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**2009-2010**

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### CONTACT THE BRITISH SOCIETY FOR GEOMORPHOLOGY

*For further information on the BSG contact:*

**Honorary Secretary, Dr Richard Chiverrell** Department of Geography, University of Liverpool  
**E-mail:** rchiv@liv.ac.uk  

*For general enquiries, including details of membership and meetings contact:*

**BSG Administrator, Dr Stephanie Mills** RGS-IBG, 1 Kensington Gore, London, SW7 2AR  
**E-mail:** bsg@rgs.org  

*For electronic submission to Geophemera contact:*

**Editor, Geophemera, Dr Liz Whitfield** School of Natural Sciences and Psychology, Liverpool John Moores University, **Tel:** +44 (0)151 231 2473  
**E-mail:** e.whitfield@ljmu.ac.uk
Editorial

Dear Members,

The program for the upcoming annual conference will be published in the next issue of Geophemera, due out in early June.

As always, preliminary findings from research projects are encouraged to be submitted to Geophemera for discussion amongst the BSG community.

If you would like to make a submission to the next issue of Geophemera, the deadline for submissions has been changed to accommodate the changing time of the AGM. Please note the following deadline for submission to Geophemera:

15th May 2009

Best Wishes,

Liz Whitfield
Editor

Geophemera is the newsletter of the British Society for Geomorphology (incorporating the BGRG) and is published 3 times a year (Spring-Summer, Autumn, Winter). Available online at www.geomorphology.org.uk Compiled by Liz Whitfield, School of Natural Sciences and Psychology, Liverpool John Moores University.

Cover Photo: Scanning transient aeolian features on a drying beach at Ynyslas, Wales (Jo Nield)

PLEASE SUBMIT MATERIAL FOR Geophemera 109 BY 15th May 2010.
The Changing Face of the Earth

As part of our 50th year celebrations, a BSG exhibition is being organized in partnership with the Royal Geographical Society for display in the Pavilion area of the RGS/IBG headquarters in Kensington Gore, London. The exhibition will run for approximately 4 weeks including the period of the BSG Annual Conference 31st August - 4th September 2010 which will include sessions on the theme of Grand Geomorphological Challenges for the next 50 years.

The exhibition will demonstrate how analysis and understanding of Earth’s land surface has changed in the 50 years since the BSG (originally the BGRG) was founded in 1960, highlighting some key contributions made by its members. This is an excellent opportunity to provide vivid, eye-catching displays of progress made, revealing exciting ways in which the land surface can now be analysed, understood and depicted. It should be of interest to non-geomorphologists and, because the location is very visible and accessible, will provide an outstanding way to showcase what geomorphology is all about and what it has already achieved.

A group led by Ken Gregory is gathering materials under the following general themes: foundation of BGRG/BSG; geomorphological publications from the BGRG/BSG; mapping technologies and geomorphological mapping; measuring and analysing processes; monitoring and dating landscape change; remote sensing of the land surface; modelling geomorphological processes; GIS in geomorphology; geomorphological theory and key concepts; applications of geomorphological understanding.

If you have any examples of striking research results or other materials that you think would be helpful, especially high-quality images that illustrate these themes or key contributions from BGRG/BSG members, please contact Ken Gregory (k.j.gregory@ntlworld.com) by April 9th.
BSG Annual Conference: 50\textsuperscript{th} Anniversary Meeting

Tuesday 31\textsuperscript{st} August to Wednesday 2\textsuperscript{nd} September 2010 in London

This year is the 50\textsuperscript{th} anniversary of the British Society for Geomorphology (incorporating the British Geomorphological Research Group). As a result, the Society is holding a special 50\textsuperscript{th} Anniversary Meeting, in parallel with the Royal Geographical Society (with IBG) Annual Conference.

Paper sessions will run from Tuesday morning to Thursday lunch time. Sessions will be focused on five 50\textsuperscript{th} anniversary challenges, identified at recent BSG meetings:

- simulation and uncertainty;
- providing the baseline: records of environmental change;
- processes at the surface of the Earth;
- connectivity in earth surface systems;
- technological advances.

