochemical changes across the Permian–Triassic environmental crisis have been conducted (Beaty et al., 2025; Buchwald et al., 2025, 2026; Foster et al., 2017, 2022, 2023; Nabbefeld et al., 2010; Osvárt et al., 2026).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

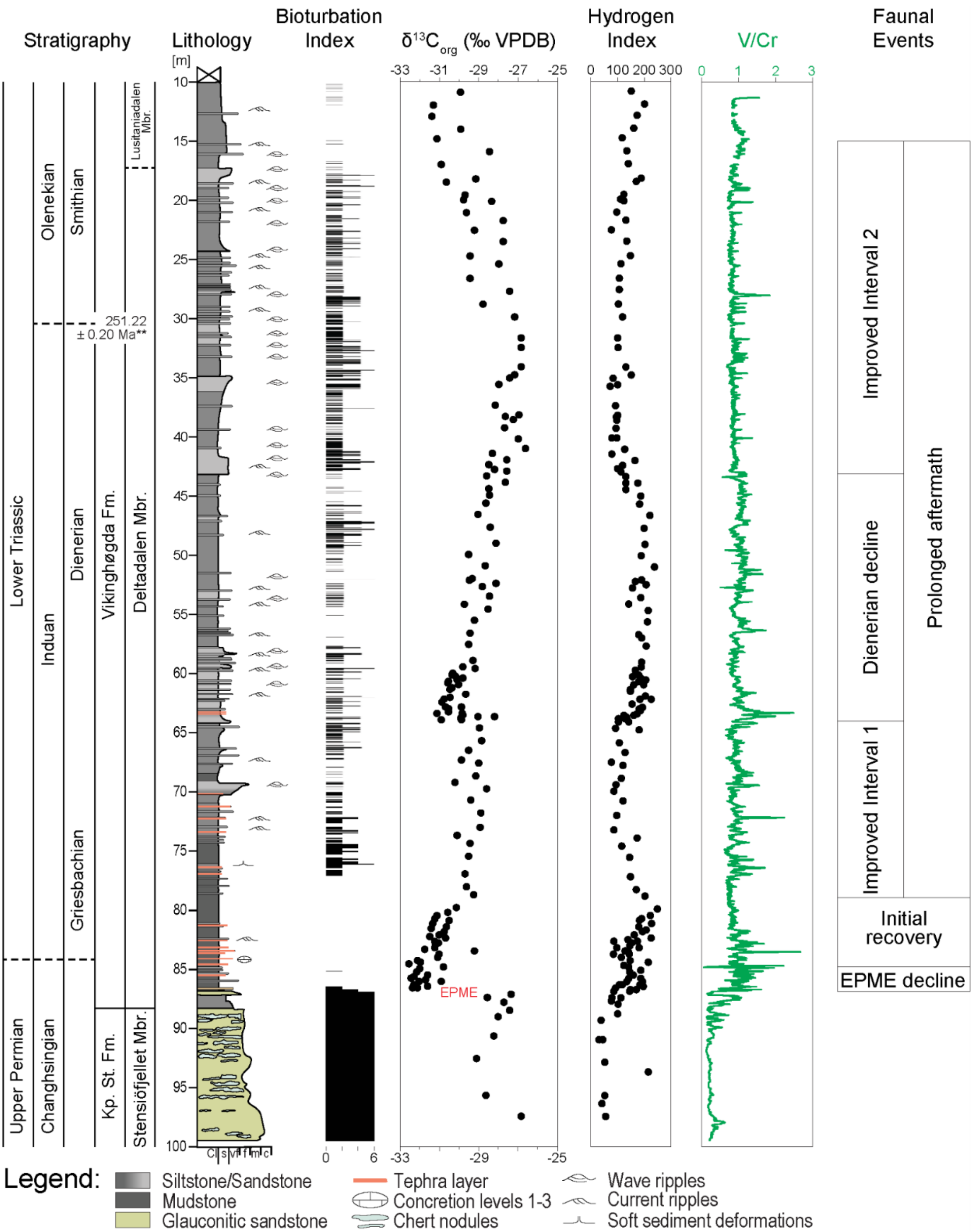


Figure 8: Illustration of some of the analyses conducted on the Deltadalen DD-1 and DD-2 cores. Figure modified from Nagy et al. (2026). VBDP = Vienna Peedee Belemnite. EPME = End-Permian Mass Extinction.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Table 5: Summary of published deep-time paleoclimate studies conducted on the Deltadalen drill cores.

Reference	Stratigraphy, Formations (Fm.)	Borehole, log interval (m)	Chrono-stratigraphy	Data types	No. of samples	Age constraint
Beaty et al. (2025)	Kapp Starostin and Vikinghøgda Fm.	DD-1; 10-100 mbs (meters below surface); Lusitaniadalen, (correlation to Festningen, Reinodden)	Changhsingian–Olenekian (P–T)	Ichnofabric, TOC, total carbon (TC), total sulphur (TS), major and trace elements, P-speciation, V, U, Mo	194 DD-1, 15 Lusitaniadalen	Reference to Nagy et al., 2025; Schobben et al., 2020; Zuchuat et al., 2020.
Foster et al. (2023)	Kapp Starostin and Vikinghøgda Fm.	Lusitaniadalen, Deltadalen	Changhsingian–Induan (P–T)	Species diversity (siliceous marine organisms; radiolarians, sponges)	4 fossil yielding	Conodont and dating from Zuchuat et al. (2020)
Foster et al. (2022)	Kapp Starostin and Vikinghøgda Fm.	Lusitaniadalen	Changhsingian–Induan (P–T)	Fossilised shells of gastropods, bivalves	5 fossil yielding	Conodont and dating from Zuchuat et al. (2020)
Nagy et al. (2026)	Kapp Starostin and Vikinghøgda Fm.	DD-1 and DD-2; 16-90 mbs	Changhsingian–Olenekian (P–T)	Foraminifera	38 (of 40) productive samples	Conodont and dating from Zuchuat et al. (2020)
Rodríguez-Tovar et al. (2021)	Kapp Starostin and Vikinghøgda Fm.	DD-1; 75-88 mbs	Changhsingian–Induan (P–T)	Detailed trace fossil assemblage	-	Conodont and dating from Zuchuat et al. (2020)
Schobben et al. (2020)	Kapp Starostin and Vikinghøgda Fm.	DD-1; 80-100 mbs; (correlation to Festningen)	Changhsingian–Induan (P–T)	$\delta^{13}C$, TOC, Fe speciation, P, $\delta^{34}S$ Mo, U, and Re, microscale mineralogy	40	$\delta^{13}C$ chemostratigraphy, conodont from Zuchuat et al. (2020)
Zuchuat et al. (2020)	Kapp Starostin and Vikinghøgda Fm.	DD-1 and DD-2; 10-100 mbs; Deltadalen section	Changhsingian–Olenekian (P–T)	$\delta^{13}C$, TOC, pyrolysis, XRF, lithofacies, U-Pb dating, conodont biostratigraphy	167 $\delta^{13}C$, TOC and pyrolysis, 2 zircons, 3 conodonts	Absolute U-Pb age: 252.13 ± 0.62 Ma, *Hindeodus parvus*, (Induan-defining conodont), $\delta^{13}C$ chemostratigraphy, cyclostratigraphy

555 ## 5.3 Festningen

The Festningen section in western Spitsbergen (78°09.98'N, 13°94.32'E) is subvertically bedded along 5–10 m high cliffs, with exposure close to 100%, providing easy access to strata spanning the Permian to Paleogene. The Festningen section has been studied extensively by geologists since the early 1900s (early work was summarised by Hoel and Ørvin, 1937), and it has

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

been used for a number of deep-time paleoclimate studies (Table 6). Tectonism has tilted the layers to near-vertical, and extensive sedimentary logging and many lithostratigraphic type sections (e.g., Dallmann 1999) make this one of the best-studied sections in Svalbard and its only geotope. In this case study, we use a digital outcrop model (Senger et al., 2022) to tie these studies together in a matrix comprising the entire Festningen section and various proxies by integrating multiple studies spanning different portions of the stratigraphy (Figure 9).

The Permian/Triassic boundary and the EPME have been extensively studied at Festningen (e.g., Bond et al., 2015; Grasby et al., 2015; Table 6). The Cretaceous part of the section (Figure 9) is also well studied in terms of its sedimentology (e.g., Grundvåg et al., 2019; Jelby et al., 2025) and geochemistry (e.g., Vickers et al., 2023), with examples of dinosaur footprints (sadly now lost to coastal erosion) (Hurum et al., 2006), This is also an outstanding locality for observation of iron ooids (Mutrux et al., 2008), canon-ball concretions (Vickers, 2017) and glendonites (Vickers et al., 2018, 2019).

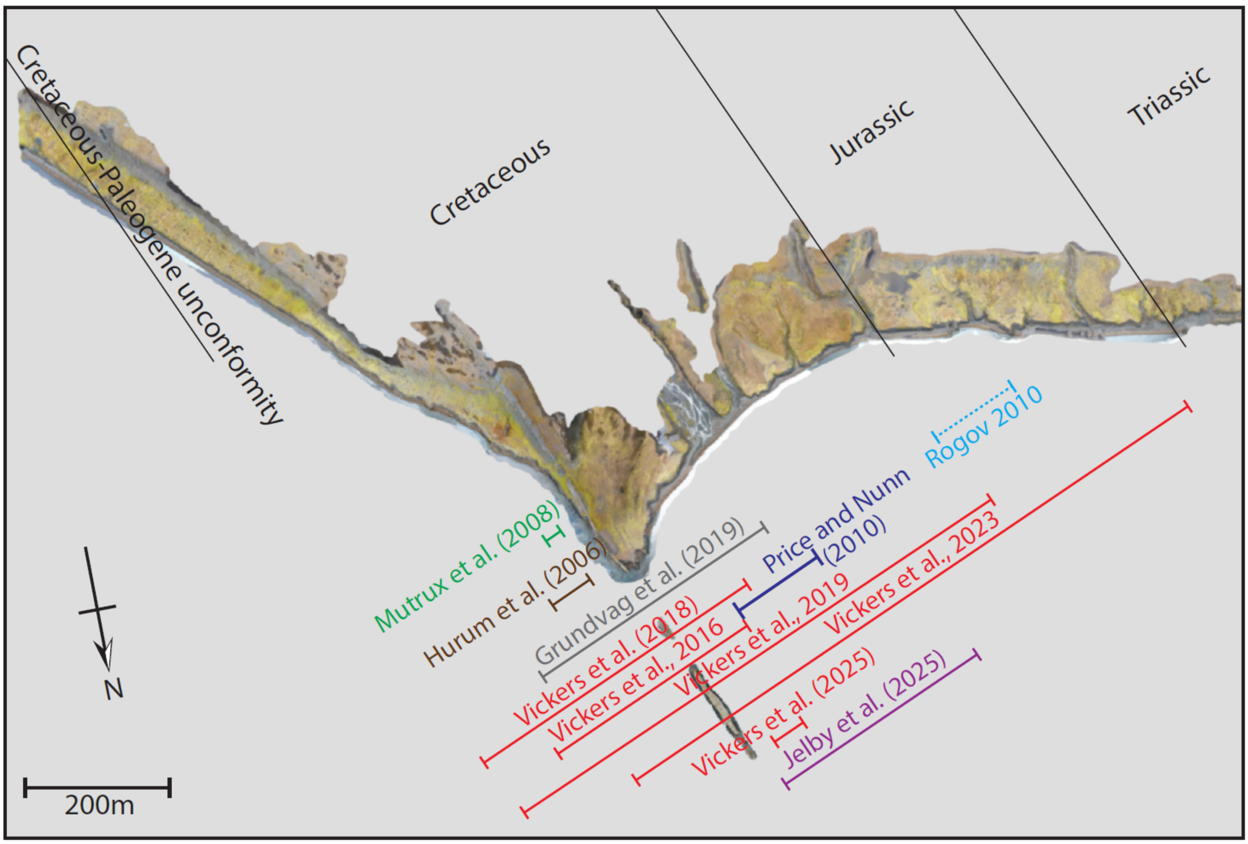


Figure 9: Integration of a selection of studies conducted in the Mesozoic part of the Festningen section, overlain on the digital outcrop model of Senger et al. (2022).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Table 6: Summary of published deep-time paleoclimate studies conducted on the Festningen outcrop.

Reference	Stratigraphy, Formations (Fm.)	Log interval (m)	Chrono-stratigraphy	Data types	No. of samples	Age constraint
Bond et al. (2015)	Kapp Starostin Fm.	0–90, continued at other sections	Capitanian–upper Permian	$\delta^{13}C$, redox proxies, brachiopods	-	$\delta^{13}C$ chemostratigraphy, brachiopod biostratigraphy
Grasby et al. (2016)	Kapp Starostin, Vardebukta, Tvillingodden Fms.	-100 – 500 of Kapp Starostin/ Vardebukta Fms. contact	Changhsingian–Olenekian (P–T)	$\delta^{13}C$, TOC, Hg	341	$\delta^{13}C$ chemostratigraphy
Grundvåg et al. (2019)	Rurikfjellet, Helvetiafjellet, Carolinefjellet Fms.	Total of 360, (correlation to Longyearbyen CO_2 lab)	Valangian–Aptian	Lithofacies	-	$\delta^{13}C$ chemostratigraphy from Vickers et al. (2016)
Hurum et al. (2006)	Helvetiafjellet Fm.	-	Barremian	Ornithopod dinosaur tracks	-	-
Jelby et al. (2025)	Rurikfjellet Fm. (Wimanfjellet and Bohemanneset Mbs.)	c. 0–310	Valangian–lower Barremian	Lithofacies, and synthesis of latest sedimentiological, biostratigraphic, petrophysical, sequence stratigraphic, chemostratigraphic and chronostratigraphic results	5 new sections with lithofacies, other data based on prev. publications	Reference to other sections and prev. publications
Mutrux et al. (2008)	Carolinefjellet Fm. (Dlakjegla Mb.)	0–30	Aptian	Lithofacies, iron ooids	-	-
Price and Nunn (2010)	Upper Rurikfjellet Fm.	-	Lower Valangian	$\delta^{13}C_{carb}$, $\delta^{18}O_{carb}$, cathodoluminescence, trace elements	44 belemnites and glendonites	Lithofacies and biostratigraphy from Hoel and Ørvin (1937)
Rogov (2010)	Agardhfjellet to lower Rurikfjellet Fms.	unclear, (correlation to Myklegardfjellet)	Kimmeridgian–Ryazanian (J–K)	Ammonites	-	Ammonite biostrat.
Senger et al. (2022)	Kapp Starostin to Firkanten Fms.	0–2250	Upper Permian–Paleocene	Digital outcrop model (DOM), regional log	-	-
Schobben et al. (2020)	Kapp Starostin to Vardebukta Fms.	c. -30–5 of P/T boundary	Changhsingian–Induan (P–T)	$\delta^{13}C$, TOC, Fe speciation, P, $\delta^{34}S$	42	Biostratigraphy and chemostratigraphy

