

Do Periglacial Landscapes Evolve Under Periglacial Conditions ?

M.F. ANDRE

Laboratory of Physical Geography, UMR 6042-CNRS

University of Clermont-Ferrand, France

m-francoise.andre@univ-bpclermont.fr

Non-glacierized polar environments are traditionally regarded as parts of the world where the geomorphic activity is primarily controlled by frost-related mechanical processes. Such a view is more and more questioned amongst the international scientific community, and the time has come to cross the smoke-screen of the periglacial scenery to search for the real agents of landscape transformation which may involve more ubiquitously occurring biochemically and thermally driven processes. It is proposed to re-examine the role played by the so called "periglacial" processes acting in the high latitude erosion system by adopting a multiscale time-space approach taking into account : 1. the variety of hillslope systems, rock properties and local bioclimatic conditions ; 2. the history of landform development (from pre-Quaternary inheritance to minor Holocene glacioclimatic fluctuations) ; 3. the representativeness of study sites.

Key words : polar geomorphology, erosion system, rock control, climate change

The Maritime Subantarctic: A Distinct Periglacial EnvironmentJ.BOELHOUWERS¹, S.HOLNESS² and P.SUMNER³¹Department of Earth Sciences, Uppsala University, Sweden²Department of Earth Sciences, University of the Western Cape, South Africa³Department of Geography and Geoinformatics, University of Pretoria, South Africa

Recent research on slope processes and weathering on Marion Island has highlighted fundamental differences of the maritime Subantarctic periglacial environment, compared to other periglacial environments. This distinctiveness is largely a function of its hyper-maritime setting at low mean annual temperatures (MAT). This results in some of the highest frost cycle frequencies in the world, with associated effectiveness in sediment transport and patterned ground development. In addition a high frequency of wetting and drying cycles is observed in rocks.

While the maritime Subantarctic shows similarities with low latitude alpine environments in the dominance of diurnal frost activity, ground thermal profiles are very different. Small seasonal temperature ranges and steep profiles indicate a rapid transition of a diurnal frost environment to permafrost conditions with very shallow active layer, under only small reductions in MAT. This makes the periglacial environment in the maritime Subantarctic highly responsive to even small climate changes. It also suggests that paleoclimatic interpretations of relict periglacial forms may differ significantly from those in other parts of the world.

Key words: periglacial, diurnal frost, needle ice, maritime Subantarctic

The Geomorphological Significance of Alpine Permafrost in Southern Norway.

BERND ETZELMÜLLER & IVAR BERTHLING

Department of Physical Geography, University of Oslo, Norway

bernde@geografi.uio.no

Alpine permafrost in Norway and Scandinavia has been recognised since the turn of the last century. First quantitative mapping approaches were carried out in the late seventies in the Jotunheimen and Rondane area, using morphological mapping and geophysical soundings. Recently, a GISbased model of permafrost distribution in Southern Norway was established. Permafrost is an important factor for understanding geomorphological process pattern in high-mountain environments. Permafrost governs the thermal regime of glacier marginal areas, and therefore has an important influence on the morphogenesis of glacial landforms and the sediment flux pattern from glaciated areas. Furthermore, the morphological signal of permafrost and its spatial and temporal changes is dependant on the type of topographic region permafrost is predominating. This paper presents a study of the effect of permafrost on glacial processes, and on the distribution of permafrost and its spatial changes due to climate warming, in relation to topographic regions in southern Norway.

Keywords: permafrost, glaciers, sediment fluxes, topographic regions

Session 4 - Glacial and periglacial geomorphology

Presentation: ORAL presentation preferred

Fossil polygonal periglacial structures in Flanders (Belgium)**I. HEYSE * and G. GHYSELS****

* & ** Department of Geography, Physical Geography, University of Ghent, Belgium

irenee.heyse@rug.ac.be / gunther.ghysels@pandora.be

A systematic survey of aerial photographs during several years in Flanders reveals an ephemere visible polygonal pattern upon the dissected plateau of the Coastal Plain-Flemish Valley interfluve.