Leading geomorphologists have been invited from around the world to present a range of keynote or benchmark papers. Other events at the 50\textsuperscript{th} Anniversary Meeting will include the Frost, Linton, Warwick and Wiley lectures. The BSG annual awards ceremony and dinner will be held on the Wednesday evening.

**Special events:** There will be two special events at the meeting, jointly hosted by the BSG and RGS-IBG.

- The first 30\textsuperscript{th} IGC Lecture will be presented by Professor Will Graf, University of South Carolina.
- A 50\textsuperscript{th} Anniversary Debate will be held as part of the BSG meeting and as the main opening plenary session of the RGS-IBG conference. The debate, to be held on the Tuesday evening will address the question: *Fragile environments: are we at a tipping point?*

**CALL FOR PAPERS: DEADLINE TUESDAY 1\textsuperscript{ST} JUNE 2010**

Members of the BSG are invited to submit papers (oral and poster) to be presented at the 50\textsuperscript{th} Anniversary Meeting. The submitting author should indicate which of the five 50\textsuperscript{th} anniversary challenges their contribution to most directly addresses. Postgraduates members are particularly encouraged, and the Society will award a Wiley-Blackwell prize (£100) for the best presentation (oral or poster) by postgraduate at the Conference. Postgraduates are asked to clearly identify themselves on abstract submission. An open session will be timetabled for other contributions.

Abstracts of 250 words, which should include a title, names and addresses of contributors and contact details of the corresponding author / presenter, should be submitted to Professor Bob Allison, Sussex House, University of Sussex, Brighton, BN1 9RH (email: r.j.allison@sussex.ac.uk), no later than Tuesday 1\textsuperscript{st} June 2010.

**REGISTRATION**

Conference registration is via the RGS-IBG website: [http://www.rgs.org/BSG2010](http://www.rgs.org/BSG2010)
British Society for Geomorphology Awards 2010

The BSG Executive Committee are pleased to announce the following Awards for 2010.

David Linton Award: Professor Adrian Harvey, University of Liverpool. The award recognises the leading contribution by a geomorphologist to the discipline over a sustained period. Prof Adrian Harvey will present the Linton Lecture at the ‘BSG 50th Year Anniversary challenges conference’ in London.

Gordon Warwick Award: Dr Dan Parsons, University of Leeds. The award recognises excellence in geomorphological research by a researcher under 35 years of age or have commenced work on their doctorate not more than 15 years previously. Dr Dan Parsons will present the Warwick Lecture at the ‘BSG 50th Year Anniversary challenges conference’ in London.

Dick Chorley Award: Dr Ian Thrasher, University of Liverpool. The award recognises the most significant original published contribution to geomorphology by a current or recently graduated post-graduate student, and goes to Dr Ian Thrasher for his paper ‘Thrasher IM, Mauz B, Chiverrell RC, Lang A, Thomas GSP. 2009. Testing an approach to OSL dating of Late Devensian glaciofluvial sediments of the British Isles. Journal of Quaternary Science 24: 785–801.’

New BSG Funding Opportunities
BSG — Wiley-Blackwell Grants

Research networks in SE Asia and China
Up to £4000 is available to support development of research networks in SE Asia and China. The purpose of this grant is to bring together global partners with a research interest in the SE Asia or China region. It is envisaged the £4000 may support one or more workshops or conferences hosted within the region by SE Asia or China colleagues. The region supported by these awards includes India but excludes Japan.

Deadline: 30 September.

Further guidelines and application forms (in Word and PDF formats) can be found http://www.geomorphology.org.uk/pages/funding/forms.html

Innovative and emerging techniques in geomorphology
Up to £4000 is available to support the development of new technology and/or analytical techniques in geomorphology as stated in the BSG Mission, Sections 1.5 and 1.6. It is envisaged that the pump-priming of new techniques in geomorphology will support applications to the RCUK. Applications must have a geomorphological focus.

Deadline: 30 September.

