Erosion of low-relief basement by the Fennoscandian ice sheet based on bedrock ¹⁰Be and ²⁶Al

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Outline

- Motivation
- Study region
- Forsmark exposure ages and cosmogenic nuclide inheritance
- Glacial erosion simulation
- Inheritance and glacial erosion of other Fennoscandian bedrock samples









Studies on glacial erosion has primarily focused on mountainous regions

Extensive regions under past and present ice sheets are characterized by low-relief topography









Forsmark study region

Granitic basement low-relief topography with traces of glacial erosion including striae, roche moutonnées, whalebacks, and glacial lineations





Low-relief region characterized by 10s of m topography over 10s of km distances

¹⁰Be and ²⁶Al measurements (PRIME Lab) in 32 bedrock and 3 boulder samples from 0-67 m elevation







All samples have cosmogenic nuclides inherited from prior ice-free periods!

The last ice sheet did not erode enough (>3 m) to remove the cosmogenic nuclide inventory





Key assumptions for erosion rate quantification

- Full shielding from cosmic rays during ice cover periods
- Constant glacial erosion

Two modes of glacial erosion

- Constant glacial erosion rate: erosion scaled by duration of ice cover
- Constant glacial erosion depth: erosion scaled by number of ice cover periods

 Crude simplifications of the reality:
Variable erosion over time much more likely!

Start of simulation



Limited glacial erosion - typically a few meters over the last 100 ka



The Forsmark samples have similar amounts of inheritance as other Fennoscandian low-relief (and alpine) bedrock samples



Simulated ranges of erosion (rates and depths) for all low-relief samples

Simulation start: 2.588 Ma

Conclusions

- Low-relief bedrock surfaces of the Fennoscandian ice sheet region typically have inherited cosmogenic nuclides
- Limited glacial erosion of the low-relief parts of Fennoscandia during the last glacial cycle: typically ~0.1 mm/yr or ~1 m per ice cover period
- Although the glacial erosion was limited, it was not zero