				Mo, U, and Re, microscale mineralogy		with reference to other publ. incl. (Zuchuat et al. 2020; Deltadalen DD-1)
Vickers et al. (2016)	Rurikfjellet Fm. (Kikutodden/ Bohemanneset Mb.) to Carolinefjellet Fm. (Inkkjegla Mb.)	400–700	Hauterivian–Aptian	TOC, $\delta^{13}C$, lithofacies	139	$\delta^{13}C$ chemostrati-graphy
Vickers et al. (2018)	Rurikfjellet Fm. (Kikutodden/ Bohemanneset Mb.) to Carolinefjellet Fm. (Inkkjegla Mb.)	-	Lower Cretaceous	Glendonites, $\delta^{13}C$, $\delta^{18}O$, lithofacies from Vickers et al. (2016)	9 glendonite horizons	Reference to Vickers et al. (2016)
Vickers et al. (2019)	Rurikfjellet - Carolinefjellet Fm.	0–800, (correlation to Longyearbyen airport road outcrop)	Lower Cretaceous (Volgian–Aptian	$\delta^{13}C$, TOC, lithofacies, org. biomarkers, palynology	463 bulk rock $\delta^{13}C$, 20 palyno-logy	$\delta^{13}C$ chemostrati-graphy, palyno-facies
Vickers et al. (2023)	Agardfjellet to Carolinefjellet Fm. (incl. uppermost Wilh. sub. - top Daljeg. Mb)	-260–640	Callovian–lower Aptian (J-K)	TOC, $\delta^{13}C$, Hg, pyrolysis, elemental analysis	80 $\delta^{13}C$, 180 pyrolysis, 119 elements	$\delta^{13}C$ chemostrati-graphy, reference to Vickers et al. (2019)
Vickers et al. (2025)	Rurikfjellet Fmn (Bohemanneset Mb)	-	Hauterivian	Glendonites, $\delta^{13}C$, $\delta^{18}O$, lithofacies	41	Reference to Jelby et al. (2025)
Wignall et al. (1998)	Kapp Starostin, Vardebukta Fm.	c. 0–50	Changhsingian–Induan (P–T)	$\delta^{13}C$, lithofacies, ichnofabric, Fe-S geochemistry	13	$\delta^{13}C$ chemostrati-graphy, ichnofabric
Zuchuat et al. (2026)	Kapp Starostin and Vardebukta Fm.	0–221, (correlation to Reinodden, Hornsund)	Changhsingian–Induan (P–T)	$\delta^{13}C_{org}$, lithofacies	48	$\delta^{13}C$ complimentary to Grasby et al. (2016)

5.4 Munindalen and Billefjorden

The Munindalen section in central Spitsbergen hosts Upper Devonian deposits of the Andrée Land Group, representing continental Old Red Sandstone formed in post-Caledonian extensional collapse basins (Blomeier et al., 2003a, b; Braathen et al., 2018; Friend et al., 1997; Moody-Stuart, 1966; Piepjohn et al., 2000; Smelror et al., 2024). These strata provide terrestrial paleoclimate constraints through sedimentological and paleontological proxies, including fluvial facies, paleosols and plant

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

fossil assemblages (e.g., Berry and Marshall, 2015; Davies et al., 2021). Palynomorph assemblages (Friend et al., 1997; Vigran, 1964), along with sparse marine-influenced fauna such as ostracods and bivalves (e.g., Friend, 1961; Worsley, 1972), constrain vegetation development and depositional environments in the Devonian. Rooted horizons and fossil wood document early forest ecosystems and their potential role in modulating weatherability and thus, on sub-million-year time scales, potential short-term fluctuations in atmospheric CO_2 concentrations. Facies variability further constrains hydrological regimes and seasonality under warm, semi-arid to seasonally humid conditions during low-latitude deposition (Davies et al., 2021). Recent high-resolution work from Svalbard has provided ~100 m-scale terrestrial $\delta^{13}C_{org}$ records resolving short-timescale (<10^5 yr) carbon cycle perturbations and associated CO_2 fluctuations during the Middle Devonian Taghanic crisis (van der Boon et al., 2026).

The inner part of Billefjorden provides access to outcrops of the Mississippian Billefjorden Group, which unconformably overlies folded Paleoproterozoic–Neoproterozoic and Devonian successions. The succession records predominantly terrestrial deposition on extensive fluvial to lacustrine floodplains, with abundant coal seams formed under humid tropical conditions (Gjelberg and Steel, 1981; Lopes et al., 2019; Steel and Worsley, 1984;). The Billefjorden Group provides multiple paleoclimate proxies, including coal petrography, organic geochemistry, and sedimentological facies associations. Coal seams and associated palynological assemblages constrain humid, peat-forming environments and vegetation dynamics (Nicolaisen, 2019; Scheibner et al., 2012).

A major shift from humid tropical to arid–semiarid conditions occurred during the late Serpukhovian at the Billefjorden–Gipsdalen transition, coinciding with regional rifting (Holliday and Cutbill, 1972; Gjelberg and Steel, 1981; Braathen et al., 2012; Smyrak-Sikora et al., 2018, 2021). In the Billefjorden Trough, syn-rift deposits record this change through paleosol development and facies shifts indicating increasing aridity (Smyrak-Sikora et al., 2025). The overlying Pennsylvanian–Permian succession preserves >130 glacioeustatic cycles, expressed by alternations between siliciclastics, evaporites, and carbonates, reflecting repeated climate-driven sea-level fluctuations during the Late Paleozoic Ice Age (Stemmerik, 2008; Ahlborn and Stemmerik, 2015; Sorento et al., 2020; Smyrak-Sikora et al., 2021, 2025). These records, together with $\delta^{18}O$ and atmospheric dust proxies, document glacial–interglacial variability and progressive deglaciation (Stemmerik, 2008; Oordt et al., 2020).

Table 7: Summary of papers/studies from Munindalen and Billefjorden.

Reference	Stratigraphy, Formations (Fm.)	Log interval (m)	Chrono-stratigraphy	Data types	No. of samples	Age constraint
Ahlborn and Stemmerik (2015)	Wordiekammen Fm.	-	Upper Carboniferous–lower Permian (Moscovian to	Lithofacies	13 sections	Cyclostratigraphy

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

			lower Sakmarian)			
Berry and Marshall (2015)	Mimerdalen Subgroup, Plantekløfta Fm.	4.5	Upper Devonian, Frasnian (ca. 380 Ma)	Lithofacies, lycopsids, palynology	125	Palynomorph biostratigraphy
Blomeier et al. (2003a)	Wood Bay Fm., Andrée Land Group	-	Lower Devonian	Lithofacies	300 thin sections, 30 polished slabs	-
Blomeier et al. (2003b)	Wood Bay Fm., Andrée Land Group	-	Lower Devonian	$\delta^{13}C$, $\delta^{18}O$, lithofacies	22 isotopes, 88 thin sections, 36 polished slabs	-
Davies et al. (2021)	Siktefjellet Group, Red Bay Group, Andree Land Group	-	Uppermost Silurian to upper Devonian	Lithofacies, fossilised flora	-	-
Friend et al. (1997)	Siktefjellet and Red Bay Groups	>240	Upper Silurian and lower Devonian	Lithofacies	-	-
Lopes et al. (2019)	Billefjorden Group, Hørbyebreen Fm. and Mumien Fm.	260	Mississippian, Visean	Palynology, Lithofacies	58	Palynomorph biostratigraphy
Oordt et al. (2020)	Wordiekammen Fm.	37	Moscovian and Asselian	Lithofacies, XRF, ICP-MS, detrital zircons	181	Cyclostratigraphy, reference to Ahlborn and Stemmerik (2015)
Sorento et al. (2020)	Gipshuken Fm.	962	Lower Permian (Sakmarian–Artinskian?)	Lithofacies	11, sections, 54 thin sections	-
van der Boon et al. (2026)	Andree Land Group	270	Middle Devonian, Givetian	$\delta^{13}C$	30 block samples for paleomag., 109 samples for $\delta^{13}C$	$\delta^{13}C$ chemostrati-graphy, reference to Berry and Marshall (2015) biostratigraphy

6 Best practices for data management

Data collection is costly, especially in remote regions like Svalbard, making it essential to maximise the impact and knowledge gained from acquired datasets. The FAIR guiding principles for data publication (Wilkinson et al., 2016) promote data reuse to reduce unnecessary duplication of data collection efforts. Over the past decade, the scientific community has made significant progress in ensuring data is Findable and Accessible, primarily by publishing datasets in dedicated repositories with rich discovery metadata and persistent identifiers. However, the principles of interoperability and reusability have often been overlooked or oversimplified. Many datasets still lack standardised data formats and controlled vocabularies for metadata, which are essential for machine readability and automation. Without these, it becomes difficult to develop software tools for visualising, analysing, or integrating data across disciplines. Such software tools can reduce the workload of scientists, automating repetitive or tedious tasks so they can focus on core research activities such as hypothesis testing, innovation, and discovery.

The publication of interoperable data presents significant challenges, particularly in geoscience, where datasets are often highly heterogeneous. This heterogeneity makes it difficult to find existing standards that fully encompass all aspects of a dataset, as diverse data types—such as quantitative measurements, descriptive observations (e.g., field sketches, geological maps, or outcrop descriptions), and novel experimental results—rarely align with a single existing standard. Encoding such data in interoperable formats can be resource-intensive, especially when suitable standards and conventions don't exist or are insufficient. The learning curve, time, and effort required to adopt these formats can often discourage researchers from engaging with the process. Successful adoption depends on strong commitment from a project's leadership in advocating for and funding these efforts (Marsden et al., 2025).

To address these issues, clearer guidelines are essential to help geoscientists select or adapt appropriate data formats for their specific needs. The following steps can help achieve this:

- Expand existing standards where possible to accommodate a broader range of data types, rather than creating new ones, since the unnecessary proliferation of standards defeats the purpose of standardisation itself.
- Divide datasets into separate data publications when distinct user communities exist for different components. These datasets can still be linked as part of a citable collection, preserving the context of the original study.
- Develop new standards when neither expansion of existing standards nor division of dataset collections is feasible.

The data management community should take a proactive role in this process, as it is unrealistic to expect researchers to independently navigate these complexities. In this way, the community can help ensure that geoscientific data are published in a way that maximises interoperability and reusability.

7 Data availability

7.1 Physical drill cores

Drill cores are fundamental for deep-time paleoclimate research. Permanent and adequate storage of drill cores is thus important and normally handled by national geological surveys who maintain drill core repositories. However, in Svalbard, no such repository or overseeing authority is currently institutionalised (Senger and Jochmann, 2026).

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

7.2 Curated data packages

The data packages presented herein are openly available in the National Infrastructure for Research Data (NIRD) Research Data Archive, a Norwegian long-term storage service for research data following the Open Archival Information System (OAIS) reference model (https://archive.sigma2.no/; Schad and Senger, 2025a, b, c, d, 2026; Schad et al., 2026). Other data collections, i.e., the Longyearbyen CO_2 lab and Deltadalen data are published in Zenodo repositories (Senger et al., 2025b; Zuchuat et al., 2026b).

7.3 Potential dataset use and reuse

The comparison of long-term paleoclimate records from Svalbard (as reviewed by Smyrak-Sikora et al., 2025), along with data stemming from characterisation of other lower-paleolatitude key sites is important to decipher past environments and climate. For the past ca. 100 million years, Svalbard has been located above the Arctic Circle and Svalbard sites recording this interval may help constrain whether polar amplification as we experience at present day was also manifested during intervals of the Mesozoic and Cenozoic. Furthermore, openly available data from Svalbard synthesised in this contribution (Table 3) serve as key input parameters to calibrate and test global deep-time paleoclimate models. Future projects, for instance the proposed ICDP project SvalCLIME (Senger et al., 2023; Kulhanek et al., 2024), will acquire new data complementary to those documented herein. The data packages presented herein will be updated on an annual basis while the SvalCLIME project operates. We invite the scientific community to provide further input on peer-reviewed publications, reports and academic theses that should be included in future iterations using the templates provided within the data packages. Stored in comma-separated values (CSV) as a plain text data format, these can be sent to corresponding authors to facilitate integration into the respective data packages.

8 Conclusions

We have synthesised data from 133 publications in six curated data packages collectively comprising the state-of-the-art for Phanerozoic paleoclimatic and paleoenvironmental records collected from Svalbard's stratigraphic successions. This open data compilation serves as a complement to a recent review of Svalbard's deep-time paleoclimate (Smyrak-Sikora et al, 2025) and an ICDP scientific drilling proposal, SvalCLIME (Kulhanek et al., 2024; Senger et al., 2023). We conclude that Svalbard's geologic records represent a unique opportunity to characterise climate evolution throughout the Phanerozoic and data from Svalbard sites provide much-needed complimentary data points to lower-(paleo)latitude sites for many key events including the EPME and the PETM.

Data availability

This is a data paper and all synthesized data are available in curated data packages listed in Table 3 (Schad and Senger, 2025a, b, c, d, 2026; Schad et al., 2026; Senger et al., 2025b; Zuchuat et al., 2026b).

Author contributions

Author Conceptualization: SMS, DKK, KS. Data curation: SMS, LM. Formal analysis: SMS. Funding acquisition: MEJ, MTJ, SP, KS. Project administration: SMS, KS. Supervision: DKK, KS. Visualization: SMS, MEJ, KKS, AS, MLV, VZ. Writing (original draft preparation): SMS, JB, SZB, SAG, MEJ, MTJ, LM, KKS, AS, LGT, MLV, VZ, KS. Writing (review and editing): DKK, WJF, SP.

Competing interests

The contact author has declared that none of the authors has any competing interests.

Disclaimer

Publisher's note: Copernicus Publications remains neutral with regard to jurisdictional claims made in the text, published maps, institutional affiliations, or any other geographical representation in this paper. While Copernicus Publications makes every effort to include appropriate place names, the final responsibility lies with the authors. Views expressed in the text are those of the authors and do not necessarily reflect the views of the publisher.

Acknowledgements

We thank our colleagues Grace Shephard, Peter Betlem, Snorre Olaussen, Øivind Hammer, Brian Beaty and the extended SvalCLIME science team for fruitful discussions, ongoing collaborations and open data sharing.

Financial support

This study was largely funded through in-kind contributions of the involved authors and their institutions. Networking funding was provided by the Research Council of Norway (through the Svalbard Science Forum, grant 352811) and the University of the Arctic (UArctic). The Svalbard Integrated Earth Observing System (SIOS) partially funded the completion of the SVALGEOL2 SESS chapter (Senger et al., 2026) upon which this contribution builds. MLV and MTJ acknowledge the support

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

of Kempe foundation grant HotSeas (grant number JCSMK23–0220); SP and MTJ are supported by the PETROMAKS programme from The Research Council of Norway, with the RCN project number 336293 (PALMAR); and MEJ acknowledges the Carlsberg Foundation for granting two Postdoctoral Fellowships that were carried out during the course of this study (grant numbers CF22-0122, CF24-1960).

Review statement

The review statement will be added by Copernicus Publications listing the handling editor as well as all contributing referees according to their status anonymous or identified.

References

Ahlborn, M. and Stemmerik, L.: Depositional evolution of the Upper Carboniferous–Lower Permian Wordiekammen carbonate platform, Nordfjorden High, central Spitsbergen, Arctic Norway, Norw. J. Geol., 95, 91–126, http://dx.doi.org/10.17850/njg95-1-03, 2015.

Allen, K. C.: Spore assemblages and their stratigraphical application in the Lower and Middle Devonian of North and Central Vestspitsbergen, Palaeontology, 10, 280–97, 1967.

Alsen, P., Jelby, M. E., Śliwińska, K. K., and Mutterlose, J.: An Early Cretaceous stratigraphic marker fossil in the High Arctic: the belemnite Arctoteuthis bluethgeni, Geol. Mag., 157, 1715–1728, https://doi.org/10.1017/s0016756819000803, 2020.

Århus, N.: Dinoflagellate cyst stratigraphy of some Aptian and Albian sections from North Greenland, southeastern Spitsbergen and the Barents Sea, Cretac. Res., 12, 209–225, https://doi.org/10.1016/0195-6671(91)90035-B, 1991.

Århus, N.: Some dinoflagellate cysts from the Lower Cretaceous of Spitsbergen, Grana, 31, 305–314, https://doi.org/10.1080/00173139209429453, 1992.

Bäckström, S. A. and Nagy, J.: Depositional history and fauna of a Jurassic phosphorite conglomerate (the Brentskardhaugen Bed) in Spitsbergen, Norsk Polarinst. Skrifter, 183, pp. 44, 1985.