Further guidelines and application forms (in Word and PDF formats) can be found http://www.geomorphology.org.uk/pages/funding/forms.html

Support funds for scientific sessions at AGU Fall 2010
Up to £2000 is available to contribute to the costs of hosting one of more scientific sessions at the AGU Fall Conference, San Francisco, 13-17 December 2010. The grant will provide session convenors with funds to help support incidental expenses such as invited contributor costs, convenor costs and local accommodation costs for postgraduates. It is expected that as a minimum, each supported session will have an introductory slide that acknowledges support from the BSG and Wiley-Blackwell.

Please note that the AGU Program Committee is accepting session proposals up to 27 May 2010. There is no guarantee of an oral session and the BSG will support both oral and poster sessions.

Deadline: 1 September 2010.

Further guidelines and application forms (in Word and PDF formats) can be found http://www.geomorphology.org.uk/pages/funding/forms.html
BSG Committee Membership and Officers

The BSG urgently needs and is seeking volunteers for elected and non-elected roles on the BSG Executive and various Subcommittees. The elected roles will be subject to a vote at the AGM of the BSG at the Annual Conference in London. For the non-elected roles the successful candidates will be co-opted onto sub-committees soon after that. The roles are without remuneration.

BSG Deputy Chair (serving 2 years as DC before assuming the role of BSG Chair)

BSG Vice Chair Publications (3 year term succeeding Steve Rice)

BSG Website Officer (Publications Subcommittee)

All the roles are key to future success of the BSG and we need volunteers. Please send an email indicating your interest and briefly detailing relevant experience, to Richard Chiverrell (BSG Honorary Secretary (rchiv@liv.ac.uk) no later than May 31st 2010.

Richard Chiverrell (BSG Honorary Secretary).

WANTED!!! THREE NEW POSTGRAD REPS

The current postgrad reps, Reka Fulop, Peter Schuerch and Annie Ockelford are coming to the end of their time on the committee so this is your time to make your voice heard!! It’s a great way to meet your fellow postgrads, voice their views, make sure the BSG is postgrad friendly……and it looks great on your CV!!

WHAT YOU WILL GET UP TO AS A POSTGRAD REP

♦ Help out at the Windsor Workshop
♦ Development of postgraduate activities within the BSG e.g. running an annual postgraduate conference, developing a series of postgrad workshops
♦ Attending committee meetings to put forward any postgraduate issues

WHEN

3 reps are needed to sit on each of the three committees (Research sub committee, Publications sub committee and Outreach sub committee)
♦ 2 Postgrad reps will be elected at this years Annual Conference in London (September 2010) for a 2 year term
♦ 1 Postgrad rep will be elected after the Windsor Conference (December 2010) for a 3 year term

FURTHER DETAILS

If you’re interested please contact either
♦ Reka Fulop (R.Fulop@suerc.gla.ac.uk) – Current Publications Rep
♦ Peter Schuerch (Peter.Schuerch@durham.ac.uk) – Current Outreach rep
♦ Annie Ockelford (Ockelford@civil.gla.ac.uk) – Current Research Rep
Geomorphological Techniques (Online Edition)- Call for Contributions

Are you an expert on a particular geomorphological technique? Have you just written a methods chapter for your PhD and would like to share it with the world? Would you like to help others to avoid the pitfalls you have uncovered, or get a head start at applying a method to further geomorphic research? The BSG is developing an updated, online version of Geomorphological Techniques and we are looking for authors to volunteer articles. Each article should be approximately 2000 – 3000 words in length, outlining the current methods utilised in your specialist area and will be peer reviewed by members of the BSG committee. Honorariums of £100 are available for BSG members that author articles. A suggested Table of Contents is reproduced below, but it is anticipated that this will grow and more than one item are welcomed if they cover a specific aspect of a topic. The first solicited articles will be available on the new Society website later this year. Please contact the Publications sub-Committee secretary, Jo Nield (J.Nield@soton.ac.uk) if you are interested in contributing.

**Composition of Earth Materials (generic, not environment-specific)**

- **Clast properties**
  - Particle size analysis (direct, field and lab. Sieving, settling, laser sizing, Wentworth scale etc.)
  - Particle form analysis (shape, roundness etc.)
  - Particle texture (SEM...)

