

# Deep-time climate archives in Svalbard: opportunities for scientific drilling

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The high Arctic archipelago of Svalbard is globally unique in that it facilitates scientific coring across multiple stratigraphic intervals within a relatively small area. The polar location of Svalbard for some of the Mesozoic and the entire Cenozoic makes sites in Svalbard highly complementary to the more easily accessible mid-latitude sites, allowing investigation of the polar amplification effect over geological time. Coal, petroleum and research wells provide insights into the stratigraphy and linkage to the well exposed outcrops. Nonetheless, only the two 100 m deep boreholes drilled in Deltadalen in 2014 specifically targeted one of the deep-time paleoclimatic events of global significance, namely the end Permian mass extinction.

Other globally important climatic and paleoenvironmental events are recorded in Svalbard's rock record. However, since these are out of the scope of the coal and petroleum industry, the available core material is limited. Therefore, we have initiated the SvalClime project (Senger et al., 2023) and developed a scientific plan to address three main objectives through scientific drilling onshore Svalbard:

- a) Investigate the coevolution of life and repeated greenhouse- icehouse-greenhouse climate transitions, likely forced by orbital variations, by coring Neoproterozoic and Late Paleozoic glacial and interglacial intervals in the Cryogenian ("Snowball/Slushball Earth") and Upper Carboniferous to Lower Permian (Late Paleozoic Ice Age) sedimentary successions.
- b) Assess the impact of Large Igneous Province emplacement on rapid climate change and mass extinctions, including the end-Permian Mass Extinction, the end-Triassic Mass Extinction, the Jenkyns Event (Toarcian Oceanic Anoxic Event), the Jurassic Volgian Carbon Isotopic Excursion, the Cretaceous Weissert Event and Oceanic Anoxic Event 1a.
- c) Examine the Early Eocene hothouse and subsequent transition to a coolhouse world of the Oligocene by coring Paleogene sediments, including records of the Paleocene-Eocene Thermal Maximum, the Eocene Thermal Maximum 2, and the Eocene-Oligocene Transition.

The SvalClime science team created plans for a three-year drilling program using two platforms: 1) a light-weight coring system for holes of ~100 m length (4–6 sites), and 2) a larger platform that can drill deep holes of up to ~2 km (1–2 sites). The results from the proposed scientific drilling will be integrated with existing industry and scientific boreholes to establish an almost continuous succession of geological environmental data spanning the Phanerozoic. In this contribution we outline the background and motivation of the SvalClime ICDP proposal, focusing on describing the main hypotheses and presenting the potential drill sites.

## References

Senger, K., Kulhanek, D., Jones, M.T., Smyrak-Sikora, A., Planke, S., Zuchuat, V., Foster, W.J., Grundvåg, S.-T., Lorenz, H., Ruhl, M., Sliwinska, K.K., Vickers, M.L., and Xu, W. (2023). Deep-time Arctic climate archives: high-resolution coring of Svalbard's sedimentary record – SVALCLIME, a workshop report. Scientific Drilling.