Batten, D. J.: Palynofacies, palaeoenvironments and petroleum, J. Micropalaeontol., 1, 107–114, https://d-nb.info/1151036250/34 1982.

Beaty, B., Foster, W. J., Zuchuat, V., Moller, S. R., Buchwald, S. Z., Brooks, H., Rauzi, S., Isson, T., Planke, S., Rodríguez-Tovar, F. J., Senger, K., Planavsky, N., and Tarhan, L.: Bioturbation shapes marine biogeochemical cycling following the end-Permian mass extinction in Svalbard, Geobiology, 1–25, https://doi.org/10.1111/gbi.70032, 2025.

Beauchamp, B. and Baud, A.: Growth and demise of Permian biogenic chert along northwest Pangea: evidence for end-Permian collapse of thermohaline circulation, Palaeogeogr. Palaeoclimatol. Palaeoecol., 184, 37–63, https://doi.org/10.1016/S0031-0182(02)00245-6, 2002.

Berry, C. M. and Marshall, J. E. A.: Lycopsid forests in the early Late Devonian paleoequatorial zone of Svalbard, Geology, 43, 1043–1046, https://doi.org/10.1130/g37000.1, 2015.

Birchall, T., Senger, K., Hornum, M. T., Olaussen, S., and Braathen, A.: Underpressure in the northern Barents shelf: Causes and implications for hydrocarbon exploration, AAPG Bull., 104, 2267–2295, https://doi.org/10.1306/02272019146, 2020.

Bjaerke, T.: Mesozoic palynology of svalbard IV. toarcian dinoflagellates from spitsbergen, Palynology, 4, 57–77, https://doi.org/10.1080/01916122.1980.9989202, 1980.

Bjaerke, T and Manum, S. B.: Mesozoic Palynology of Svalbard - I. The Rhaetian of Hopen, with a preliminary report on the Rhaetian and Jurassic of Kong Karls Land, Norsk Polarinst. Skrifter, 165, 48 pp., 1977.

Błażejowski, B.: Foraminifers from the Treskelodden Formation (Carboniferous–Permian) of south Spitsbergen, Pol. Polar Res., 30, 193–230, https://doi.org/10.4202/ppres.2009.10, 2009.

Błażejowski, B., Hołda-Michalska, A., and Michalski, K.: *Schellwienia arctica* (Fusulinidae) from the Carboniferous–?Permian strata of the Treskelodden Formation, south Spitsbergen, Pol. Polar Res., 27, 91–103, 2006.

Blattmann, F. R., Schneebeli-Hermann, E., Adatte, T., Bucher, H. F., Vérard, C., Hammer, Ø., Luz, Z. A., and Vennemann, T. W.: Palaeoenvironmental variability and carbon cycle perturbations during the Smithian-Spathian (Early Triassic) in Central Spitsbergen, Lethaia, 57, 1–14, 2024.

Blattmann, F. R., Vennemann, T. W., Schneebeli-Hermann, E., Bucher, H. F. R., and Magill, C. R.: Land-ocean connections in organic carbon cycling amid the Early Triassic (Smithian-Spathian) revealed through compound specific isotope analysis, Geochim. Cosmochim. Acta, 394, 126–136, https://doi.org/10.1016/j.gca.2025.01.037, 2025a.

Blattmann, F. R., Ragon, C., Vennemann, T. W., Schneebeli-Hermann, E., Vérard, C., Kasparian, J., Brunetti, M., Bucher, H. F. R., Adatte, T., and Magill, C. R.: Wildfire, ecosystem, and climate interactions in the Early Triassic, Commun. Earth Environ., 6, 830, https://doi.org/10.1038/s43247-025-02789-x, 2025b.

Blomeier, D., Wisshak, M., Dallmann, W., Volohonsky, E., and Freiwald, A.: Facies analysis of the old Red Sandstone of Spitsbergen (Wood Bay Formation): Reconstruction of the depositional environments and implications of basin development, Facies, 49, 151–174, https://doi.org/10.1007/s10347-003-0030-1, 2003a.

Blomeier, D., Wisshak, M., Joachimski, M., Freiwald, A., and Volohonsky, E.: Calcareous, alluvial and lacustrine deposits in the old red sandstone of central north Spitsbergen (Wood Bay Formation, Early Devonian), Norw. J. Geol./Norsk Geologisk Forening, 83, 281–298, 2003b.

Blomeier, D., Scheibner, C. and Forke, H.: Facies arrangement and cyclostratigraphic architecture of a shallow-marine, warm-water carbonate platform: the Late Carboniferous Ny Friesland Platform in eastern Spitsbergen (Pyefjellet Beds, Wordiekammen Formation, Gipsdalen Group), Facies, 55, 291–324, https://doi.org/10.1007/s10347-008-0163-3, 2009.

Blythe, A. E., and K. L. Kleinspehn, Tectonically versus climatically driven Cenozoic exhumation of the Eurasian plate margin, Svalbard: Fission track analyses, Tectonics, 17, 621–639, https://doi.org/10.1029/98TC01890, 1998.

Bond, D. P. G. and Wignall, P. B.: Pyrite framboid study of marine Permian–Triassic boundary sections: A complex anoxic event and its relationship to contemporaneous mass extinction, Geol. Soc. Am. Bull., 122, 1265–1279, https://doi.org/10.1130/b30042.1, 2010.

Bond, D. P. G., Wignall, P. B., Joachimski, M. M., Sun, Y., Savov, I., Grasby, S. E., Beauchamp, B., and Blomeier, D. P. G.: An abrupt extinction in the Middle Permian (Capitanian) of the Boreal Realm (Spitsbergen) and its link to anoxia and acidification, Geol. Soc. Am. Bull., 127, 1411–1421, https://doi.org/10.1130/b31216.1, 2015.

Braathen, A., Bergh, S. G., and Maher, H. D., Jr: Application of a critical wedge taper model to the Tertiary transpressional fold-thrust belt on Spitsbergen, Svalbard, Geol. Soc. Am. Bull., 111, 1468–1485, 1999.

Braathen, A., Osmundsen, P. T., Maher, H., and Ganerød, M.: The Keisarhjelmen detachment records Silurian–Devonian extensional collapse in Northern Svalbard, Terra Nova, 30, 34–39, https://doi.org/10.1111/ter.12305, 2018.

Braathen, A., Bælum, K., Maher Jr, H., and Buckley, S. J.: Growth of extensional faults and folds during deposition of an evaporite-dominated half-graben basin; the Carboniferous Billefjorden Trough, Svalbard, Norw. J. Geol., 91, 137, 2012a.

Braathen, A., Bælum, K., Christiansen, H. H., Dahl, T., Eiken, O., Elvebakk, H., Hansen, F., Hanssen, T. H., Jochmann, M., Johansen, T. A., Johnsen, H., Larsen, L., Lie, T., Mertes, J., Mørk, A., Mørk, M. B., Nemec, W., Olaussen, S., Oye, V., Rød, K., Titlestad, G. O., Tveranger, J., and Vagle, K.: The Longyearbyen CO_2 Lab of Svalbard, Norway—initial assessment of the geological conditions for CO_2 sequestration, Norw. J. Geol., 92, 353–376, 2012b.

Bradley, J. A., Amend, J. P., and LaRowe, D. E.: Survival of the fewest: Microbial dormancy and maintenance in marine sediments through deep time, Geobiology, 17, 43–59, https://doi.org/10.1111/gbi.12313, 2019.

Buchan, S. H., Challinor, A., Harland, W. B., and Parker, J.: The Triassic stratigraphy of Svalbard, Norsk Polarinst. Skrifter, 135, 1–92, 1965.

Buchwald, S. Z., Frank, A. B., Birgel, D., Senger, K., Mosociova, T., Pei, Y., Beaty, B., Tarhan, L. G., Galasso, F., Gómez Correa, M. A., Grasby, S. E., Struck, U., Yuan, D., Steinkrauss, R., Gliwa, J., Lahajnar, N., Peckmann, J., and Foster, W. J.: Reconstructing Environmental and Microbial Ecosystem Changes Across the Permian–Triassic Mass Extinction at Lusitaniadalen, Svalbard, Paleoceanogr. Paleoclimatol., 41, e2025PA005321, https://doi.org/10.1029/2025PA005321, 2026.

Buchwald, S. Z., Birgel, D., Senger, K., Mosociova, T., Pei, Y., Zuchuat, V., Tarhan, L. G., Frank, A. B., Galasso, F., Gómez Correa, M. A., Koşun, E., Karapunar, B., Wang, X., Kustatscher, E., Prinoth, H., Lahajnar, N., Steinkrauss, R., Peckmann, J., and Foster, W. J.: Phytoplankton Blooms on the Barents Shelf, Svalbard, Associated With the Permian–Triassic Mass Extinction, AGU Adv., 6, e2025AV001785, https://doi.org/10.1029/2025AV001785, 2025.

Błażejowski, B., Duffin, C. J., Gieszcz, P., Małkowski, K., Binkowski, M., Walczak, M., McDonald, S. A., and Withers, P. J.: Saurichthys (Pisces, Actinopterygii) teeth from the Lower Triassic of Spitsbergen, with comments on their stable isotope composition (δ13C and δ18O) and X− ray microtomography, Pol. Polar Res., 2013.

Charles, A. J., Condon, D. J., Harding, I. C., Pälike, H., Marshall, J. E., Cui, Y., Kump, L., and Croudace, I. W.: Constraints on the numerical age of the Paleocene-Eocene boundary, Geochem. Geophys. Geosyst., 12, https://doi.org/10.1029/2010GC003426, 2011.

Chlebowski, R. and Wierzbowski, A.: Pyroclastic material from the Upper Triassic deposits of Sassenfjorden, Spitsbergen, Polar Res., 1, 75–81, https://doi.org/10.3402/polar.v1i1.6971, 2010.

Cohen, A. S., Coe, A. L., Harding, S. M., and Schwark, L.: Osmium isotope evidence for the regulation of atmospheric CO2 by continental weathering, Geology, 32, 157–160, https://doi.org/10.1130/g20158.1, 2004.

Cohen, K., Harper, D., Gibbard, P., and Car, N.: The ICS international chronostratigraphic chart this decade, IUGS, 48, 105–115, https://doi.org/10.18814/epiiugs/2025/025001, 2025.

Corfu, F., Polteau, S., Planke, S., Faleide, J. I., Svensen, H., Zayoncheck, A., and Stolbov, N.: U–Pb geochronology of Cretaceous magmatism on Svalbard and Franz Josef Land, Barents Sea large igneous province, Geol. Mag., 150, 1127–1135, https://doi.org/10.1017/S0016756813000162, 2013.

Croudace, I. W., Löwemark, L., Tjallingii, R., and Zolitschka, B.: Current perspectives on the capabilities of high resolution XRF core scanners, Quatern. Int., 514, 5–15, https://doi.org/10.1016/j.quaint.2019.04.002, 2019.

Cui, Y., Diefendorf, A. F., Kump, L. R., Jiang, S., and Freeman, K. H.: Synchronous Marine and Terrestrial Carbon Cycle Perturbation in the High Arctic During the PETM, Paleoceanogr. Paleoclimatol., 36, e2020PA003942, https://doi.org/10.1029/2020PA003942, 2021.

Cui, Y., Kump, L. R., Ridgwell, A. J., Charles, A. J., Junium, C. K., Diefendorf, A. F., Freeman, K. H., Urban, N. M., and Harding, I. C.: Slow release of fossil carbon during the Palaeocene–Eocene Thermal Maximum, Nat. Geosci., 4, 481–485, https://doi.org/10.1038/ngeo1179, 2011.

Daniau, A.-L., Desprat, S., Aleman, A. C., Bremond, L., Davis, B., Fletcher, W., Marlon, J. R., Marquer, L., Montade, V., Morales-Molino, C., Rius, D., and Urrego, D. H.: Terrestrial plant microfossils in palaeoenvironmental studies, pollen, microcharcoal and phytolith. Towards a comprehensive understanding of vegetation, fire and climate changes over the past one million years, Rev. Micropaleontol., 63, 1–35, https://doi.org/10.1016/j.revmic.2019.02.001, 2019.

D'Hondt, S., Rutherford, S., and Spivack, A. J.: Metabolic Activity of Subsurface Life in Deep-Sea Sediments, Science, 295, 2067–2070, https://doi.org/10.1126/science.1064878, 2002.

Dallmann, W. K., Blomeier, D., Elvevold, S., Mørk, A., Olaussen, S., Grundvåg, S.-A., Bond, D., and Hormes, A., Historical geology., in: Geoscience Atlas of Svalbard (Report Series No. 148 – 2nd edition), edited by Dallmann, W. K., Norwegian Polar Institute, 89–131, 2015.

Dallmann, W. K., Dypvik, H., Gjelberg, J. G., Harland, W. B., Johannessen, E. P., Keilen, H. B., Larssen, G. B., Lønøy, A., Midbøe, P. S., Mørk, A., Nagy, J., Nilsson, I., Nøttvedt, A., Olaussen, S., Pcelina, T. M., Steel, R. J., and Worsley, D.: Lithostratigraphic Lexicon of Svalbard: Review and recommendations for nomenclature use, Norsk Polarinstitutt, Tromsø, 318 pp., 1999.

Dalseg, T. S., Nakrem, H. A., and Smelror, M.: Dinoflagellate cyst biostratigraphy, palynofacies, depositional environment and sequence stratigraphy of the Agardhfjellet Formation (Upper Jurassic-Lower Cretaceous) in central Spitsbergen (Arctic Norway), Norw. J. Geol., 96, 1–14, http://dx.doi.org/10.17850/njg96-2-04, 2016.

Davies, N. S., Berry, C. M., Marshall, J. E. A., Wellman, C. H., and Lindemann, F.-J.: The Devonian landscape factory: plant–sediment interactions in the Old Red Sandstone of Svalbard and the rise of vegetation as a biogeomorphic agent, J. Geol. Soc., 178, https://doi.org/10.1144/jgs2020-225, 2021.

Dellinger, M., Bouchez, J., Gaillardet, J., Faure, L., and Moureau, J.: Tracing weathering regimes using the lithium isotope composition of detrital sediments, Geology, 45, 411–414, https://doi.org/10.1130/g38671.1, 2017.

Doerner, M., Berner, U., Erdmann, M., and Barth, T.: Geochemical characterization of the depositional environment of Paleocene and Eocene sediments of the Tertiary Central Basin of Svalbard, Chem. Geol., 542, 119587, https://doi.org/10.1016/j.chemgeo.2020.119587, 2020.

Dutta, A., Dutta Gupta, S., Gupta, A., Sarkar, J., Roy, S., Mukherjee, A., and Sar, P.: Exploration of deep terrestrial subsurface microbiome in Late Cretaceous Deccan traps and underlying Archean basement, India, Sci. Rep., 8, 17459, https://doi.org/10.1038/s41598-018-35940-0, 2018.

Dypvik, H., Hvoslef, S., Bjaerke, T., and Finnerud, E.: The Wilhelmøya Formation (Upper Triassic-Lower Jurassic) at Bohemanflya, Spitsbergen, Polar Res., 3, 155–165, https://doi.org/10.3402/polar.v3i2.6949, 1985.

Dypvik, H., Riber, L., Burca, F., Rüther, D., Jargvoll, D., Nagy, J., and Jochmann, M.: The Paleocene–Eocene thermal maximum (PETM) in Svalbard—clay mineral and geochemical signals, Palaeogeogr. Palaeoclimatol. Palaeoecol., 302, 156–169, https://doi.org/10.1016/j.palaeo.2010.12.025, 2011.