- **Bulk properties of soils and sediments**
  - Porosity
  - Permeability
  - Moisture content and suction

- **Strength of materials**
  - Shear stress (e.g. cohesive strength meter)
  - Rock hardness (e.g. Schmidt hammer)

- **Mineralogical and chemical composition (e.g. AAS, etc.)**
  - Environmental magnetism
  - Major element geochemistry – XRF, AAS
  - Minor and REE geochemistry – ICP
  - Mineral crystallography XRD
  - Mineral inference – FTIR, NIR, VIS and UV spectroscopy
Form and Structure of Sediment Bodies

Describing and logging sedimentary sequences
Fabric and structure of clastic sediments
Thin section micromorphology (in glacial sediments)
Imaging sediment structures (x-ray, tomography etc.)
GPR (and other geophysical techniques, e.g. ice radar)

Topographic and Spatial Analysis

Direct acquisition of elevation data
Surveying basics
Total station
dGPS
Airborne LiDAR
Terrestrial laser scanning
Bathymetric methods

Photogrammetric techniques (including georeferencing of historical maps and rectification of modern and historical aerial photos)

Digital Elevation/Terrain Models
Creating DEMs from survey data (interpolation methods and determination of accuracy)
DEM of difference (using DODs to quantify landscape change and uncertainty analysis in DoDs)

Geospatial analysis
GIS platforms and tools
Terrain analysis and landform recognition
Network delimitation and analysis
Geospatial statistics (for analysis of form – semivariance techniques, spatial pattern recognition etc.)

Sediment fingerprinting

Processes, Forms and Materials in Specific Environments

This section will be divided by environment and mirror sections will discuss modelling in Part Five.
Aeolian

Local form (cross-section and slope)

Plan geometry

Velocity and flow properties (e.g. anemometers, towers, different types, placement etc.)

Sediment transport (saltation probes, sediment traps, etc.)

Coastal

Beach morphology (physical and remote sensing techniques)

Cliff and shore platform geometry

Surf-zone hydrodynamics (measuring waves and currents)

Surf-zone sediment transport (traps and sampling methods for different sediment types)

Surf-zone sediment transport (tracer techniques)

Swash dynamics

Coastal cell sediment balance (erosion and deposition on different types of beaches/cliffs – rock, sediments, etc.)

Fluvial

Local form (cross-section and slope)

Plan geometry

Bed material sampling

Velocity and flow properties (ECMs, ADVs, ADCPs etc. for velocity and turbulence measurements)

Discharge estimation and stream gauging (velocity-area, weirs and flumes, stage measurement – pressure, ultrasonics etc.)

Suspended sediment sampling (time and point integrating samplers e.g. DH48, turbidity sensors)

Bed load sediment (traps, samplers, movement detectors)

Tracing fluvial sediments (bed load and suspended load tracing techniques)

River bed scour and fill (scour chains, bed disturbance)

Bank Erosion (PEEPs etc.)

Hyporheic measurements (subsurface flow, infiltration etc.)

Glacial

Sampling and describing ice

Meltwater sampling and analysis
Tracer investigations
Borehole drilling and instrumentation
Glacier movement
Glacier energy balance
Basal processes
Hill slope/Mass movement
Sensors
Karst
Landform classification techniques
Local form measurements
Dissolutional denudation rates
Tracer techniques
Lacustrine
Contemporary environment – water, thermal stratification, inflow monitoring, sediment traps
Recent sediment accumulation – sediment water interface
Sediment provenance – catchment – sink linkages
Periglacial
Environmental factors
Sediment transport

Long-term Environmental Change (dating techniques, etc.)
Palaeoecology (geomorphology relevant aspects)
Coring methods (soils, bogs, floodplains, lakes)
diatoms
charcoal
pollen
Marine organisms (forams)
Dating
General context – absolute, relative, radiometric, errors
radiocarbon
Pb210 Am241 Cs236 – short isotopes
U series
Amino acid racemisation
Luminescence
Lichenometry
Dendro
Archaeo and Palaeomagnetism
Cosmogenics

Modelling Geomorphic Systems

Generic and conceptual
Numerical Modelling
Physical Modelling
Statistical Modelling
Evaluating and testing models
Environment Specific Models (brief intro on each followed by case notes on relevant tools)