The authors describe the characteristics of this pattern and discuss the origin and the age of these phenomena. The research is based upon a comparative study of the literature, the morphometric analysis of the aerial photographs combined with intensive fieldwork based upon excavations. Until now no evidence was found in Northern Belgium of these phenomena. The distribution of the sites is studied in relation to the geology and the geomorphology. The visibility and the spatial structure of the pattern itself are also investigated. Based upon the air photos, the sides of the polygonal pattern were carefully reconstructed in the field in order to excavate trenches and to find underlying sedimentological field evidence. The pattern corresponds with infillings of sandwedges up to 1,5 m deep and it shows to some extent characteristics of ice-wedge pseudomorphs related to a fossil periglacial environment wherein thermal contraction of frozen ground is considered as the main cause. The age span is probable Late Pleistocene (Elster-Weichsel).

Keywords: aerial photographs, fossil periglacial polygonal pattern, ice-wedge pseudomorphs, sandwedges, thermal contraction

Typology of Periglacial Landforms in Dry Champagne (France).

M. LAURAIN and A. MARRE

GREURCA-GAGE (EA 2076), Département de Géographie, Université de Reims
Champagne-Ardenne, 57 rue Pierre Taittinger, 51096 REIMS cedex
michel.laurain@univ-reims.fr and alain.marre@univ-reims.fr

The Dry Champagne region is settled in the sedimentary bassin of Paris. Different from the neighbouring regions where the chalk is covered by deep superficial formations, in Dry Champagne, the chalk show on the surface. This coherent rock is very sensitive to the cycles of frost and thaw. Here, we can observe a large variety of superficial deposits with associated periglacial landforms herited from the last cold period. On the top of the interfluves, there are different types of circles of stones corresponding, to cryoturbation forms in the soil. On the slopes, there are different types of superficial deposits. They are the result of the fractration of the chalk and they present formations without organisation or formations with a good organisation as « grèzes litées » called in this region « graveluches ». Different genesis can explain the born of this deposits : slope processes and also eolian processes. On the foot of the slopes, these deposits are connected with terraces in which we can find some « blocs glaciels » of sand transported, frozen, on blocks of ice floating on the river. On each slope, we can see a sequence of periglacial landforms and deposits from the top to the bottom of the valley. Today, these superficial formations are the support of a rich farming.

Key words : Periglacial landforms, superficial deposits, Champagne, France.

**Temperature regime of sporadic permafrost in the block slope,
Mt. Nishi-Nupukaushinupuri, Hokkaido**

Y. SAWADA*¹ and Y. ONO¹

¹Graduate School of Environmental Earth Science, Hokkaido University, Japan

*jury@ees.hokudai.ac.jp

Sporadic permafrost was found in the block slope far below the timberline at the southwestern slope of Mt. Nishi-nupukaushinupuri (1254m a.s.l.), central Hokkaido. Permafrost (ground ice generated by re-freezing of snow melt water) developed only at the foot of the block slope. Active layer was 1.5m thick. A whole-year ground temperature measured at the foot, middle and top of the block slope revealed that the ground surface temperature at the permafrost site dropped from -3 to -8°C in winter until snow melting, while it was kept positive (9 to 4 °C) at the top of slope. In winter, snow is removed by the strong wind from the middle slope, while a snow accumulation exceeds 1.5m thick in foot slope. These results suggest the existence of air circulation: the cold air penetrating into the block slope flows down towards the foot of the slope through the voids between blocks, while the warmer air moves upwards.

key words: sporadic permafrost, block slope, air circulation

Glacier Surging due to Basal Smoothing by Sediment Accumulation

J. M. TURNBULL¹ and *T. R. H. DAVIES²

¹Riccarton High School, Christchurch, New Zealand

²Natural Resources Engineering, Lincoln University, New Zealand

Daviet@lincoln.ac.nz

It is proposed that a glacier surge begins when the form resistance exerted on the glacier sole by the uneven bedrock base is reduced by sediment infilling basal depressions. Ice flow velocity then increases locally, forcing downvalley ice to form a surge front; this causes intense crevassing and thrust faulting, disrupting the subglacial drainage system and storing water and sediment behind the front. Increased basal water pressures then reduce the shear resistance of the basal sediments and increase the water pressure gradient across the front, assisting front propagation. When the surge front slows, normal subglacial drainage re-establishes; stored water and sediment are released as a turbid flood, evacuating basal hollows and increasing basal form resistance again. Slower ice flow and positive mass balance increase the driving force, sediment refills the subglacial hollows and another surge starts. Field evidence and theory support the proposed sediment accumulation and evacuation processes; published data support the proposed infilling processes and rates. This mechanism explains for the first time the observed decadal-scale surge cyclicality of glaciers in the absence of similar input behaviour.

