Landscape preservation under ice sheets

D. FABEL[1], A. P. STROEVEN[2] AND J.HARBOR[3]

[1]The Australian National University, Canberra, Australia (d.fabel@anu.edu.au)
[2]Stockholm University, Stockholm, Sweden (arjen@geo.su.su)
[3]Purdue University, West Lafayette, Indiana, U.S.A. (jharbor@purdue.edu)

Some areas within ice sheet boundaries retain landforms that appear unmodified by glacial erosion. These relict areas have either remained ice-free islands (nunataks), or were preserved under ice. Differentiating between these alternatives has significant implications for palaeoenvironment, ice sheet surface elevation, and ice volume reconstructions.

We collected samples from what are mapped as glacially eroded and relict surfaces in the northern Swedish mountains and areas closer to the centre of maximum Fennoscandian ice sheet extent, to test whether or not the mapped relict areas have indeed been preserved. In situ cosmogenic ^{10}Be and ^{26}Al concentrations from erratics on relict surfaces, and glacially eroded bedrock adjacent to these surfaces, provide consistent last deglaciation exposure ages (~8-13 kyr), confirming ice sheet overriding as opposed to ice free conditions. Exposure ages of 34 kyr to 61 kyr on bedrock surfaces in these same relict areas demonstrate that these areas were preserved through at least the last glacial cycle, probably as a result of frozen-bed conditions. Based on the relative decay of ^{26}Al and ^{10}Be it can be inferred that these relict bedrock surfaces remained largely unmodified during multiple ice sheet growth and decay phases.

Subglacial preservation implies that source areas for glacial sediments in ocean cores are considerably smaller than the total area covered by ice sheets. Our results indicate that boundaries between glacially sculpted and preserved landscapes should not automatically be interpreted as former ice limits in palaeoclimatic and palaeoglaciological reconstructions. Relict areas need to be accounted for as frozen bed patches in basal boundary conditions for ice sheet models, and in landscape development models.

Biogeochemical cycling of various metals in Baldeggersee, Switzerland

D. FABIAN AND B. WEHRLI

EAWAG - Swiss Federal Institute for Environmental Science and Technology, Kastanienbaum, Switzerland (daniel.fabian@eawag.ch, bernhard.wehrli@eawag.ch)

This study focuses on the biogeochemical cycling of Ca, Mg, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Sb, Mo, and Pb in Baldeggersee, a eutrophic lake in Switzerland. Sedimentation was recorded at the deepest site of Baldeggersee (65 m) during 1994 using sediment traps. A sediment core was taken at the same site with a freeze corer five years later (1999). The sediment layer deposited in 1994 was sampled and the metal accumulation in this layer was determined. Based on this data, we established the balance of sedimentation and remobilisation (Table 1).

Table 1: Annual (1994) sedimentation found in sediment traps and accumulation in the sediment (in mg m^{-2}).

	Sedimentation	Accumulation	Remobilisation
Ca	390’000	260’000	34%
Fe	32’000	27’000	16%
Mn	30’000	9’000	70%
Mg	15’000	10’000	31%
Zn	240	180	23%
Ni	150	150	0%
V	78	69	11%
Cr	64	42	34%
Cu	62	54	13%
As	52	40	22%
Pb	21	17	19%
Mo	6.1	1.7	72%
Sb	2.1	1.2	47%

The results show that the lake sediment acts as a sink for most of the metals studied. Less than 25% of the settling Fe, Cu, Ni, Zn, V, Pb, and As are remobilised. For Ca, Mg, and Cr, remobilisation accounts for one third. On the other side, the major fraction of Mn, Mo, and Sb are remobilised upon sedimentation.

References

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