Weathering
Aeolian
Coastal
Fluvial
Glacial
Hill slope/Mass movement
Karst
Lacustrine
Periglacial
Introduction

Following on from the success of the revived Glacial Landsystems Working Group in 2008, GLWG 10 was met with a substantial following of 38 people from all over the UK (Aberdeen to Southampton, Durham to Aberystwyth). The group assembled at Whitley Bay Caravan Park on the Durham coast on Friday 23rd October, 2009, to taste the local beer and listen to an introductory talk by Bethan Davies and Dave Roberts. The weekend began at the Durham coastline at Whitburn and Warren House Gill, focusing on a glacial and interglacial record stretching back to the Middle Pleistocene, before moving south to the Devensian glacial sediments at Upgang, North Yorkshire.

Saturday 24th October

Although storms were forecast, the morning started off dry, but windy and once the group had assembled, a convoy headed out to the first site, Whitburn Bay. There are a number of issues regarding the behaviour of the British and Irish Ice Sheet (BIIS) along this coastline and the lack of chronostratigraphic control associated with both advance and retreat phases. Whitburn Bay is located in an area of coalescence of several competing ice lobes, making it useful for understanding east coast ice-sheet flow dynamics.

The group was introduced to the Late Devensian tills by Bethan Davies. Glaciogenic sediments were well exposed above the Magnesian Limestone bedrock with the lower Blackhall Member and the upper Horden Member clearly identified, separated by a boulder pavement. The glaciofluvial sands and gravels sparked a lively debate regarding their possible subglacial and proglacial origin. The two tills represented ice flow from two different locations during the Late Devensian, supporting the existence of multiple competing ice lobes in the eastern sector of the BIIS. The dynamic group discussions continued despite the ensuing rain and increasing winds. Fortunately, the next stop was to sample the delightful Whitburn fish & chips and dry off.

The afternoon saw the convoy bracing the high winds to assemble at Warren House Gill to discuss the Middle Pleistocene, Warren House Gill Formation (WHF). GLWG members were impressed by the vast sections cleared along the cliff by a JCB, courtesy of the QRA! These sediments have previously been interpreted as indicating the onshore presence of the Scandinavian ice sheet during MIS 6. However, the WHF apparently pre-dates a raised beach dated to MIS 7. In short, the age, genesis and provenance of the WHF remains unresolved. The revised lithostratigraphy proposed by Bethan Davies provoked much discussion. Bethan suggested that the basal deposit was a glaciomarine diamicton that had been overridden by an ice sheet, that was deposited at some point between MIS 8 and 12, and which contained almost entirely British and North Sea detrital material. There was no evidence of an onshore Scandinavian ice sheet at Warren House Gill. Bethan Davies and Dave Roberts concluded the afternoon by suggesting that the Fennoscandian ice had interacted with the BIIS in the North Sea possibly twice during the Quaternary, during MIS 6 and MIS 12, with the precise chronostratigraphical framework for the site still under development - so watch this space!
After a day blowing the cobwebs away, the evening was spent tasting the local pub grub and Ale, only moving on once last orders was called. The GLWGers then had the excellent idea to go to the Whitley Bay Caravan Park karaoke night, which we could only get into after some quick-talking from Dave Roberts. This was quite an experience and although none of the group volunteered to sing, we could tell Dave Evans was close!

Sunday 25th October

The following morning, the high winds continued. The bright eyed group from the night before said a few goodbyes before some people started the long journey home. After some unpredictable convoy driving, the remaining crowd arrived at Upgang, North Yorkshire, led by Dave Roberts. We discussed Late Devensian tills and ice marginal environments, aiming to resolve some of the issues of glaciation along the east coast.

With the sun now shining, the group was led down to the beach and was in awe of the impressive section 750 metres long and 30 meters high. They were even more amazed that it was discovered by a friend on a stag night! Upgang displayed four lithofacies associations, with an initial ice advance from the north, followed by ice recession and the formation of an ice marginal lake. Ice later readvanced into the area, infilling the lake and eventually the entire site. As the rain started to fall, the talks progressed to dating control. A crude chronostratigraphic framework was suggested, with the initial ice advance occurring at ca. 21,000 cal. years BP, and the second advance at ca. 16,000 cal. years BP, with speculative correlation to Heinrich Event 1.

