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Glacial erosion of the Sub-Cambrian Peneplain in Sweden

Adrian M. Hall (1,2), Bradley W. Goodfellow (1,2), Jakob Heyman (3), Seulgi Moon (4), Marc W. Caffee (5,6), Karin Ebert (1,2,7), Clas Hättestrand (1,2), Maarten Krabbendam (8), Stephen J. Martel (9), Jens-Ove Näslund (10), Taylor Perron (11), Finlay M. Stuart (12), Arjen P. Stroeven (1,2)

(1) Stockholm University, Department of Physical Geography, Stockholm, Sweden (arjen.stroeven@natgeo.su.se), (2) Stockholm University, Bolin Centre for Climate Research, Stockholm, Sweden, (3) University of Gothenburg, Department of Earth Sciences, Gothenburg, Sweden, (4) University of California, Los Angeles, Department of Earth, Planetary, and Space Sciences, Los Angeles, USA, (5) Purdue University, Department of Earth, Atmospheric, and Planetary Sciences, West Lafayette, USA, (6) Purdue University, Department of Physics and Astronomy, and Purdue Rare Isotope Measurement Laboratory (PRIME Lab), West Lafayette, USA, (7) Södertörn University, School of Natural Science, Technology and Environmental Studies, Stockholm, Sweden, (8) British Geological Survey, Edinburgh, Scotland, (9) University of Hawaii, Department of Geology and Geophysics, Honolulu, Hawaii, USA, (10) Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden, (11) Massachusetts Institute of Technology, Department of Earth, Atmospheric and Planetary Sciences, Cambridge, Massachusetts, USA, (12) Scottish Universities Environmental Research Centre, Glasgow, UK

Bedrock fractures exert a key control on spatial patterns and rates of glacial erosion. Across parts of central and southern Sweden, the re-exposed Sub-Cambrian Peneplain (SCP), set in gneissic basement, provides an initial boundary condition for Quaternary glacial erosion. From remnants adjacent to, or beneath, Cambro-Ordovician sedimentary cover rocks, we find that the SCP displays low-amplitude (meters-scale) convexities, is locally chemically weathered to depths of some meters, and has complex fracture patterns. In this study, we combine new and existing analyses of bedrock fracturing, existing measurements of near-surface gravitational and tectonic stress fields, modelling of topographic controls on fracturing through the perturbation of these stresses, and erosion rate inferences from ^{10}Be and ^{26}Al produced *in situ* in bedrock convexities, to interpret the spatial distribution of Quaternary glacial erosion and how that may relate to bedrock fractures. We focus on the Forsmark site, south-central Sweden, to provide input to assessments of long-tern safety of a planned geological repository for nuclear waste. Our data show that even low amplitude topography may, in granite gneiss rock blocks, perturb near surface stresses to $>$100 m beneath the ground surface and can therefore influence bedrock fracturing to this depth. Because of high horizontal compression, this perturbation is predicted to open surface-parallel fractures beneath convexities and to form or reactivate some shear fractures.

Our cosmogenic nuclide data are generally well-clustered and indicate that many sampled gneiss bedrock summits underwent as much as to 2-3 m of erosion during the last glaciation. Considering shielding by post-glacial marine submergence, 11 samples have ^{10}Be (^{26}Al) inheritance corresponding to 2.2-5.4 ka (3.0-7.0 ka) of exposure and three samples have ^{10}Be (^{26}Al) inheritance corresponding to 12-65 ka (10-73 ka) of exposure. We model erosion rates over 1 Ma assuming that inferred erosion rates for the last glacial are representative of earlier glaciations, and using a marine δ^{18}O history of global glaciation to infer ice-covered and ice-free periods for the Forsmark location. Preliminary results indicate a minimum denudation rate of $\sim$20 m/Ma, if erosion occurs through abrasion averaged over each glacial/stadial, and a maximum rate of 40 m/Ma, if erosion occurs through episodic abrasion and/or plucking towards the end of each glacial/stadial. Higher erosion rates likely applied before softer Ordovician limestone was stripped from the SCP. We infer from our combined results that this low-relief shield bedrock landscape is slowly evolving, where summit erosion likely occurs through a combination of plucking of bedrock sheets and abrasion.