Dörr, N., Lisker, F., Clift, P. D., Carter, A., Gee, D. G., Tebenkov, A. M., and Spiegel, C.: Late Mesozoic–Cenozoic exhumation history of northern Svalbard and its regional significance: Constraints from apatite fission track analysis, Tectonophysics, 514-517, 81–92, https://doi.org/10.1016/j.tecto.2011.10.007, 2012.

Dörr, N., Lisker, F., Jochmann, M., Rainer, T., Schlegel, A., Schubert, K., and Spiegel, C.: Subsidence, rapid inversion, and slow erosion of the Central Tertiary Basin of Svalbard: Evidence from the thermal evolution and basin modeling, in: Circum-Arctic Structural Events: Tectonic Evolution of the Arctic Margins and Trans-Arctic Links with Adjacent Orogens, edited by: Piepjohn, K., Strauss, J. V., Reinhardt, L., and McClelland, W. C., Geol. Soc. Am., 0, https://doi.org/10.1130/2018.2541(09), 2019a.

Dörr, N., Lisker, F., Piepjohn, K., and Spiegel, C.: Cenozoic development of northern Svalbard based on thermochronological data, Terra Nova, 31, 306–315, https://doi.org/10.1111/ter.12402, 2019b.

Dustira, A. M., Wignall, P. B., Joachimski, M., Blomeier, D., Hartkopf-Fröder, C., and Bond, D. P. G.: Gradual onset of anoxia across the Permian–Triassic Boundary in Svalbard, Norway, Palaeogeogr. Palaeoclimatol. Palaeoecol., 374, 303–313, https://doi.org/10.1016/j.palaeo.2013.02.004, 2013.

Ehrenberg, S. N., McArthur, J. M., and Thirlwall, M. F.: STRONTIUM ISOTOPE DATING OF SPICULITIC PERMIAN STRATA FROM SPITSBERGEN OUTCROPS AND BARENTS SEA WELL-CORES, J. Petr. Geol., 33, 247–254, https://doi.org/10.1111/j.1747-5457.2010.00476.x, 2010.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Elling, F. J., Spiegel, C., Estrada, S., Davis, D. W., Reinhardt, L., Henjes-Kunst, F., Allroggen, N., Dohrmann, R., Piepjohn, K., and Lisker, F.: Origin of Bentonites and Detrital Zircons of the Paleocene Basilika Formation, Svalbard, Front. Earth Sci., 4:73, https://doi.org/10.3389/feart.2016.00073, 2016.

Engelschiøn, V. S., Hammer, Ø., Wesenlund, F., Hurum, J. H., and Mørk, A.: Palaeoenvironment and new chemostratigraphic markers for the Middle Triassic succession in Svalbard, Norw. J. Geol., 105, 3, 1–45, https://dx.doi.org/10.17850/njg105-3-2, 2025.

Fairchild, I. J., Fleming, E. J., Bao, H., Benn, D. I., Boomer, I., Dublyansky, Y. V., Halverson, G. P., Hambrey, M. J., Hendy, C., McMillan, E. A., Spötl, C., Stevenson, C. T. E., and Wynn, P. M.: Continental carbonate facies of a Neoproterozoic panglaciation, north-east Svalbard, Sedimentology, 63, 443–497, https://doi.org/10.1111/sed.12252, 2016.

Feyling-Hanssen, R. W.: A Tertiary-Quaternary section at Sarsbukta, Spitsbergen, Svalbard, and its foraminifera, Polar Res., 2, 77–106, https://doi.org/10.3402/polar.v2i1.6963, 1984.

Forwick, M. and Vorren, T. O.: Holocene mass-transport activity and climate in outer Isfjorden, Spitsbergen: marine and subsurface evidence, Holocene, 17, 707–716, https://doi.org/10.1177/0959683607080510, 2007.

Foster, W. J., Danise, S., and Twitchett, R. J.: A silicified Early Triassic marine assemblage from Svalbard, J. Syst. Palaeontol., 15, 851–877, https://doi.org/10.1080/14772019.2016.1245680, 2017.

Foster, W. J., Hirtz, J. A., Farrell, C., Reistroffer, M., Twitchett, R. J., and Martindale, R. C.: Bioindicators of severe ocean acidification are absent from the end-Permian mass extinction, Sci. Rep., 12, 1202, https://doi.org/10.1038/s41598-022-04991-9, 2022.

Foster, W. J., Asatryan, G., Rauzi, S., Botting, J. P., Buchwald, S. Z., Lazarus, D. B., Isson, T., Renaudie, J., and Kiessling, W.: Response of Siliceous Marine Organisms to the Permian-Triassic Climate Crisis Based on New Findings From Central Spitsbergen, Svalbard, Paleoceanogr. Paleoclimatol., 38, e2023PA004766, https://doi.org/10.1029/2023PA004766, 2023.

Friend, P. F.: The Devonian Stratigraphy of north and central Vestspitsbergen, Proc. Yorks. Geol. Soc., 33, 77–118, https://doi.org/10.1144/pygs.33.1.77, 1961.

Friend, P. F., Harland, W. B., Rogers, D. A., Snape, I., and Thornley, R. S. W.: Late Silurian and Early Devonian stratigraphy and probable strike-slip tectonics in northwestern Spitsbergen, Geol. Mag., 134, 459–479, https://doi.org/10.1017/S0016756897007231, 1997.

Galfetti, T., Hochuli, P. A., Brayard, A., Bucher, H., Weissert, H., and Vigran, J. O.: Smithian-Spathian boundary event: Evidence for global climatic change in the wake of the end-Permian biotic crisis, Geology, 35, 291–294, https://doi.org/10.1130/g23117a.1, 2007.

Gaździcki, A. and Trammer J.: The *sverdrupi* Zone in the Lower Triassic of Svalbard, Acta Geol. Pol., 27, 1977.

Gittins, D. A., Desiage, P.-A., Morrison, N., Rattray, J. E., Bhatnagar, S., Chakraborty, A., Zorz, J., Li, C., Horanszky, O., Cramm, M. A., Bisiach, F., Bennett, R., Webb, J., MacDonald, A., Fowler, M., Campbell, D. C., and Hubert, C. R. J.: Geological processes mediate a microbial dispersal loop in the deep biosphere, Sci. Adv., 8, eabn3485, https://doi.org/10.1126/sciadv.abn3485, 2022.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Gjelberg, J. and Steel, R.: An outline of Lower-Middle Carboniferous sedimentation on Svalbard: Effects of tectonic, climatic and sea level changes in rift basin sequences, 1981.

Grasby, S. E., Beauchamp, B., Bond, D. P. G., Wignall, P., Talavera, C., Galloway, J. M., Piepjohn, K., Reinhardt, L., and Blomeier, D.: Progressive environmental deterioration in northwestern Pangea leading to the latest Permian extinction, , Geol. Soc. Am. Bull., 127, 1331–1347, https://doi.org/10.1016/10.1130/b31197.1, 2015.

Grasby, S. E., Beauchamp, B., Bond, D. P. G., Wignall, P. B., and Sanei, H.: Mercury anomalies associated with three extinction events (Capitanian Crisis, Latest Permian Extinction and the Smithian/Spathian Extinction) in NW Pangea, Geol. Mag., 153, 285–297, https://doi.org/10.1016/10.1017/S0016756815000436, 2016.

Grasby, S. E., Knies, J., Beauchamp, B., Bond, D. P. G., Wignall, P., and Sun, Y.: Global warming leads to Early Triassic nutrient stress across northern Pangea, Geol. Soc. Am. Bull., 132, 943–954, https://doi.org/10.1016/10.1130/b32036.1, 2019a.

Grasby, S. E., Them, T. R., Chen, Z., Yin, R., and Ardakani, O. H.: Mercury as a proxy for volcanic emissions in the geologic record, Earth-Sci. Rev., 196, 102880, https://doi.org/10.1016/j.earscirev.2019.102880, 2019b.

Grøsfjeld, K.: Palynological age constraints on the base of the Helvetiafjellet Formation (Barremian) on Spitsbergen, Polar Res., 11, 11–19, https://doi.org/10.3402/polar.v11i1.6713, 1992.

Grundvåg, S. A., Marin, D., Kairanov, B., Śliwińska, K. K., Nøhr-Hansen, H., Jelby, M. E., Escalona, A., and Olaussen, S.: The Lower Cretaceous succession of the northwestern Barents Shelf: Onshore and offshore correlations, Mar. Petrol. Geol., 86, 834–857, https://doi.org/10.1016/j.marpetgeo.2017.06.036, 2017.

Grundvåg, S., Jelby, M. E., Sliwinska, K. K., Nøhr-Hansen, H., Aadland, T., Sandvik, S. E., Tennvassås, I., Engen, T., and Olaussen, S.: Sedimentology and palynology of the Lower Cretaceous succession of central Spitsbergen: integration of subsurface and outcrop data, Norw. J. Geol., 99, 247–277, https://dx.doi.org/10.17850/njg99-2-02, 2019.

Grundvåg, S.-A., Jelby, M. E., Olaussen, S., and Śliwińska, K. K.: The role of shelf morphology on storm-bed variability and stratigraphic architecture, Lower Cretaceous, Svalbard, Sedimentology, 68, 196–237, https://doi.org/10.1111/sed.12791, 2021.

Gruszczynski, M., Hoffman, A., Malkowski, K., and Veizer, J.: Seawater strontium isotopic perturbation at the Permian-Triassic boundary, West Spitsbergen, and its implications for the interpretation of strontium isotopic data, Geology, 20, 779–782, https://doi.org/10.1130/0091-7613(1992)020<0779:Ssipat>2.3.Co;2, 1992.

Halverson, G. P.: Glacial sediments and associated strata of the Polarisbreen Group, northeastern Svalbard, in: The Geological Record of Neoproterozoic Glaciations, edited by: Arnaud, E., Halverson, G. P., and Shields-Zhou, G., Geol. Soc. Lond., 0, https://doi.org/10.1144/m36.55, 2011.

Halverson, G. P., Maloof, A. C., and Hoffman, P. F.: The Marinoan glaciation (Neoproterozoic) in northeast Svalbard, Basin Res., 16, 297–324, https://doi.org/10.1111/j.1365-2117.2004.00234.x, 2004.

Halverson, G. P., Kunzmann, M., Strauss, J. V., and Maloof, A. C.: The Tonian-Cryogenian transition in Northeastern Svalbard, Precambrian Res., 319, 79–95, https://doi.org/10.1016/j.precamres.2017.12.010, 2018.

Hammer, Ø., Nakrem, H. A., Little, C. T. S., Hryniewicz, K., Sandy, M. R., Hurum, J. H., Druckenmiller, P., Knutsen, E. M., and Høyberget, M.: Hydrocarbon seeps from close to the Jurassic–Cretaceous boundary, Svalbard, Palaeogeogr. Palaeoclimatol. Palaeoecol., 306, 15–26, https://doi.org/10.1016/j.palaeo.2011.03.019, 2011.

Hammer, Ø., Collignon, M., and Nakrem, H. A.: Organic carbon isotope chemostratigraphy and cyclostratigraphy in the Volgian of Svalbard, Norw. J. Geol./Norsk Geologisk Forening, 92, 2012.

Hammer, Ø., Jones, M. T., Schneebeli-Hermann, E., Hansen, B. B., and Bucher, H.: Are Early Triassic extinction events associated with mercury anomalies? A reassessment of the Smithian/Spathian boundary extinction, Earth-Sci. Rev., 195, 179–190, https://doi.org/10.1016/j.earscirev.2019.04.016, 2019.

Harland, W. B.: Part 1: Chapter 3 Svalbard's geological frame, Geol. Soc. Lond. Mem., 17, 23–46, https://doi.org/10.1144/GSL.MEM.1997.017.01.03, 1997.

He, W., Shi, G. R., Zhang, K., Suzuki, N., Wang, H., Yang, F., Xiao, Y., Yang, T., Huang, Y., Wu, C., and Jiang, K.: The deterioration and collapse of late Permian marine ecosystems and the end-Permian mass extinction: A global view, Earth-Sci. Rev., 261, 104971, https://doi.org/10.1016/j.earscirev.2024.104971, 2025.

Head, M.: A palynological investigation of Tertiary strata at Renardodden, West Spitsbergen, 6th International Palynological Conference, Abstract, 61 pp., 1984.

Helland-Hansen, W. and Grundvåg, S.-A.: The Svalbard Eocene-Oligocene (?) Central Basin succession: Sedimentation patterns and controls, Basin Res., 33, 729–753, http://dx.doi.org10.1111/bre.12492, 2020.

Hjálmarsdóttir, H. R., Hammer, Ø., Nagy, J., and Grundvåg, S.-A.: Foraminiferal stratigraphy and palaeoenvironment of a storm-influenced marine shelf: Upper Aptian – lower Albian, Svalbard, Arctic Norway, Cretac. Res., 130, 105033, https://doi.org/10.1016/j.cretres.2021.105033, 2022.

Hoel, A. and Ørvin, A. K.: Das Festungsprofil auf Spitzbergen: Karbon – Kreide. I Vermessungresultate., Skrifter om Svalbard og Ishavet, 18, 1–58, 1937.

Holland, M. M. and Bitz, C. M.: Polar amplification of climate change in coupled models, Clim. Dyn., 21, 221–232, https://doi.org/10.1007/s00382-003-0332-6, 2003.

Holliday, D. W. and Cutbill, J. L.: THE EBBADALEN FORMATION (CARBONIFEROUS), SPITSBERGEN, Proc. Yorks. Geol. Soc., 39, 1–32, https://doi.org/10.1144/pygs.39.1.1, 1972.

Hounslow, M. W. and Nawrocki, J.: Palaeomagnetism and magnetostratigraphy of the Permian and Triassic of Spitsbergen: a review of progress and challenges, Polar Res., 27, 502–522, https://doi.org/10.1111/j.1751-8369.2008.00075.x, 2008.

Hounslow, M. W., Hu, M., Mørk, A., Vigran, J. O., Weitschat, W., and Orchard, M. J.: Magneto-biostratigraphy of the Middle to Upper Triassic transition, central Spitsbergen, arctic Norway, J. Geol. Soc., 164, 581–597, https://doi.org/10.1144/0016-76492005-184, 2007.

Hounslow, M. W., Hu, M., Mørk, A., Weitschat, W., Vigran, J. O., Karloukovski, V., and Orchard, M. J.: Intercalibration of Boreal and Tethyan time scales: the magnetobiostratigraphy of the Middle Triassic and the latest Early Triassic from Spitsbergen, Arctic Norway, Polar Res., 27, 469–490, https://doi.org/10.1111/j.1751-8369.2008.00074.x, 2008a.

Hounslow, M. W., Peters, C., Mørk, A., Weitschat, W., and Vigran, J. O.: Biomagnetostratigraphy of the Vikinghøgda Formation, Svalbard (Arctic Norway), and the geomagnetic polarity timescale for the Lower Triassic, Geol. Soc. Am. Bull., 120, 1305–1325, https://doi.org/10.1130/B26103.1, 2008b.

Hounslow, M. W., Harris, S. E., Karloukovski, V., and Mørk, A.: Geomagnetic polarity and carbon isotopic stratigraphic assessment of the late Carnian–earliest Norian in Svalbard: evidence for a major hiatus and improved Boreal to Tethyan correlation, Nor. J. Geo., 102, 1–30, https://dx.doi.org/10.17850/njg102-1-4, 2022.

Huq, F., Smalley, P. C., Mørkved, P. T., Johansen, I., Yarushina, V., and Johansen, H.: The Longyearbyen CO2 Lab: Fluid communication in reservoir and caprock, J. Greenh. Gas Control, 63, 59–76, 2017.

Hurum, J. H., Milàn, J., Hammer, Ø., Midtkandal, I., Amundsen, H., and Sæther, B.: Tracking polar dinosaurs – new finds from the Lower Cretaceous of Svalbard, Norw. J. Geol., 86, 397, 2006.