Figure 1. The GLWGers at Upgang, North Yorkshire
In summary, Bethan Davies’ Ph.D. field sites stimulated interesting discussions about the genesis of the LGM sediments and the behaviour of the British Ice Sheet along this coastline. An excellent meeting and look forward to seeing you all next year for the QRA GLWG in Anglesey.

Danni Pearce

Department of Geography

Queen Mary University of London

A GLWG website is now hosted at Durham University Geography Department, where you can read more about the group and find reports on all of the past meetings and links information about future meetings: http://www.dur.ac.uk/geography/qec/research_groups/glwg/
Research Article:
Linking high altitude glacier melting to Late Quaternary sedimentation in environmentally sensitive range-front alluvial fans in the Sparta Basin, southern Greece

Dr Richard Pope, Geography and Earth Systems Science, University of Derby.

Background:
The prevailing view emerging from over two decades of research into Mediterranean alluvial fans is that almost without exception the dominant control of sediment transfer and subsequent deposition within such systems is excessive runoff generated by extreme rainfall events (e.g. Harvey, 1997). However, investigations of river systems in northern Greece (e.g. Woodward et al., 2008) have demonstrated that glacial activity has exerted a significant influence upon river behaviour and sediment transfer. In southern Greece, the presence of high-level glacial moraines in the sediment source areas of alluvial fans in the southern portion of the Sparta basin was noted by Hagedorn (1969) and Mastronuzzi et al. (1994), although no attempt was made to elucidate relationships between glacial activity and alluvial fan processes. Recent investigations have focused upon developing a detailed sedimentary history of the Spartan fans (Pope and Wilkinson, 2006), which marks a key stage in clarifying linkages between fan sedimentation and high altitude glacial melting.

Project aim and objectives:
The overarching aim is to establish the degree to which late Pleistocene sedimentation in Spartan range-front fans was driven by glacial melting in the Taygetos range. The key objectives are to combine analysis of aerial photographs with detailed field mapping to identify the distribution of moraines; relatively date moraines on the basis of mineral magnetic and iron (Fe\textsubscript{d}) properties of soils formed on moraine surfaces; confirm whether soils formed on moraine and fan surfaces share similar magnetic and Fe\textsubscript{d} properties; and derive a preliminary (OSL and U-series based) chronostratigraphic framework for moraine deposits.

Preliminary results:
i. Mapping of moraines:
Detailed field-mapping confirmed the existence of the Aghia Varvara and Varda Vrissi moraines (described previously by Mastronuzzi et al., 1994) with a third highly eroded moraine identified immediately east of Sidirokastros (Figure 1). Due to inaccessibility no investigation of the Varda Vrissi moraine was possible. The Aghia Varvara moraine (1870 to 1895m amsl) forms a 250m long, 25m high N-S trending arcuate-shaped deposit that has been bisected by a channel draining a glacially-modified depression immediately to the west. Approximately 0.75km to the north, the highly eroded Sidirokastros moraine (1975 to 1983m amsl) occupies a depression positioned in front of a small glacially modified gorge. Exposures of glacial sediments are strictly limited to those areas where the moraines have been significantly incised by runoff generated by a combination of snow-melt and rainfall. The exposed sediments comprise distinctively angular to sub-angular gravel-sized clasts composed of locally-derived Vigla and Pantokrator limestone. The gravels are poorly sorted and supported by a distinctive white to pale yellow fine sand-silt matrix. By comparison, the depositional style of the lowermost sediments is more distinctive, consisting of better sorted, fine gravels and granules that are separated by locally continuous (35 to 50cm thick) fine-sand/coarse silt units (Figure 2).

ii. Relative age dating of moraines:
Trenches excavated across the surface of the Aghia Varvara and Sidirokastros moraines revealed a 15 to 35cm thick cambisol characterised by Ah- and Bh-horizons above a C-horizon comprising partially weathered moraine sediment (Figure 3). To establish if both moraines were of the same age, a total of 26 samples were collected from both sites at 2cm intervals to facilitate high resolution down-profile measurements of mineral magnetic concentration (cM, cM(%)i, cMarm, HFIRM) and dithionite extractable (Fed) iron concentration. For both moraines an almost identical down-profile trend was observed whereby the maximum concentration of magnetic minerals and secondary iron oxides occurred in the Bh-horizon, and decreased rapidly within the parent material and underlying moraine sediment (Table 1). The slight variation in the down-profile values of magnetic parameters and iron oxide concentration between adjacent sampling sites was statistically insignificant (p>0.05), suggesting that despite the difference in altitude, the two moraines are capped by the same soil that almost certainly formed over the same time-interval.

