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Contrasting long-term landscape evolution of Spitsbergen, Svalbard

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The high arctic archipelago of Svalbard features an area of extreme morphological contrasts that denote a vivid paleo-tectonic history. Flat plateaus in the central and eastern terrain, making up most of the land area of Svalbard, contrast with the Alpine topography of the western part of Spitsbergen in the area of the Forlandsundet Graben and the West Spitsbergen Fold and Thrust Belt. Stratigraphically, the northern and eastern part of central Spitsbergen exposes strata from the Caledonian basement up to the Mesozoic, and is topped by a late Cretaceous paleo-surface. Towards the south and west, these strata are covered by Paleocene to Eocene deposits of the Central Tertiary Basin. Coal-bearing consolidated marine and coastal sedimentary rocks build up table mountains and incised valleys. The eponymous western part of Spitsbergen comprises folded and thrusted tectonic basement units and Paleogene strata, bordering the Central Tertiary Basin.

Published apatite and zircon fission track data (Blythe & Kleinspehn, 1998) of western Spitsbergen and the Central Tertiary Basin suggest a differential thermal evolution of these tectonic units. Earlier cooling is recorded for western Spitsbergen than for the Central Tertiary Basin representing a sudden westward shift of the sediment source $\sim$ 55 Ma. Furthermore, data of the Central Tertiary Basin indicate a multiphase thermal history during the last 70 Ma due to Tertiary tectonics along the western margin of Spitsbergen, likely superimposed by climatic changes and glaciations during the last 5 Ma.

In contrast to the dynamic tectonic history of western and southern Central Spitsbergen, new own apatite fission track data between 86 - 92 Ma (NW Svalbard) and 200 - 75 Ma (NE) denote relative tectonic tranquility in northern Svalbard since the Mesozoic. The Svalbard Archipelago thus portrays a long and active multidimensional tectonic history that requests further exploration of the interplay of its tectonic structures. Our study focuses on the relevance of main structural elements with regards to denudation, especially in the Central Tertiary Basin, where the appearance of Eocene hard coal and various thermal indications suggest substantial heating. The combined approach of thermochronological methods such as apatite fission track and apatite U-Th/He analysis, with thermal maturity analysis of the Paleogene coal seams from the Central Tertiary Basin and clay mineralogy will allow concluding on maximum temperatures, paleo-isotherm patterns, and paleo-geothermal gradient(s). Based on these data, exhumation and erosion rates of northern and central Spitsbergen, as well as the maximum burial depth of the basin fill can be estimated, and considered in the structural context and with focus on structural elements of northern Svalbard, that were involved in Tertiary extensional tectonics during the opening of the North Atlantic. Moreover, the temperature-time pattern will be used to evaluate the cause of basin heating: burial/ denudation vs. elevated geothermal gradient. Correlation of our thermal history constrains with sedimentation rates from offshore sediment cores (IODP) gives further estimates on the timing and dimension of tectonic activity on Svalbard and can give a closer look on the evolution of the sediment sources further back in time.