Intergovernmental Panel on Climate Change: Climate Change 2021: The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, https://doi.org/10.1017/9781009157896, 2023.

Jafarian, E., Groen, R. D., Nooitgedacht, C. W., Scheibner, C., Blomeier, D., and Reijmer, J. J.: Facies arrangement and cyclostratigraphic architecture of the Templet Member and the Kapp Starostin Formation (Permian) on Spitsbergen, Svalbard, Norw. J. Geol., 97, https://dx.doi.org/10.17850/njg97-4-02, 2017.

Japsen, P., Green, P. F., Chalmers, J. A., and Bonow, J. M.: Episodes of post-Caledonian burial and exhumation in Greenland and Fennoscandia, Earth-Sci. Rev., 248, 104626, https://doi.org/10.1016/j.earscirev.2023.104626, 2024.

Jelby, M. E., Grundvåg, S.-A., Helland-Hansen, W., Olaussen, S., and Stemmerik, L.: Tempestite facies variability and storm-depositional processes across a wide ramp: Towards a polygenetic model for hummocky cross-stratification, Sedimentology, 67, 742–781, https://doi.org/10.1111/sed.12671, 2020a.

Jelby, M. E., Śliwińska, K. K., Koevoets, M. J., Alsen, P., Vickers, M. L., Olaussen, S., and Stemmerik, L.: Arctic reappraisal of global carbon-cycle dynamics across the Jurassic–Cretaceous boundary and Valanginian Weissert Event, Palaeogeogr. Palaeoclimatol. Palaeoecol., 555, 109847, https://doi.org/10.1016/j.palaeo.2020.109847, 2020b.

Jelby, M. E., Grundvåg, S.-A., Śliwińska, K. K., Alsen, P., Vickers, M. L., Olaussen, S., and Stemmerik, L.: Lower Cretaceous holostratigraphy in Svalbard: the Arctic key piece of the Boreal basin puzzle, Geol. Soc. Lon. Spec. Publ., 545, SP545–2023–2177, https://doi.org/10.1144/sp545-2023-177, 2025.

Johannessen, E. P., Henningsen, T., Bakke, N. E., Johansen, T. A., Ruud, B. O., Riste, P., Elvebakk, H., Jochmann, M., Elvebakk, G., and Woldengen, M. S.: Palaeogene clinoform succession on Svalbard expressed in outcrops, seismic data, logs and cores, First Break, 29, 35–44, https://doi.org/10.3997/1365-2397.2011004, 2011.

Jones, M. T., Eliassen, G. T., Shephard, G. E., Svensen, H. H., Jochmann, M., Friis, B., Augland, L. E., Jerram, D. A., and Planke, S.: Provenance of bentonite layers in the Palaeocene strata of the Central Basin, Svalbard: implications for magmatism and rifting events around the onset of the North Atlantic Igneous Province, J. Volcanol. Geotherm. Res., 327, 571–584, https://doi.org/10.1016/j.jvolgeores.2016.09.014, 2016.

Jones, M. T., Augland, L. E., Shephard, G. E., Burgess, S. D., Eliassen, G. T., Jochmann, M. M., Friis, B., Jerram, D. A., Planke, S., and Svensen, H. H.: Constraining shifts in North Atlantic plate motions during the Palaeocene by U-Pb dating of Svalbard tephra layers, Sci. Rep., 7, 6822, https://doi.org/10.1038/s41598-017-06170-7, 2017.

Jones, M. T., Percival, L. M. E., Stokke, E. W., Frieling, J., Mather, T. A., Riber, L., Schubert, B. A., Schultz, B., Tegner, C., Planke, S., and Svensen, H. H.: Mercury anomalies across the Palaeocene–Eocene Thermal Maximum, Clim. Past, 15, 217–236, https://doi.org/10.5194/cp-15-217-2019, 2019.

Jones, M. T., Stokke, E. W., Rooney, A. D., Frieling, J., Pogge von Strandmann, P. A. E., Wilson, D. J., Svensen, H. H., Planke, S., Adatte, T., Thibault, N., Vickers, M. L., Mather, T. A., Tegner, C., Zuchuat, V., and Schultz, B. P.: Tracing North Atlantic volcanism and seaway connectivity across the Paleocene–Eocene Thermal Maximum (PETM), Clim. Past, 19, 1623–1652, https://doi.org/10.5194/cp-19-1623-2023, 2023.

Jones, M. T., Augland, L. E., Ovtcharova, M., Stokke, E. W., Ganerød, M., and Planke, S.: New constraints on the absolute age and duration of the Paleocene – Eocene Thermal Maximum (PETM) from ash layer +19 in Denmark, Earth Planet. Sci. Lett., 671, 119643, https://doi.org/10.1016/j.epsl.2025.119643, 2025.

Kadnikov, V. V., Mardanov, A. V., Beletsky, A. V., Banks, D., Pimenov, N. V., Frank, Y. A., Karnachuk, O. V., and Ravin, N. V.: A metagenomic window into the 2-km-deep terrestrial subsurface aquifer revealed multiple pathways of organic matter decomposition, FEMS Microbiol. Ecol., 94, https://doi.org/10.1093/femsec/fiy152, 2018.

Kadnikov, V. V., Mardanov, A. V., Beletsky, A. V., Karnachuk, O. V., and Ravin, N. V.: Microbial Life in the Deep Subsurface Aquifer Illuminated by Metagenomics, Front. Microbiol., Volume 11 - 2020, https://doi.org/10.3389/fmicb.2020.572252, 2020.

Klausen, T. G., Nyberg, B., and Helland-Hansen, W.: The largest delta plain in Earth's history, Geology, 47, 470–474, https://doi.org/10.1130/G45507.1, 2019.

Koevoets, M., Abay, T., Hammer, Ø., and Olaussen, S.: High-resolution organic carbon–isotope stratigraphy of the Middle Jurassic–Lower Cretaceous Agardhfjellet Formation of central Spitsbergen, Svalbard, Palaeogeogr. Palaeoclimatol. Palaeoecol., 449, 266–274, https://doi.org/10.1016/j.palaeo.2016.02.029, 2016.

Koevoets, M. J., Hammer, Ø., Olaussen, S., Senger, K., and Smelror, M.: Integrating subsurface and outcrop data of the Middle Jurassic to Lower Cretaceous Agardfjellet Formation in central Spitsbergen, Norw. J. Geol., 98, 1–34, https://dx.doi.org/10.17850/njg98-4-01, 2019.

Kopik, J. and Wierzbowski, A.: Ammonites and stratigraphy of the Bathonian and Callovian at Janusfjellet and Wimanfjellet, Sassenfjorden, Spitsbergen, Palaeontologica, 33, 145–168, 1988.

Kröger, B., Finnegan, S., Franeck, F., and Hopkins, M. J.: The Ordovician Succession Adjacent to Hinlopenstretet, Ny Friesland, Spitsbergen, Am. Mus. Novit., 3882, 1–28, https://doi.org/10.1206/3882.1, 2017.

Kulhanek, D. K., Zuchuat, V., Jones, M., Barta, J., Foster, W. J., Geissler, W. H., Grundvåg, S.-A., Lorenz, H., Planke, S., and Senger, K.: SVALCLIME–Targeting deep-time Arctic climate archives of Svalbard, Copernicus Meetings, 2024.

Kwon, H., Woo, J., Oh, J.-R., Ji Joo, Y., Lee, S., Nakrem, H. A., and Sub Sim, M.: Responses of the biogeochemical sulfur cycle to Early Permian tectonic and climatic events, Earth Planet. Sci. Lett., 591, 117604, https://doi.org/10.1016/j.epsl.2022.117604, 2022.

Lee, C., Love, G. D., Hopkins, M. J., Kröger, B., Franeck, F., and Finnegan, S.: Lipid biomarker and stable isotopic profiles through Early-Middle Ordovician carbonates from Spitsbergen, Norway, Org. Geochem., 131, 5–18, https://doi.org/10.1016/j.orggeochem.2019.02.008, 2019.

Lee, S., Shi, G. R., Nakrem, H. A., Woo, J., and Tazawa, J.-I.: Mass extinction or extirpation: Permian biotic turnovers in the northwestern margin of Pangea, GSA Bull., 134, 2399–2414, https://doi.org/10.1130/b36227.1, 2022.

Lerch, B., Karlsen, D. A., Thieβen, O., Abay, T. B., van Soelen, E. E., Kürschner, W. M., Planke, S., and Backer-Owe, K.: Investigations on the use of triaromatic dimethylcholesteroids as age-specific biomarkers in bitumens and oils from Arctic Norway, Org. Geochem., 122, 1–16, https://doi.org/10.1016/j.orggeochem.2018.04.011, 2018.

Leu, M., Schneebeli-Hermann, E., Hammer, Ø., Lindemann, F.-J., and Bucher, H.: Spatiotemporal dynamics of nektonic biodiversity and vegetation shifts during the Smithian–Spathian transition: conodont and palynomorph insights from Svalbard, Lethaia, 57, 1–19, https://doi.org/10.18261/let.57.2.3, 2024.

Lever, M. A., Rogers, K. L., Lloyd, K. G., Overmann, J., Schink, B., Thauer, R. K., Hoehler, T. M., and Jørgensen, B. B.: Life under extreme energy limitation: a synthesis of laboratory- and field-based investigations, FEMS Microbiol. Rev., 39, 688–728, https://doi.org/10.1093/femsre/fuv020, 2015.

Long, P. E., Williams, K. H., Hubbard, S. S., and Banfield, J. F.: Microbial Metagenomics Reveals Climate-Relevant Subsurface Biogeochemical Processes, Trends Microbiol., 24, 600–610, https://doi.org/10.1016/j.tim.2016.04.006, 2016.

Lopes, G., Mangerud, G., and Clayton, G.: The palynostratigraphy of the Mississippian Birger Johnsonfjellet section, Spitsbergen, Svalbard, Palynology, 43, 631–649, https://doi.org/10.1080/01916122.2018.1518849, 2019.

Lopes, G., Mangerud, G., Clayton, G., and Vigran, J. O.: Palynostratigraphic reassessment of the Late Devonian of Bjørnøya, Svalbard, Rev. Paleobot. Palynol., 286, 104376, https://doi.org/10.1016/j.revpalbo.2020.104376, 2021.

Lucas, S. G.: The GSSP Method of Chronostratigraphy: A Critical Review, Front. Earth Sci., Volume 6 - 2018, https://doi.org/10.3389/feart.2018.00191, 2018.

Luppold, F. W.: New Biostratigraphic Data from West Spitsbergen Based on Conodonts, Geol. Jb., B 91, 603–633, 2001.

Macdonald, F. A.: Deep-Time Paleoclimate Proxies, AGU Adv., 1, e2020AV000244, https://doi.org/10.1029/2020AV000244, 2020.

Magnabosco, C., Lin, L. H., Dong, H., Bomberg, M., Ghiorse, W., Stan-Lotter, H., Pedersen, K., Kieft, T. L., van Heerden, E., and Onstott, T. C.: The biomass and biodiversity of the continental subsurface, Nat. Geosci., 11, 707–717, https://doi.org/10.1038/s41561-018-0221-6, 2018.

Maletz, J. and Bruton, D. L.: Lower Ordovician (Chewtonian to Castlemainian) Radiolarians of Spitsbergen, J. Syst. Palaeontol., 5, 245–288, https://doi.org/10.1017/S1477201907002039, 2007.

Mangerud, G. and Konieczny, R. M.: Palynology of the Permian succession of Spitsbergen, Svalbard, Polar Res., 12, 65–93, https://doi.org/10.3402/polar.v12i1.6704, 1993.

Manum, S.: Some Dinoflagellates and Hystrichosphaerids from the Lower Tertiary of Spitsbergen, Nytt Magasin for Botanikk, 8, 17–24, 1960.

Manum, S.: Studies in the Tertiary Flora of Spitsbergen: With Notes on Tertiary Floras of Ellesmere Island, Greenland, and Iceland, a Palynological Investigation, Norsk Polarinst. Skrifter, 125, 127 pp., 1962

Manum, S. B. and Throndsen, T.: Age of Tertiary formations on Spitsbergen, Polar Res., 4, 103–131, https://doi.org/10.3402/polar.v4i2.6927, 1986.

Marsden, L. H., Godøy, Ø., Gabrielsen, T. M., Ellingsen, P. G., Reigstad, M., Marquardt, M., Morvik, A., Sagen, H., Tronstad, S., and Ferrighi, L.: Best practices for data management in marine science: lessons from the Nansen Legacy project, Earth Syst. Sci. Data, 17, 5983–5996, https://doi.org/10.5194/essd-17-5983-2025, 2025.

McCann, A. J. and Dallmann, W. K.: Reactivation history of the long-lived Billefjorden Fault Zone in north central Spitsbergen, Svalbard, Geol. Mag., 133, 63–84, https://doi.org/10.1017/S0016756800007251, 1996.

Meier, K., O'Sullivan, P., Jochmann, M. M., Wallrath, T., Monien, P., Piepjohn, K., Lisker, F., and Spiegel, C.: Shallow Thermal Anomalies and Their Role in the Breakup Evolution Along the Conjugate Margins of the Fram Strait (Svalbard and Eastern North Greenland), Indicated by Low-Temperature Thermochronology, Geochem. Geophys. Geosyst., 25, e2023GC011074, https://doi.org/10.1029/2023GC011074, 2024.

Midtkandal, I., Svensen, H. H., Planke, S., Corfu, F., Polteau, S., Torsvik, T. H., Faleide, J. I., Grundvåg, S.-A., Selnes, H., Kürschner, W., and Olaussen, S.: The Aptian (Early Cretaceous) oceanic anoxic event (OAE1a) in Svalbard, Barents Sea, and the absolute age of the Barremian-Aptian boundary, Palaeogeogr. Palaeoclimatol. Palaeoecol., 463, 126–135, https://doi.org/10.1016/j.palaeo.2016.09.023, 2016.

Mii, H.-s., Grossman, E. L., and Yancey, T. E.: Stable carbon and oxygen isotope shifts in Permian seas of West Spitsbergen-Global change or diagenetic artifact?, Geology, 25, 227–230, https://doi.org/10.1130/0091-7613(1997)025<0227:Scaois>2.3.Co;2, 1997.

Mikhailova, K. Y., Rogov, M. A., Ershova, V. B., Vasileva, K. Y., Pokrovsky, B. G., and Baraboshkin, E. Y.: New Data on Stratigraphy and Distributions of Glendonites from the Carolinefjellet Formation (Middle Aptian–Lower Albian, Cretaceous), Western Spitsbergen, Stratigr. Geol. Correl., 29, 21–35, https://doi.org/10.1134/S0869593821010056, 2021.

Moody-Stuart, M.: High- and low-sinuosity stream deposits, with examples from the Devonian of Spitsbergen, J. Sediment. Res., 36, 1102–1117, https://doi.org/10.1306/74d71609-2b21-11d7-8648000102c1865d, 1966.

Mueller, S., Veld, H., Nagy, J., and Kürschner, W. M.: Depositional history of the Upper Triassic Kapp Toscana Group on Svalbard, Norway, inferred from palynofacies analysis and Org. Geochem., Sediment. Geol., 310, 16–29, https://doi.org/10.1016/j.sedgeo.2014.06.003, 2014.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Mueller, S., Hounslow, M. W., and Kürschner, W. M.: Integrated stratigraphy and palaeoclimate history of the Carnian Pluvial Event in the Boreal realm; new data from the Upper Triassic Kapp Toscana Group in central Spitsbergen (Norway), J. Geol. Soc., 173, 186-202, https://doi.org/10.1144/jgs2015-028, 2016.