Luminescence dating suggests that proximal fan sediments were deposited between 250k to 130k yr BP (MIS 8 to 6 [Pope and Wilkinson, 2006]). To confirm if the deposition of moraines occurred over this time interval proximal fan surface soils were also subjected to mineral magnetic and Fed analysis. The chromic luvisols formed on the fan surfaces are characterised by noticeably higher concentrations of magnetic minerals and secondary iron oxides (Table 2). At each of the 16 sampling points the maximum concentration of magnetic minerals and secondary iron oxides occurred in the Bt-horizon, and decreased rapidly through the C-horizon and underlying fan sediments. Statistical analysis of the mean values of each magnetic parameter and iron oxide concentration for the moraine and fan surface soils indicate that the difference is significant (p>0.01). Whether this result indicates that fan and moraine surface soils formed at different times is uncertain. In addition to any temporal factor, the difference in altitude and
Figure 3: Cambisol formed on the surface of the Aghia Varvara moraine (view to W altitude 1891 [±5] m amsl). This soil type also occurs on the Sidirokastros moraine.

Figure 4: Proximal fan sediments
associated climate has almost certainly influenced the observed differences in mineral magnetic and iron oxide concentrations within the soils.

Table 1a: Representative mineral magnetic and secondary (Fe\textsubscript{d}) iron results for Aghia Varvara moraine

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Units: χ\textsubscript{lf} (10\textsuperscript{-8} m\textsuperscript{3} kg\textsuperscript{-1}) Xfd\% (10\textsuperscript{-5} m\textsuperscript{3} kg\textsuperscript{-1}) χ\textsubscript{arm} (10\textsuperscript{-5} m\textsuperscript{3} kg\textsuperscript{-1}) H\textsubscript{firm} (10\textsuperscript{-5} Am\textsuperscript{2} kg\textsuperscript{-1}) Fe\textsubscript{d} (mg g\textsuperscript{-1})

iii. Identification of moraine sediments in fan deposits:

The deposition of the middle gravel units (MIS 8 to 6) coincided with the glacial melting phases of the Vlasian stage and increased sediment loads in river systems in northern Greece (Hughes et al., 2006; Woodward et al., 2008). Evidence for glacial control of sedimentation is limited to the Palaeoponagia, south Palaeoponagaia and Skatias fans. In each fan the proximal sediments comprise locally continuous sequences of gravels and silty-sands (Figure 4). The moderate to well-sorted gravel units are dominantly clast-supported with imbricated and flow-parallel fabrics. These characteristics strongly suggest transport and deposition by stream flow rather than gravity flow processes. The silty-sand units lack any obvious internal structure. However, these finer units share similar grain size characteristics and colour characteristics as the fine-grained component of the Aghia Varvara and Sidirokastros moraines. Magnetic and Fe\textsubscript{d} analysis of the silty-sand units produces values that are of a similar range to those recorded by the fine-grained moraine deposits (Table 3), suggesting that the latter could be fluvially reworked glacial moraine.

iv. A chronology of deposition:

Fine sands exposed towards the top and base of Aghia Varvara moraine and within proximal units of south Palaeoponagia fan are undergoing OSL dating at the Nordic Laboratory for Luminescence Dating. A test sample taken from the top of the Aghia Varvara moraine has produced an OSL age estimate of 40 ±3 k yr BP (Table 4). However, until the additional fine-grained units have been dated little can
be said about the test date result. If reliable the result indicates deposition of fine-grained moraine from seasonal melting of highly localised small glaciers during an otherwise cold and dry phase of MIS 3. An application to NERC is currently being finalised to fund U-series dating of flowstones at the base Table 1b: Representative mineral magnetic and secondary (Fe\(d\)) iron results for Sidirokas-tros moraine.

