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Quantifying long-term exhumation and glacial topographic evolution of the Sognefjord (western Scandinavia) using low-temperature thermochonometry

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The high-relief landscapes around the coast of Scandinavia show a strong glacial imprint with spectacular glacial fjords surrounded by typically high-altitude low-relief surfaces [1,2]. These areas have been the subject of intense debate concerning the respective role of internal and external processes controlling the long-term exhumation history and topographic evolution [3-5].
One key issue relating to this debate is the presence of high-altitude, low-relief surfaces surrounded by strongly incised fjords. Some studies [3,4] relate these landscape features to remnants of Mesozoic "peneplanation" that were subsequently uplifted during the Cenozoic. As an alternative, others [5] propose that present-day topography results from slowly eroding Caledonian orogeny which has been subsequently rejuvenated during late-Cenozoic glaciations (carving deep fjords and shaping low-relief surfaces by preferential glacial/periglacial erosion around the ELA). A recent study [2] quantifying mass-balance between fjord erosion and offshore sedimentation volumes gave support to idea of recent glacial rejuvenation of the entire Scandinavian topography. There is to date, however, no direct quantitative constraint on both the age and the Cenozoic to present-day evolution of these surfaces, as well as the topographic evolution of deeply-incised fjords.

In this study, we propose to use low-temperature thermochronometry ((U-Th-Sm)/He, 4He/3He and Luminescence thermochronometry) to obtain quantitative constraints on both the long-term exhumation and Late Cenozoic topographic evolution of the Sognefjord (western Scandinavia). The Sognefjord is the longest and deepest fjord of western Scandinavia, with up to $\sim$2.8 km of local relief in its central part. It is surrounded by low-relief surfaces rising from $\sim$400 m on the coast up to $\sim$2000 m inland [1,2]. Published fission-track ages along the fjord are $\sim$150-200 Ma, and fission-track lengths reveal a long residence time in the partial annealing zone [5,6]. We collected $\sim$10 samples along the fjord bottom (where potential recent exhumation has been maximized), an elevation profile ($\sim$1km) in the outer part of the fjord, and sampled supplementary low-relief surfaces in the inner part. (U-Th-Sm)/He ages in the outer part of the Sognefjord are $\sim$100-300 Ma, potentially very close or even older than fission-track ages in the area. Preliminary 4He/3He analyses reveal U-Th zonation in the apatites: laser-ablation ICP-MS analysis will be conducted to quantify the zonation effect in order to extract samples exhumation histories.

A subset of bedrock samples (including fjord bottoms and low-relief surfaces) has been selected to perform feldspar Luminescence themochronometry [7]. With this novel and extremely low closure temperature method, we aim at quantifying the late-stage exhumation history and potential glacial impact on the Sognefjord topographic evolution.

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