Keywords: Glacier surging; basal topography; sediment accumulation; periodicity.

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asymmetry is less consistent between the two approaches: the highest ranges have numerous south-facing glaciers and weak vector strengths, but clearly lower north-facing glaciers. Greatest asymmetry is in sunny areas with steepest slopes: some anomalies may be explained topographically. The Alps are compared with other areas and with results for cirques or former glaciers.

Key words: glacier distribution, Alps, vector resultant, Fourier analysis, cirque glaciation.

Aspect asymmetry of mountain glaciation: variation altitudes with aspect.

I. S. EVANS

Department of Geography, University of Durham,
i.s.evans@durham.ac.uk

Conventionally, the asymmetry of past or present glaciation is measured by the mean and strength of the resultant vector for all aspects. From climatic hypotheses, favoured aspects should have more glaciers: this is expressed precisely by Fourier Analysis. Fourier and vector approaches give consistent results. For example, for the 5180 glaciers of the (European) Alps, there are 27 groups in 27 districts. There are more north-facing glaciers (on average by 222 m). Tendencies east of north are strong in the presence of westerly winds, in the northern Swiss and western

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Slope Denudation, Streamwork, and Relief Development in Two Periglacial Environments in East Iceland and Swedish Lapland

A. A. BEYLICH

Department of Earth Sciences, Geocentrum, Uppsala University, Sweden
achim.beylich@geo.uu.se

By an integrated view of slope and channel systems and by a combined recording of slope denudation and streamwork in representative drainage basins information on process intensities and on recent trends of relief development in two periglacial environments in East Iceland and northern Swedish Lapland is collected. Gravitational and fluvial sediment transfers in both study areas are presented as annual mass transfers [t m/yr]. The process intensities in the subarctic-oceanic environment in East Iceland (Austdalur drainage basin, 23 km²) and in the arctic-oceanic environment in Swedish Lapland (Latnjavagge drainage basin, 9 km²) are low. In Austdalur aquatic slope denudation is the most important slope process, followed by chemical denudation, ground avalanches, rockfalls/boulder falls, creep, debris slides/flows, and deflation. Fluvial sediment transport dominates over slope processes. In Latnjavagge chemical denudation is more important than aquatic slope denudation. In both study areas slope processes cause a widening of the trough valleys. Because of the low process intensities during the Holocene Postglacial modifications of the glacial reliefs are negligible. In both environments there has been no adjustment of the Pleistocene glacial landforms to the processes operating in the recent periglacial morphoclimates.

Key words: slope denudation, streamwork, relief development, periglacial environment

Cold Region Weathering: New Data From the Antarctic

K. HALL

Geography Program, University of Northern British Columbia, Canada

hall@unbc.ca

Rock breakdown in cold regions has been preoccupied with the assumed role of freeze-thaw weathering. In the more arid regions of the Antarctic and some high mountain ranges, spatial and temporal constraints on water availability inhibit water-based processes such as freeze-thaw and yet rocks still breakdown. In many instances, data record frequency has simply been inadequate to determine the role (or not) of thermal stress. Here data that have been collected at one-minute intervals from spring to fall at an Antarctic site for the four cardinal aspects of both a light-coloured and a dark-coloured sandstone are presented. Data analysis of $\Delta T/t$, coupled with the impact this has on $\Delta \ell/t$ for the various minerals, plus the thermal gradient, indicates that the likelihood for thermal-based weathering processes is very high. The role of incoming radiation greatly affects the thermal regime of the rock and this has a significant seasonal variation. The results are such that the argument is made that the character of high latitude and high altitude cold region weathering is need of serious reappraisal and that greater consideration be given to weathering by thermal stress.