Mulrooney, M. J., Larsen, L., Stappen, J. V., Cnudde, V., Senger, K., Rismyhr, B., Braathen, A., Olaussen, S., Mørk, M. B. E., and Ogata, K.: Fluid flow properties of the Wilhelmøya Subgroup, a potential unconventional CO_2 storage unit in central Spitsbergen, Norw. J. Geol., 2019.

Mutrux, J., Maher, H., Shuster, R., and Hays, T.: Iron ooid beds of the Carolinefjellet Formation, Spitsbergen, Norway, Polar Res., 27, 28–43, https://doi.org/10.1111/j.1751-8369.2007.00039.x, 2008.

Mørk, A. and Bromley, R. G.: Ichnology of a marine regressive systems tract: the Middle Triassic of Svalbard, Polar Res., 27, 339–359, https://doi.org/10.3402/polar.v27i3.6191, 2008.

Mørk, A., Os Vigran, J., and Hochuli, P. A.: Geology and palynology of the Triassic succession of Bjørnøya, Polar Res., 8, 141–163, https://doi.org/10.3402/polar.v8i2.6810, 1990.

Mørk, M. B. E.: Diagenesis and quartz cement distribution of low-permeability Upper Triassic–Middle Jurassic reservoir sandstones, Longyearbyen CO2 lab well site in Svalbard, Norway, AAPG bull., 97, 577–596, 2013.

Nabbefeld, B., Grice, K., Summons, R. E., Hays, L. E., and Cao, C.: Significance of polycyclic aromatic hydrocarbons (PAHs) in Permian/Triassic boundary sections, Appl. Geochem., 25, 1374–1382, https://doi.org/10.1016/j.apgeochem.2010.06.008, 2010a.

Nabbefeld, B., Grice, K., Twitchett, R. J., Summons, R. E., Hays, L., Böttcher, M. E., and Asif, M.: An integrated biomarker, isotopic and palaeoenvironmental study through the Late Permian event at Lusitaniadalen, Spitsbergen, Earth Planet. Sci. Lett., 291, 84–96, https://doi.org/10.1016/j.epsl.2009.12.053, 2010b.

Nagy, J.: Ammonite faunas and stratigraphy of Lower Cretaceous (Albian) rocks in southern Spitsbergen, Norsk Polarinst. Skrifter, 152, 58 pp., 1970.

Nagy, J.: Delta-influenced foraminiferal facies and sequence stratigraphy of Paleocene deposits in Spitsbergen,Palaeogeogr. Palaeoclimatol. Palaeoecol., 222, 161–179, https://doi.org/10.1016/j.palaeo.2005.03.014, 2005.

Nagy, J. and Naoroz, M.: Changing depositional environments reflected by foraminifera in a transgressive-regressive sequence of the Lower Cretaceous on Spitsbergen, Palaeogeogr. Palaeoclimatol. Palaeoecol., 511, 144–167, https://doi.org/10.1016/j.palaeo.2018.07.026, 2018.

Nagy, J., Hess, S., Dypvik, H., and Bjærke, T.: Marine shelf to paralic biofacies of Upper Triassic to Lower Jurassic deposits in Spitsbergen, Palaeogeogr. Palaeoclimatol. Palaeoecol., 300, 138–151, https://doi.org/10.1016/j.palaeo.2010.12.018, 2011.

Nagy, J., Jargvoll, D., Dypvik, H., Jochmann, M., and Riber, L.: Environmental changes during the Paleocene–Eocene Thermal Maximum in Spitsbergen as reflected by benthic foraminifera, Polar Res., 32, 19737, https://doi.org/10.3402/polar.v32i0.19737, 2013.

Nagy, J., Foster, W. J., Svensen, H. H., and Planke, S.: Permian-Triassic mass extinction and its aftermath in Boreal waters reflected by foraminifera from Spitsbergen, Palaeogeogr. Palaeoclimatol. Palaeoecol., 690, 113698, https://doi.org/10.1016/j.palaeo.2026.113698, 2026.

Nakamura, K., Kimura, G., and Winsnes, T. S.: Brachiopod zonation and age of the Permian Kapp Starostin Formation (central Spitsbergen), Polar Res., 5, 207–219, https://doi.org/10.3402/polar.v5i2.6877, 1987.

Nakazawa, K.: Permian bivalves from West Spitsbergen, Svalbard Islands, Norway, Paleontol. Res., 3, 1–17, 1999.

Nakrem, H. A. and Kiessling, W.: Late Jurassic (Volgian) radiolarians from central Spitsbergen–a preliminary study, Norw. J. Geol., 92, 149–155, 2012.

Nakrem, H. A. and Mørk, A.: New early Triassic Bryozoa (Trepostomata) from Spitsbergen, with some remarks on the stratigraphy of the investigated horizons, Geol. Mag., 128, 129–140, https://doi.org/10.1017/S001675680001832X, 1991.

Nakrem, H. A., Nilsson, I., and Mangerud, G.: Permian biostratigraphy of Svalbard (Arctic Norway)–a review, Int. Geol. Rev., 34, 933–959, https://doi.org/10.1080/00206819209465645, 1992.

Nakrem, H. A., Orchard, M. J., Weitschat, W., Hounslow, M. W., Beatty, T. W., and Mørk, A.: Triassic conodonts from Svalbard and their Boreal correlations, Polar Res., 27, 523–539, https://doi.org/10.3402/polar.v27i3.6190, 2008.

Nakrem, H. A., Błażejowski, B., and Gaździcki, A.: Lower Permian Bryozoans from Southern and Central Spitsbergen, Svalbard, Acta Palaeontol. Pol., 54, 677–698, 622, 2009.

Nawrocki, J.: Paleomagnetism of Permian through Early Triassic sequences in central Spitsbergen: implications for paleogeography, Earth Planet. Sci. Lett., 169, 59–70, https://doi.org/10.1016/S0012-821X(99)00069-2, 1999.

Nicolaisen, J. B., Elvebakk, G., Ahokas, J., Bojesen-Koefoed, J. A., Olaussen, S., Rinna, J., Skeie, J. E., and Stemmerik, L.: Characterization of Upper Palaeozoic organic-rich units in Svalbard: Implications for the petroleum systems of the Norwegian Barents Shelf, J. Petr. Geol., 42, 59–78, https://doi.org/10.1111/jpg.12724, 2019.

Nielsen, J. K., Błażejowski, B., Gieszcz, P., and Nielsen, J. K.: Carbon and oxygen isotope records of Permian brachiopods from relatively low and high palaeolatitudes: climatic seasonality and evaporation, in: Palaeozoic Climate Cycles: Their Evolutionary and Sedimentological Impact, edited by: Gąsiewicz, A., and Słowakiewicz, M., Geol. Soc. Lond., 0, https://doi.org/10.1144/sp376.6, 2013.

Norwegian Polar Institute: Terrengmodell Svalbard (S0 Terrengmodell) [Dataset], https://doi.org/10.21334/NPOLAR.2014.DCE53A47, 2014.

Norwegian Polar Institute: Geologic map of Svalbard (1:250000) [Dataset], https://doi.org/10.21334/NPOLAR.2016.616F7504, 2016.

Nuus, M., Fuchs, S., Smyrak-Sikora A., Kubutat, T., and Senger, K.: Thermal conductivity and heat flow modeling of petroleum exploration and research wells onshore Svalbard, Geothermics, 136, https://doi.org/10.1016/j.geothermics.2025.103585, 2026.

Ogata, K., Senger, K., Braathen, A., Tveranger, J., and Olaussen, S.: The importance of natural fractures in a tight reservoir for potential CO_2 storage: case study of the upper Triassic to middle Jurassic Kapp Toscana Group (Spitsbergen, Arctic

Norway), in: Advances in the Study of Fractured Reservoirs, edited by: Spence, G. H., Redfern, J., Aguilera, R., Bevan, T. G., Cosgrove, J. W., Couples, G. D., and Daniel, J. M., Geol. Soc. Lond. Spec. Publ., Geol. Soc. Lond., London, 22, http://dx.doi.org/10.1144/SP374.9, 2012.

Ogata, K., Senger, K., Braathen, A., Tveranger, J., and Olaussen, S.: Fracture systems and meso-scale structural patterns in the siliciclastic Mesozoic reservoir-caprock succession of the Longyearbyen CO2 Lab project: implications for geologic CO2 sequestration on Central Spitsbergen, Svalbard, Norw. J. Geol., 94, 121–154, 2014.

Ohm, S. E., Larsen, L., Olaussen, S., Senger, K., Birchall, T., Demchuk, T., Hodson, A., Johansen, I., Titlestad, G. O., Karlsen, D. A., and Braathen, A.: Discovery of shale gas in organic rich Jurassic successions, Adventdalen, Central Spitsbergen, Norway, Norw. J. Geol., 2019.

Olaussen, S., Senger, K., Braathen, A., Grundvåg, S. A., and Mørk, A.: You learn as long as you drill; research synthesis from the Longyearbyen CO2 Laboratory, Svalbard, Norway, Norw. J. Geol., 99, 157–187, https://dx.doi.org/10.17850/njg008, 2019.

Olaussen, S., Grundvåg, S.-A., Senger, K., Anell, I., Betlem, P., Birchall, T., Braathen, A., Dallmann, W., Jochmann, M., Johannessen, E. P., Lord, G., Mørk, A., Osmundsen, P. T., Smyrak-Sikora, A., and Stemmerik, L.: Svalbard Composite Tectono-Sedimentary Element, Barents Sea, Geol. Soc. Lond. Mem., 57, M57–2021–2036, https://doi.org/10.1144/M57-2021-36, 2025.

Olempska, E. and Błaszyk, J.: Ostracods from Permian of Spitsbergen, Pol. Polar Res., 3–20–23–20, 1996.

Oordt, A. J., Soreghan, G. S., Stemmerik, L., and Hinnov, L. A.: A record of dust deposition in northern, mid-latitude Pangaea during peak icehouse conditions of the late Paleozoic ice age, J. Sediment. Res., 90, 337–363, https://doi.org/10.2110/jsr.2020.15, 2020.

Orcutt, B. N., LaRowe, D. E., Biddle, J. F., Colwell, F. S., Glazer, B. T., Reese, B. K., Kirkpatrick, J. B., Lapham, L. L., Mills, H. J., Sylvan, J. B., Wankel, S. D., and Wheat, C. G.: Microbial activity in the marine deep biosphere: progress and prospects, Front. Microbiol., Volume 4 - 2013, https://doi.org/10.3389/fmicb.2013.00189, 2013.

Ozsvárt, P., Foster, W. J., Asatryan, G., Buchwald, S. Z., Gómez Correa, M. A., Mosociova, T., Galasso, F., and Zajzon, N.: Exceptional preservation and unexpected diversity of radiolarians in the aftermath of the Permian–Triassic mass extinction, Pap. Palaeontol., 12, e70090, https://doi.org/10.1002/spp2.70090, 2026.

Park, J., Stein, H. J., Hannah, J. L., Georgiev, S. V., Hammer, Ø., and Olaussen, S.: Re-Os geochronology of the Middle to Upper Jurassic marine black shales in the Agardhfjellet Formation, Central Spitsbergen, Svalbard: A cornerstone for global faunal correlation and Os isotopic change, Palaeogeogr. Palaeoclimatol. Palaeoecol., 633, 111878, https://doi.org/10.1016/j.palaeo.2023.111878, 2024.

Parker, J. R.: The Jurassic and Cretaceous Sequence in Spitsbergen, Geol. Mag., 104, 487–505, 1967.

Parkes, R. J., Cragg, B., Roussel, E., Webster, G., Weightman, A., and Sass, H.: A review of prokaryotic populations and processes in sub-seafloor sediments, including biosphere:geosphere interactions, Mar. Geol., 352, 409–425, https://doi.org/10.1016/j.margeo.2014.02.009, 2014.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Paterson, N. W. and Mangerud, G.: Late Triassic (Carnian – Rhaetian) palynology of Hopen, Svalbard, Rev. Palaeobot. Palynol., 220, 98–119, https://doi.org/10.1016/j.revpalbo.2015.05.001, 2015.

Paterson, N. W., Rossi, V. M., and Schneebeli-Hermann, E.: Volcanogenic mercury and plant mutagenesis during the end-Permian mass extinction: Palaeoecological perturbation in northern Pangaea, Gondwana Res., 134, 123–143, https://doi.org/10.1016/j.gr.2024.06.018, 2024.

Percival, L. M. E., Tedeschi, L. R., Creaser, R. A., Bottini, C., Erba, E., Giraud, F., Svensen, H., Savian, J., Trindade, R., Coccioni, R., Frontalini, F., Jovane, L., Mather, T. A., and Jenkyns, H. C.: Determining the style and provenance of magmatic activity during the Early Aptian Oceanic Anoxic Event (OAE 1a), Glob. Planet. Change, 200, 103461, https://doi.org/10.1016/j.gloplacha.2021.103461, 2021.

Peucker-Ehrenbrink, B. and Ravizza, G.: The marine osmium isotope record, Terra Nova, 12, 205–219, https://doi.org/10.1046/j.1365-3121.2000.00295.x, 2000.

Piepjohn, K.: The Svalbardian–Ellesmerian deformation of the Old Red Sandstone and the pre-Devonian basement in NW Spitsbergen (Svalbard), in: New Perspectives on the Old Red Sandstone, edited by: Friend, P. F., and Williams, B. P. J., Geol. Soc. Lond., 0, https://doi.org/10.1144/gsl.Sp.2000.180.01.31, 2000.

Piepjohn, K., von Gosen, W., and Tessensohn, F.: The Eurekan deformation in the Arctic: an outline, J. Geol. Soc., 173, 1007–1024, 2016.

Pogge von Strandmann, P. A. E., Jones, M. T., West, A. J., Murphy, M. J., Stokke, E. W., Tarbuck, G., Wilson, D. J., Pearce, C. R., and Schmidt, D. N.: Lithium isotope evidence for enhanced weathering and erosion during the Paleocene-Eocene Thermal Maximum, Sci. Adv., 7, eabh4224, https://doi.org/10.1126/sciadv.abh4224, 2021.

Polteau, S., Hendriks, B. W., Planke, S., Ganerød, M., Corfu, F., Faleide, J. I., Midtkandal, I., Svensen, H. S., and Myklebust, R.: The Early Cretaceous Barents Sea Sill Complex: distribution, 40Ar/39Ar geochronology, and implications for carbon gas formation, Palaeogeogr. Palaeoclimatol. Palaeoecol., 441, 83–95, 2016.

Price, G. D. and Nunn, E. V.: Valanginian isotope variation in glendonites and belemnites from Arctic Svalbard: Transient glacial temperatures during the Cretaceous greenhouse, Geology, 38, 251–254, https://doi.org/10.1130/g30593.1, 2010.

Purgstaller, B., Dietzel, M., Baldermann, A., and Mavromatis, V.: Control of temperature and aqueous Mg2+/Ca2+ ratio on the (trans-)formation of ikaite, Geochim. Cosmochim. Acta, 217, 128–143, https://doi.org/10.1016/j.gca.2017.08.016, 2017.

Rauzi, S., Foster, W. J., Takahashi, S., Hori, R. S., Beaty, B. J., Tarhan, L. G., and Isson, T.: Lithium isotopic evidence for enhanced reverse weathering during the Early Triassic warm period, P. Natl. Acad. Sci., 121, e2318860121, https://doi.org/10.1073/pnas.2318860121, 2024.

Regelous, M., Regelous, A., Grasby, S. E., Bond, D. P. G., Haase, K. M., Gleißner, S., and Wignall, P. B.: Tellurium in Late Permian-Early Triassic Sediments as a Proxy for Siberian Flood Basalt Volcanism, Geochem. Geophys. Geosyst., 21, e2020GC009064, https://doi.org/10.1029/2020GC009064, 2020.

