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# Exhumation and crustal tilting of the northern Svalbard margin: constraints from apatite fission track dating

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The Arctic Svalbard Archipelago, forming the northwestern edge of the Barents Shelf, is situated at the hinge point of two ocean margins, adjacent to the Arctic Ocean and the Norwegian-Greenland Sea. Svalbard thus plays a key role in understanding the tectonic evolution of the present-day Arctic landmasses because it comprises structural and lithological features that allow us to reconstruct their common geologic history. The Svalbard archipelago is thought to have been formed during the Early Paleozoic Caledonian orogeny from the merging of three terrains, separated by north- south trending fault zones. After further deformation in the Late Devonian, Svalbard remained in relative tectonic tranquility during the Late Paleozoic and most of the Mesozoic, although this period is poorly constrained. Upper Cretaceous sedimentary rocks were eroded to form a major unconformity. Jurassic mafic igneous rocks intruded Svalbard, Franz Joseph Land, Greenland and Arctic Canada prior to the early Cretaceous formation of the Amerasian Basin in the Arctic Ocean. During the Paleogene, opening of the Eurasian Basin of the Arctic Ocean commenced, coevally with the onset of seafloor spreading in the Labrador Sea and associated northward drift of Greenland. This led to renewed compression on Svalbard, resulting in the reactivation of the major fault zones, and the formation of the West Spitsbergen Fold Belt and the adjacent Central Tertiary Basin. The timing of tectonic events can be further constrained by resolving the thermal evolution of Svalbard using low-temperature thermochronology. This approach allows us to reconstruct the cooling history of the shallow crust to depths of 3–5 km. Apatite Fission Track (AFT) analyses were carried out on samples from northern Svalbard (Albert I Land, Ny Friesland and Nordaustlandet). AFT ages range between 214 and 70 Ma. Samples from the Newtontoppen, the highest peak of the Svalbard archipelago, show the youngest ages of 70–92 Ma. AFT ages reveal a continuous pattern, with a trend from younger ages in the west to older ages in the east. No age-jumps across the major fault zones were detected. Track lengths show an overall unimodal, narrow distribution for most of the samples, indicating fast crustal cooling during the Cretaceous. Noticeable is an inverse age-elevation relationship for the samples from the Newtontoppen area. Mesozoic ages do not correlate with any of the compressional phases previously described for Svalbard, but coincide with the formation of the Amerasian Basin. We, therefore, suggest that our AFT ages reflect exhumation and erosion of the northern Svalbard margin associated with the opening of the Amerasian Basin. This is in agreement with the sedimentary record of central Svalbard, which comprises relatively thick lower Cretaceous magmatogenous rocks that are presumably derived from the north. Because of the continuous AFT age pattern, our data give no evidence for major vertical displacements across the large north-south trending fault systems during or after the Cretaceous. The trend of younger AFT ages towards the west may be explained by post-Cretaceous large-scale crustal tilting towards the east, presumably due to compression related to the northward movement of Greenland and the opening of the Eurasian Basin. Post-Cretaceous displacements within Ny Friesland also explain the inverse age-elevation relation along the Newtontoppen. To further constrain the timing and mechanisms of the crustal tilting we will additionally apply (U-Th-Sm)/He analyses along the northern Svalbard margin, because this method is sensitive to the thermo-tectonic evolution in the uppermost crust. Further, these results should presumably also provide information on the evolution of Tertiary relief on Svalbard.