Key words: weathering, temperature measurement, thermal stress, Antarctica

**Ground Temperature Regimes in a Marginal Periglacial Mountain,
Serra da Estrela, Portugal**

G. VIEIRA^{1*}, C. MORA¹ and M. RAMOS²

¹Centro de Estudos Geográficos, University of Lisbon, Portugal

²Department of Physics, University of Alcalá, Spain

*gtvieira@ceg.ul.pt

The Serra da Estrela is a granite mountain characterized by wide plateau areas between 1,400 and 2,000 m ASL. The plateaus are cut by deep glacial valleys and cirques. Despite several references to the present-day periglacial dynamics of the upper areas, the climate control on the morphogenesis of the area is poorly understood. In order to characterize the ground thermal regimes and to assess their influence on the cryogenic processes, a climatological network was installed. It is constituted by: 9 single-channel air temperature data loggers located in different sites; two 4-channel soil temperature loggers located at 1,630 and 1,875m ASL; and two 4-channel rock temperature loggers located in opposite slopes (north and south) at 1,860m ASL. The data collected at 2-hour intervals during the winter of 1999-2000 is analysed and the relationships between air and soil or rock temperatures are studied. The data show that in the Serra da Estrela the soil thermal regimes are very irregular and that even during winter freeze-thaw cycles are frequent and very much controlled by the synoptic meteorological conditions.

Key words: ground temperature, periglacial, freeze-thaw, mediterranean mountain

Strong deflation on palsas in Finnish Lapland

M.SEPPÄLÄ

Department of Geography, University of Helsinki, POBox 64, 00014 Helsinki
University
Finland
matti.seppala@helsinki.fi

Palsas at Lake Akujärvi, western Utsjoki, Finnish Lapland display a very strong present deflation. Mainly westerly winds have removed in some cases more than 40 cm thick layers of peat from the palsa surfaces. Many palsas with heights from 1.5 to 3 m are almost uncovered by vegetation. Cracks typical for vegetated palsa surfaces are deflated away or filled with wind drifted peat. Deflation takes place in winter by wind drifted snow and ice crystals abrading the peat surfaces. On the same palsa mires some recently formed new palsas have been found. They are 60-80 cm in height and 20 to 30 square metres in area located among the deflated mature palsas. The new palsas indicate also strong wind activity in winter. No unusual development in the thickness of active layer on palsas has been noticed. The question is: Have the wind conditions during the recent winters changed? Meteorological recordings are missing. There are no meteorological stations in the close vicinity.
Key words: palsa formation, deflation, increased wind activity

**Differential Frost Heaving and Sorted Patterned Ground:
Field Measurements and a Laboratory Experiment**

N. MATSUOKA*, M. ABE and M. IJIRI

Institute of Geoscience, University of Tsukuba

*matsuoka@atm.geo.tsukuba.ac.jp

Small-scale sorted stripes and circles dominate over the alpine regions in the Upper Engadin, Swiss Alps. Most of these features are spaced at < 30 cm intervals by coarse margins consisting of small clasts thinner than 5 cm. Monitoring of soil movement on a stripe site highlights the predominance of diurnal frost heave and creep. A laboratory simulation was designed to explore the contribution of differential frost heave to the sorting process at the monitoring site. A container is filled with fine loam. A granule mantle is mounted on the half of the loam (coarse part) while not on the other half (fine part). Monitoring includes surface heave and lateral movement. A series of freeze-thaw tests with a granule mantle of 0.5, 2.5 and 5 cm, respectively, demonstrate that the heave amount on the coarse part is greatly reduced by the 5 cm-thick mantle, and that the coarse part always heaves later and subsides earlier than the fine. As a result of timelag in frost heaving, lateral movement toward the coarse part is generated within the surficial soil. The experimental results imply that differential heave associated with diurnal freeze-thaw cycles is capable of sorting of the top 5 cm of soil.
Key words: patterned ground, frost heave, frost sorting, freeze-thaw, periglacial

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