Reolid, M., Mattioli, E., Duarte, L. V., and Marok, A.: The Toarcian oceanic anoxic event and the Jenkyns event (IGCP-655 final report), Episodes, 43, 833–844, https://doi.org/10.18814/epiiugs/2020/020051, 2020.

Rismyhr, B., Bjærke, T., Olaussen, S., Mulrooney, M. J., and Senger, K.: Facies, palynostratigraphy and sequence stratigraphy of the Wilhelmøya Subgroup (Upper Triassic–Middle Jurassic) in western central Spitsbergen, Svalbard, Nor. Geol. Tidsskr., 99, 35–64, https://dx.doi.org/10.17850/njg001, 2019.

Roberts, A. J., Rucinski, M., Kear, B. P., Hammer, Ø., Engelschiøn, V. S., Scharling, T. H., Larsen, R. B., and Hurum, J. H.: Earliest oceanic tetrapod ecosystem reveals rapid complexification of Triassic marine communities, Science, 390, 722–727, https://doi.org/10.1126/science.adx7390, 2025.

Rodríguez-Tovar, F. J.: Ichnological analysis: A tool to characterize deep-marine processes and sediments, Earth-Sci. Rev., 228, 104014, https://doi.org/10.1016/j.earscirev.2022.104014, 2022.

Rodríguez-Tovar, F. J., Dorador, J., Zuchuat, V., Planke, S., and Hammer, Ø.: Response of macrobenthic trace maker community to the end-Permian mass extinction in Central Spitsbergen, Svalbard, Palaeogeogr. Palaeoclimatol. Palaeoecol., 581, 110637, https://doi.org/10.1016/j.palaeo.2021.110637, 2021.

Rogov, M. A.: New data on ammonites and stratigraphy of the Volgian stage in Spitzbergen, Stratigr. Geol. Correl., 18, 505–531, https://doi.org/10.1134/S0869593810050047, 2010.

Rogov, M., Ershova, V., Gaina, C., Vereshchagin, O., Vasileva, K., Mikhailova, K., and Krylov, A.: Glendonites throughout the Phanerozoic, Earth-Sci. Rev., 241, 104430, https://doi.org/10.1016/j.earscirev.2023.104430, 2023.

Salamon, M. A., Hanken, N., Gorzelak, P., Riise, H. E., and Ferré, B.: Crinoids from Svalbard in the aftermath of the end–Permian mass extinction, Pol. Polar Res., 2015.

Sartell, A. M. R., Söderlund, U., Senger, K., Kjøll, H. J., and Galland, O.: A Review of the Spatiotemporal Evolution of the High Arctic Large Igneous Province, and a New U-Pb Age of a Mafic Sill Complex on Svalbard, Geochem. Geophys. Geosyst., 26, e2024GC011842, https://doi.org/10.1029/2024GC011842, 2025.

Schaaf, N. W., Osmundsen, P. T., Van der Lelij, R., Schönenberger, J. L., OK, R. T., and Senger, K.: Tectono-sedimentary evolution of the eastern Forlandsundet Graben, Svalbard, Norw. J. Geol., 100, https://doi.org/10.1785/njg100-4-4, 2021.

Schad, S. and Senger, K.: Deep-time δ13C compilation Svalbard [dataset], https://doi.org/10.11582/2025.m27ev9eu.v2, 2025a.

Schad, S. and Senger, K.: Deep-time δ18O compilation Svalbard [dataset], https://doi.org/10.11582/2025.7l4tao47.v2, 2025b.

Schad, S. and Senger, K.: Deep-time Mercury compilation Svalbard [dataset], https://doi.org/10.11582/2025.9h4pe0bz.v2, 2025c.

Schad, S. and Senger, K.: Deep-time Pyrolysis compilation Svalbard [dataset], https://doi.org/10.11582/2025.kmemmsdj.v2, 2025d.

Schad, S. and Senger, K.: Overview of Phanerozoic age constraints in Svalbard [dataset], https://doi.org/10.11582/2026.sb74rnzq , 2026.

Schad, S., Śliwińska, K. K., Foster, W. J., and Senger, K.: Overview of Phanerozoic biostratigraphy in Svalbard [dataset], https://doi.org/10.11582/2026.qnrzpfz1, 2026.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Scharling, T. H., Roberts, A. J., Foffa, D., Engelschiøn, V. S., and Hurum, J. H.: Dental and Dietary Disparity Among Marine Vertebrates from the Early Triassic (Spathian) of Svalbard–Life Bites the Dust, or A New Hope?, Norw. J. Geol., 105, 1-45, https://dx.doi.org/10.17850/njg105-1-4, 2025.

Scheibner, C., Hartkopf-Fröder, C., Blomeier, D., and Forke, H.: The Mississippian (Lower Carboniferous) in northeast Spitsbergen (Svalbard) and a re-evaluation of the Billefjorden Group, Z. Dtsch. Ges. Geowiss., 163, 293, https://doi.org/10.1127/1860-1804/2012/0163-0293, 2012.

Schobben, M., Foster, W. J., Sleveland, A. R. N., Zuchuat, V., Svensen, H. H., Planke, S., Bond, D. P. G., Marcelis, F., Newton, R. J., Wignall, P. B., and Poulton, S. W.: A nutrient control on marine anoxia during the end-Permian mass extinction, Nat. Geosci., 13, 640–646, https://doi.org/10.1038/s41561-020-0622-1, 2020.

Scotese, C. R., Song, H., Mills, B. J. W., and van der Meer, D. G.: Phanerozoic paleotemperatures: The earth's changing climate during the last 540 million years, Earth-Sci. Rev., 215, 103503, https://doi.org/10.1016/j.earscirev.2021.103503, 2021.

Seilacher, A.: Bathymetry of trace fossils, Mar. Geol., 5, 413–428, https://doi.org/10.1016/0025-3227(67)90051-5, 1967.

Senger, K. and Galland, O.: Stratigraphic and Spatial extent of HALIP Magmatism in central Spitsbergen, Geochem. Geophys. Geosyst., 23, e2021GC010300, https://doi.org/10.1029/2021GC010300, 2022.

Senger, K. and Jochmann, M. M.: Svalbard Rock Vault: towards safeguarding borehole data, Polar Res., https://doi.org/10.33265/polar.v44.11413, 2025.

Senger, K., Planke, S., Polteau, S., Svensen, H., and Ogata, K.: Sill emplacement and contact metamorphism in a siliciclastic reservoir on Svalbard, Arctic Norway, Norw. J. Geol., 94, 155–169, 2014.

Senger, K., Tveranger, J., Braathen, A., Olaussen, S., Ogata, K., and Larsen, L.: CO_2 storage resource estimates in unconventional reservoirs: insights from a pilot-sized storage site in Svalbard, Arctic Norway, Environ Earth Sci, 73, 3987–4009, http://dx.doi.org/10.1007/s12665-014-3684-9, 2015.

Senger, K., Betlem, P., Birchall, T., Gonzaga Jr, L., Grundvåg, S.-A., Horota, R. K., Laake, A., Kuckero, L., Mørk, A., and Planke, S.: Digitising Svalbard's Geology: the Festningen Digital Outcrop Model, First Break, 40, 47–55, https://doi.org/10.3997/1365-2397.fb2022021, 2022.

Senger, K., Kulhanek, D., Jones, M. T., Smyrak-Sikora, A., Planke, S., Zuchuat, V., Foster, W. J., Grundvåg, S. A., Lorenz, H., Ruhl, M., Sliwinska, K. K., Vickers, M. L., and Xu, W.: Deep-time Arctic climate archives: high-resolution coring of Svalbard's sedimentary record – SVALCLIME, a workshop report, Sci. Dril., 32, 113–135, https://doi.org/10.5194/sd-32-113-2023, 2023.

Senger, K., Ammerlaan, F., Betlem, P., Dumais, M-A., Eagles, G., Foster, W., Geissler, WH., Grundvåg, S-A., Hodson, A., Horota, R., Hurum, J., Jones, M., Kierulf, HP., Majka, J., Marsden, L., Michalski, K., Minakov, A., Ogata, K., Olaussen, S., Osmundsen, PT., Planke, S., Ruppel, A., Sartell, A., Shephard, GE., Śliwińska, KK., Smeraglia, L., Smyrak-Sikora, A., Spiegel-Behnke, C., and Zuchuat, V.: Geology of Svalbard: Deep-time and Deep-Earth (SVALGEOL), in: SESS report 2024, edited by: Runge, E., Neuber, R., Łupikasza, E., Hübner, C., and Holmén, K., Svalbard Integrated Arctic Earth Observing System, Longyearbyen, 52–83, https://doi.org/10.5281/zenodo.14425478, 2025a.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Open Access Earth System Science Data Discussions

Senger, K., Betlem, P., Braathen, A., Olaussen, S., and Sand, G.: Longyearbyen CO2 lab project–from a vision of a CO2-neutral Svalbard to a geoscience data eldorado, Arct. Sci., 11, 1-26, https://doi.org/10.1139/as-2024-0019, 2025b.

Senger, K., Betlem, P., Grundvåg, S.-A., Jones, M., Kulhanek, D., Marsden, L., Planke, S., Schad, S., Shephard, G., Śliwińska, K. K., Smyrak-Sikora, A., Tarhan, L., and Zuchuat, V.: The deep-time climate archive of Svalbard (SVALGEOL 2), in: SESS report 2025, edited by: Köhler, K., Hübner, C., Myhre, P., Jawak, S., and Lihavainen, H., Svalbard Integrated Arctic Earth Observing System, Longyearbyen, 20–31, https://doi.org/10.5281/zenodo.17829839, 2026.

Shen, S. Z., Tazawa, J. I., and Shi, G. R.: Carboniferous and Permian Rugosochonetidae (Brachiopoda) from West Spitsbergen SZ, Alcheringa, 29, 241–256, https://doi.org/10.1080/03115510508619304, 2005.

Śliwińska, K. K. and Head, M. J.: New species of the dinoflagellate cyst genus Svalbardella Manum, 1960, emend. from the Paleogene and Neogene of the northern high to middle latitudes, J. Micropalaeontol., 39, 139–154, https://doi.org/10.5194/jm-39-139-2020, 2020.

Śliwińska, K. K., Jelby, M. E., Grundvåg, S.-A., Nøhr-Hansen, H., Alsen, P., and Olaussen, S.: Dinocyst stratigraphy of the Valanginian–Aptian Rurikfjellet and Helvetiafjellet formations on Spitsbergen, Arctic Norway, Geol. Mag., 157, 1693–1714, https://doi.org/10.1017/S0016756819001249, 2020.

Smelror, M.: Bathonian to early Oxfordian dinoflagellate cysts and acritarchs from Kong Karls Land, Svalbard, Rev. Palaeobot. Palynol., 56, 275–303, https://doi.org/10.1016/0034-6667(88)90061-9, 1988.

Smelror, M.: Jurassic stratigraphy of the Western Barents sea region: A review, Geobios, 27, 441–451, 1994.

Smelror, M. and Dypvik, H.: Marine microplankton biostratigraphy of the Volgian-Ryazanian boundary strata, western Barents Shelf, NGU Bull., 443, 2005.

Smelror, M. and Larssen, G. B.: Are there Upper Cretaceous sedimentary rocks preserved on Sørkapp land, Svalbard?, Norw. J. Geol., 96, 147–158, https://doi.org/10.1016/10.7850/njg96-2-05, 2016.

Smelror, M., Larssen, G. B., Olaussen, S., Rømuld, A., and Williams, R.: Late Triassic to Early Cretaceous palynostratigraphy of Kong Karls Land, Svalbard, Arctic Norway, with correlations to Franz Josef Land, Arctic Russia, Norw. J. Geol., 98, https://dx.doi.org/10.17850/njg004, 2018.

Smelror, M., Olaussen, S., Dumais, M.-A., Grundvåg, S.-A., and Abay, T. B.: Northern Svalbard Composite Tectono-Sedimentary Element, Geol. Soc. Lond. Mem., 57, M57–2023–2022, https://doi.org/10.1016/10.1144/M57-2023-2, 2025.

Smith, D. G.: The stratigraphy of Wilhelmøya and Hellwaldfjellet, Svalbard, Geol. Mag., 112, 481–491, https://doi.org/10.1017/S0016756800046203, 1975.

Smyrak-Sikora, A., Johannessen, E. P., Olaussen, S., Sandal, G., and Braathen, A.: Sedimentary architecture during Carboniferous rift initiation – the arid Billefjorden Trough, Svalbard, J. Geol. Soc., 176, 225–252, https://doi.org/10.1144/jgs2018-100, 2018.

Smyrak-Sikora, A., Nicolaisen, J., Braathen, A., Johannessen, E. P., Olaussen, S., and Stemmerik, L.: Impact of growth faults on mixed siliciclastic-carbonate-evaporite deposits during rift climax and reorganisation—Billefjorden Trough, Svalbard, Norway, Basin Res., 1–32, http://dx.doi.org10.1111/bre.12578, 2021.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Smyrak-Sikora, A., Betlem, P., Engelschiøn, V. S., Foster, W. J., Grundvåg, S.-A., Jelby, M. E., Jones, M. T., Shephard, G. E., Śliwińska, K. K., Vickers, M. L., Zuchuat, V., Augland, L. E., Faleide, J. I., Galloway, J. M., Helland-Hansen, W., Jensen, M. A., Johannessen, E. P., Koevoets, M., Kulhanek, D., Lord, G. S., Mosociova, T., Olaussen, S., Planke, S., Price, G. D., Stemmerik, L., and Senger, K.: Phanerozoic paleoenvironmental and paleoclimatic evolution in Svalbard, Clim. Past, https://doi.org/10.5194/cp-21-2133-2025, 2025.

Soares, A., Edwards, A., An, D., Bagnoud, A., Bradley, J., Barnhart, E., Bomberg, M., Budwill, K., Caffrey, S. M., Fields, M., Gralnick, J., Kadnikov, V., Momper, L., Osburn, M., Mu, A., Moreau, J. W., Moser, D., Purkamo, L., Rassner, S. M., Sheik, C. S., Sherwood Lollar, B., Toner, B. M., Voordouw, G., Wouters, K., and Mitchell, A. C.: A global perspective on bacterial diversity in the terrestrial deep subsurface, Microbiology, 169, https://doi.org/10.1099/mic.0.001172, 2023.

Sorento, T., Olaussen, S., and Stemmerik, L.: Controls on deposition of shallow marine carbonates and evaporites – lower Permian Gipshuken Formation, central Spitsbergen, Arctic Norway, Sedimentology, 67, 207–238, https://doi.org/10.1111/sed.12640, 2020.

Spath, L. F.: On Ammonites from Spitsbergen, Geol. Mag., 58, 297–305, https://doi.org/10.1017/S001675680008907X, 1921.

Spielhagen, R. F. and Tripati, A.: Evidence from Svalbard for near-freezing temperatures and climate oscillations in the Arctic during the Paleocene and Eocene, Palaeogeogr. Palaeoclimatol. Palaeoecol., 278, 48–56, https://doi.org/10.1016/j.palaeo.2009.04.012, 2009.

Steel, R., Gjelberg, J., and Haarr, G.: Helvetiafjellet Formation (Barremian) at Festningen, Spitsbergen—a field guide, Nor. Polarinst. Årbok 1977, 111–128, 1978.

Steel, R. J. and Worsley, D.: Svalbard's post-Caledonian strata — an atlas of sedimentational patterns and palaeogeographic evolution, in: Petroleum Geology of the North European Margin, edited by Spencer, A. M., Nor. Petr. Soc., 109–135, 1984.

Stemmerik, L.: Influence of late Paleozoic Gondwana glaciations on the depositional evolution of the northern Pangean shelf, North Greenland, Svalbard, and the Barents Sea, in: Resolving the Late Paleozoic Ice Age in Time and Space, edited by: Fielding, C. R., Frank, T. D., and Isbell, J. L., Geol. Soc. Am., 0, https://doi.org/10.1130/2008.2441(14), 2008.Suess, E., Balzer, W., Hesse, K.-F., Müller, P. J., Ungerer, C. A., and Wefer, G.: Calcium Carbonate Hexahydrate from Organic-Rich Sediments of the Antarctic Shelf: Precursors of Glendonites, Science, 216, 1128–1131, https://doi.org/10.1126/science.216.4550.1128, 1982.

Summons, R. E., Welander, P. V., and Gold, D. A.: Lipid biomarkers: molecular tools for illuminating the history of microbial life, Nat. Rev. Microbiol., 20, 174–185, https://doi.org/10.1038/s41579-021-00636-2, 2022.

Thiele, S. T., Kirsch, M., Lorenz, S., Saffi, H., El Alami, S., Contreras Acosta, I. C., Madriz, Y., and Gloaguen, R.: Maximising the value of hyperspectral drill core scanning through real-time processing and analysis, Front. Earth Sci., Volume 12 - 2024, https://doi.org/10.3389/feart.2024.1433662, 2024.

Tierney, J. E., Poulsen, C. J., Montañez, I. P., Bhattacharya, T., Feng, R., Ford, H. L., Hönisch, B., Inglis, G. N., Petersen, S. V., Sagoo, N., and Tabor, C. R.: Past climates inform our future, science, 370, eaay3701, https://doi.org/10.1126/science.aay3701, 2020.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Tozer, E. T. and Parker, J. R.: Notes on the Triassic biostratigraphy of Svalbard, Geol. Mag., 105, 526–542, https://doi.org/10.1017/S0016756800055886, 1968.

Trammer, J.: Middle Triassic (Ladinian) conodonts and cephalopod arm hooks from Hornsund, Spitsbergen, Acta Geol. Pol., 28, 1978.

Twitchett, R. J. and Barras, C. G.: Trace fossils in the aftermath of mass extinction events, Geol. Soc. Lon. Spec. Publ., 228, 397–418, https://doi.org/10.1144/GSL.SP.2004.228.01.18, 2004.

Uchman, A. and Hanken, N.-M.: Cambrian-Ordovician trace fossils of the Basissletta region, northeast Spitsbergen, Svalbard, Acta Geol. Pol., vol. 74, e29–e29, https://doi.org/10.24425/agp.2024.150014, 2024.

Uchman, A., Hanken, N.-M., Nielsen, J. K., Grundvåg, S.-A., and Piasecki, S.: Depositional environment, ichnological features and oxygenation of Permian to earliest Triassic marine sediments in central Spitsbergen, Svalbard, Polar Res., 35, https://doi.org/10.3402/polar.v35.24782, 2016.

van der Boon, A., Schubert, B. A., Hagopian, W. M., Domeier, M., and Jahren, A. H.: High-resolution carbon isotope record from Svalbard reveals elevated atmospheric CO2 during the Middle Devonian Taghanic crisis, Palaeogeogr. Palaeoclimatol. Palaeoecol., 691, 113747, https://doi.org/10.1016/j.palaeo.2026.113747, 2026.

Van Exem, A., Debret, M., Copard, Y., Verpoorter, C., De Wet, G., Lecoq, N., Sorrel, P., Werner, A., Roof, S., Laignel, B., and Retelle, M.: New source-to-sink approach in an arctic catchment based on hyperspectral core-logging (Lake Linné, Svalbard), Quat. Sci. Rev., 203, 128–140, https://doi.org/10.1016/j.quascirev.2018.10.038, 2019.

Vickers, M. L., Price, G. D., Jerrett, R. M., and Watkinson, M.: Stratigraphic and geochemical expression of Barremian–Aptian global climate change in Arctic Svalbard, Geosphere, 12, 1594–1605, https://doi.org/10.1130/ges01344.1, 2016.

Vickers, M., Watkinson, M., Price, G. D., and Jerrett, R.: An improved model for the ikaite-glendonite transformation: evidence from the Lower Cretaceous of Spitsbergen, Svalbard, Norw. J. Geol., 98, 1–15, https://doi.org/10.17850/njg98-1-01, 2018.

Vickers, M. L., Price, G. D., Jerrett, R. M., Sutton, P., Watkinson, M. P., and FitzPatrick, M.: The duration and magnitude of Cretaceous cool events: Evidence from the northern high latitudes, Geol. Soc. Am. Bull., 131, 1979–1994, https://doi.org/10.1130/B35074.1, 2019.

Vickers, M. L., Jelby, M. E., Śliwińska, K. K., Percival, L. M. E., Wang, F., Sanei, H., Price, G. D., Ullmann, C. V., Grasby, S. E., Reinhardt, L., Mather, T. A., Frieling, J., Korte, C., Jerrett, R. M., Jones, M. T., Midtkandal, I., and Galloway, J. M.: Volcanism and carbon cycle perturbations in the High Arctic during the Late Jurassic – Early Cretaceous, Palaeogeogr. Palaeoclimatol. Palaeoecol., 613, 111412, https://doi.org/10.1016/j.palaeo.2023.111412, 2023.

Vickers, M. L., Jelby, M. E., Blok, C. N., Price, G. D., Jerrett, R. M., Jensen, M. A., and Jones, M. T.: Early Cretaceous giant glendonites: A record of (sub-)millennial-scale cooling?, Palaeogeogr. Palaeoclimatol. Palaeoecol., 661, 112739, https://doi.org/10.1016/j.palaeo.2025.112739, 2025.

Vigran, J. O.: Spores from Devonian deposits, Mimerdalen, Spitsbergen, Norsk Polarinst. Skrifter, 132, 1–33, 1964.

https://doi.org/10.5194/essd-2026-487
Preprint. Discussion started: 28 August 2026

Vigran, J. O., Mangerud, G., Mørk, A., Worsley, D., and Hochuli, P. A.: Palynology and geology of the Triassic succession of Svalbard and the Barents Sea, Special publication - Norges geologiske undersøkelse (NGU Special Publications), 14, https://hdl.handle.net/11250/4511142, 2014.

Walsh, S., Gradstein, F., and Ogg, J.: History, philosophy, and application of the Global Stratotype Section and Point (GSSP), Lethaia, 37, 201–218, 2004.

Weitschat, W.: Ostracoden (O. Myodocopida) mit Weichkörper-Erhaltung aus der Unter-Trias von Spitzbergen, Paläontologische Zeitschrift, 57, 309–323, https://doi.org/10.1007/BF02990320, 1983.

Wesenlund, F., Grundvåg, S.-A., Engelschiøn, V.S., Thießen, O., and Pedersen, J. H.: Linking facies variations, organic carbon richness and bulk bitumen content–A case study of the organic-rich Middle Triassic shales from eastern Svalbard, Mar. Petrol. Geol., 132, 105168, https://doi.org/10.1016/j.marpetgeo.2021.105168, 2021.

Wesenlund, F., Grundvåg, S.-A., Engelschiøn, V. S., Thießen, O., and Pedersen, J. H.: Multi-elemental chemostratigraphy of Triassic mudstones in eastern Svalbard: Implications for source rock formation in front of the World's largest delta plain, Depos. Rec., 8, 718–753, https://doi.org/10.1002/dep2.182, 2022.

Westerhold, T., Marwan, N., Drury, A. J., Liebrand, D., Agnini, C., Anagnostou, E., Barnet, J. S. K., Bohaty, S. M., De Vleeschouwer, D., Florindo, F., Frederichs, T., Hodell, D. A., Holbourn, A. E., Kroon, D., Lauretano, V., Littler, K., Lourens, L. J., Lyle, M., Pälike, H., Röhl, U., Tian, J., Wilkens, R. H., Wilson, P. A., and Zachos, J. C.: An astronomically dated record of Earth's climate and its predictability over the last 66 million years, Science, 369, 1383–1387, https://doi.org/10.1126/science.aba6853, 2020.

Wieczorek, R., Fantle, M. S., Kump, L. R., and Ravizza, G.: Geochemical evidence for volcanic activity prior to and enhanced terrestrial weathering during the Paleocene Eocene Thermal Maximum, Geochim. Cosmochim. Acta, 119, 391–410, https://doi.org/10.1016/j.gca.2013.06.005, 2013.

Wierzbowski, A., Kulicki, C., and Pugaczewska, H.: Fauna and stratigraphy of the uppermost Triassic and the Toarcian and Aalenian deposits in the Sassenfjorden, Spitsbergen, Acta Palaeontol. Pol., 26, 1981.

Wierzbowski, A.: Ammonites and stratigraphy of the Kimmeridgian at Wimanfjellet, Sassenfjorden, Spitsbergen, Palaeontologica, 34, 355–378, 1989.

Wierzbowski, A., Hryniewicz, K., Hammer, Ø., Nakrem, H. A., and Little, C. T. S.: Ammonites from hydrocarbon seep carbonate bodies from the uppermost Jurassic - lowermost Cretaceous of Spitsbergen and their biostratigraphical importance, N. Jb. Geol. Paläontol. Abh., 262, 267–288, https://doi.org/10.1127/0077-7749/2011/0198, 2011.

Wignall, P. B. and Twitchett, R. J.: Oceanic Anoxia and the End Permian Mass Extinction, Science, 272, 1155–1158, https://doi.org/10.1126/science.272.5265.1155, 1996.

Wignall, P. B., Morante, R., and Newton, R.: The Permo-Triassic transition in Spitsbergen: δ13Corg chemostratigraphy, Fe and S geochemistry, facies, fauna and trace fossils, Geol. Mag., 135, 47–62, https://doi.org/10.1017/S0016756897008121, 1998.

Wignall, P. B., Bond, D. P. G., Sun, Y., Grasby, S. E., Beauchamp, B., Joachimski, M. M., and Blomeier, D. P. G.: Ultra-shallow-marine anoxia in an Early Triassic shallow-marine clastic ramp (Spitsbergen) and the suppression of benthic radiation, Geol. Mag., 153, 316–331, https://doi.org/10.1017/S0016756815000588, 2016.

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., Gonzalez-Beltran, A., Gray, A. J. G., Groth, P., Goble, C., Grethe, J. S., Heringa, J., 't Hoen, P. A. C., Hooft, R., Kuhn, T., Kok, R., Kok, J., Lusher, S. J., Martone, M. E., Mons, A., Packer, A. L., Persson, B., Rocca-Serra, P., Roos, M., van Schaik, R., Sansone, S.-A., Schultes, E., Sengstag, T., Slater, T., Strawn, G., Swertz, M. A., Thompson, M., van der Lei, J., van Mulligen, E., Velterop, J., Waagmeester, A., Wittenburg, P., Wolstencroft, K., Zhao, J., and Mons, B.: The FAIR Guiding Principles for scientific data management and stewardship, Sci. Data, 3, 160018, https://doi.org/10.1038/sdata.2016.18, 2016.

Willerslev, E., Hansen, A. J., Binladen, J., Brand, T. B., Gilbert, M. T. P., Shapiro, B., Bunce, M., Wiuf, C., Gilichinsky, D. A., and Cooper, A.: Diverse Plant and Animal Genetic Records from Holocene and Pleistocene Sediments, Science, 300, 791–795, https://doi.org/10.1126/science.1084114, 2003.

Willerslev, E., Cappellini, E., Boomsma, W., Nielsen, R., Hebsgaard, M. B., Brand, T. B., Hofreiter, M., Bunce, M., Poinar, H. N., Dahl-Jensen, D., Johnsen, S., Steffensen, J. P., Bennike, O., Schwenninger, J.-L., Nathan, R., Armitage, S., de Hoog, C.-J., Alfimov, V., Christl, M., Beer, J., Muscheler, R., Barker, J., Sharp, M., Penkman, K. E. H., Haile, J., Taberlet, P., Gilbert, M. T. P., Casoli, A., Campani, E., and Collins, M. J.: Ancient Biomolecules from Deep Ice Cores Reveal a Forested Southern Greenland, Science, 317, 111–114, https://doi.org/10.1126/science.1141758, 2007.

Worsley, D.: Sedimentological observations on the Grey Hoek Formation of northern Andrée Land (Spitsbergen), Norsk Polarinstit. Årbok, 1970, 102-111, 1972.

Worsley, D. T.: The Cretaceous-Tertiary Boundary Event in the Ocean, in: Studies in Paleo-Oceanography, edited by: Hay, W. W., SEPM Society for Sedimentary Geology, 0, https://doi.org/10.2110/pec.74.20.0094, 1974.

Worsley, D. and Mørk, A.: The environmental significance of the trace fossil Rhizocorallium jenense in the Lower Triassic of western Spitsbergen, Polar Res., 20, 37–48, https://doi.org/10.3402/polar.v20i1.6498, 2001.

Xu, G., Hannah, J. L., Stein, H. J., Bingen, B., Yang, G., Zimmerman, A., Weitschat, W., Mørk, A., and Weiss, H. M.: Re–Os geochronology of Arctic black shales to evaluate the Anisian–Ladinian boundary and global faunal correlations, Earth Planet. Sci. Lett., 288, 581–587, https://doi.org/10.1016/j.epsl.2009.10.022, 2009.

Yin, L., Zhao, P., Liu, J., and Li, J.: Re-Os isotope system in organic-rich samples for dating and tracing: Methodology, principle, and application, Earth-Sci. Rev., 238, 104317, https://doi.org/10.1016/j.earscirev.2023.104317, 2023.

Zhang, Y., Ogg, J. G., Minguez, D., Hounslow, M. W., Olaussen, S., Gradstein, F. M., and Esmeray-Senlet, S.: Magnetostratigraphy of U-Pb–dated boreholes in Svalbard, Norway, implies that magnetochron M0r (a proposed Barremian-Aptian boundary marker) begins at 121.2 ± 0.4 Ma, Geology, 49, 733–737, https://doi.org/10.1130/g48591.1, 2021.

Zhou, X., Lu, Z., Rickaby, R. E. M., Domack, E. W., Wellner, J. S., and Kennedy, H. A.: Ikaite Abundance Controlled by Porewater Phosphorus Level: Potential Links to Dust and Productivity, J. Geol., 123, 269–281, https://doi.org/10.1086/681918, 2015.

Zuchuat, V., Sleveland, A. R. N., Twitchett, R. J., Svensen, H. H., Turner, H., Augland, L. E., Jones, M. T., Hammer, Ø., Hauksson, B. T., Haflidason, H., Midtkandal, I., and Planke, S.: A new high-resolution stratigraphic and palaeoenvironmental record spanning the End-Permian Mass Extinction and its aftermath in central Spitsbergen, Svalbard, Palaeogeogr. Palaeoclimatol. Palaeoecol., 554, 109732, https://doi.org/10.1016/j.palaeo.2020.109732, 2020.

Zuchuat, V., Janocha, J., Brooks, H. L., Buchwald, S. Z., Beaty, B., Tarhan, L. G., Gilmullina, A., Jones, M. T., Frank, A. B., Lahajnar, N., Augland, L. E., Felten, B. S., and Foster, W. J.: New insights on the depositional environment and dynamics of the lowermost Triassic in Svalbard: linking the Sørkapp-Hornsund High to western and central Spitsbergen, Sedimentologika, 4, https://doi.org/10.57035/journals/sdk.2026.e41.2413, 2026a.

Zuchuat, V., Sleveland, A. R. N., Twitchett, R. J., Svensen, H. H., Turner, H., Augland, L. E., Jones, M. T., Hammer, Ø., Hauksson, B. T., Haflidason, H., Midtkandal, I., Planke, S., Senger, K., Schmid, D. W.: Deltadalen DD-1 core comprehensive dataset, Spitsbergen, Svalbard [Dataset], https://doi.org/10.5281/zenodo.20535690, 2026b.