**Table 1b: Representative mineral magnetic and secondary (Fe\(d\)) iron results for Sidirokas-tros moraine**

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<th>C(arm)</th>
<th>Hfirm</th>
<th>Fe(d)</th>
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Units: \(\chi_f\times 10^{-8}\text{ m}^3\text{ kg}^{-1}\) \(\chi_d\%\times 10^{-5}\text{ m}^3\text{ kg}^{-1}\) \(\chi_{arm}\times 10^{-5}\text{ m}^3\text{ kg}^{-1}\) Hfirm \((10^{-5}\text{ Am}^2\text{ kg}^{-1})\) Fed \((\text{mg g}^{-1})\)

**Table 2: Representative mineral magnetic and secondary (Fe\(d\)) iron results for the proximal surfaces of south Palaeophagnia fan**

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Units: \(\chi_f\times 10^{-8}\text{ m}^3\text{ kg}^{-1}\) \(\chi_d\%\times 10^{-5}\text{ m}^3\text{ kg}^{-1}\) \(\chi_{arm}\times 10^{-5}\text{ m}^3\text{ kg}^{-1}\) Hfirm \((10^{-5}\text{ Am}^2\text{ kg}^{-1})\) Fed \((\text{mg g}^{-1})\)
of the Aghia Varvara moraine and calcitic cements within the lower proximal gravel units of the south Paleaoponagaia and Skatias fans.

Table 3: Representative mineral magnetic and secondary (Fe\(\text{d}\)) iron results for fine-grained sediment within proximal sediments of south Palaeoponagia fan

| Depth | \(\chi_{\text{lf}}\) | \(\chi_{\text{df}}(\%)\) | \(\chi_{\text{arm}}\) | Hfirm | Fe\(\text{d}\) | \(\chi_{\text{lf}}\) | \(\chi_{\text{df}}(\%)\) | \(\chi_{\text{arm}}\) | Hfirm | Fe\(\text{d}\) |
|-------|-----------------|-----------------|----------------|-------|---------|----------------|-----------------|----------------|-------|---------|-------|----------------|
| 5     | 0.25            | 0.90            | 10.11         | 1.88  | 0.14    | 0.28          | 1.06            | 11.21          | 1.99  | 0.19    |       |
| 10    | 0.27            | 1.05            | 11.64         | 2.03  | 0.18    | 0.28          | 1.05            | 11.38          | 2.16  | 0.21    |       |
| 15    | 0.28            | 1.00            | 10.33         | 1.84  | 0.16    | 0.33          | 1.13            | 13.15          | 2.31  | 0.21    |       |
| 20    | 0.28            | 1.12            | 12.73         | 2.10  | 0.15    | 0.35          | 1.18            | 14.86          | 2.41  | 0.24    |       |
| 25    | 0.32            | 1.10            | 14.22         | 2.27  | 0.19    | 0.38          | 1.15            | 14.52          | 2.39  | 0.25    |       |
| 30    | 0.38            | 1.15            | 14.81         | 2.36  | 0.23    | 0.42          | 1.18            | 14.71          | 2.30  | 0.26    |       |

Units: \(\chi_{\text{lf}}\) (10\(^{-8}\) m\(^3\) kg\(^{-1}\)), \(\chi_{\text{df}}\) (10\(^{-8}\) m\(^3\) kg\(^{-1}\)), \(\chi_{\text{arm}}\) (10\(^{-8}\) m\(^3\) kg\(^{-1}\)), Hfirm (10\(^{-5}\) Am\(^2\) kg\(^{-1}\)), Fe\(\text{d}\) (mg g\(^{-1}\))

Table 4: OSL age estimate for test sample from Aghia Varvara moraine

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<th>Dose rate Gy ka(^{-1})</th>
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v. Summary:

Mapping indicates that moraines are more extensive than previously suggested. Extensive mineral magnetic and Fe\(\text{d}\) analysis indicates that: (i) the two most extensive moraines probably formed at same time; (ii) moraine and proximal fan soils differ significantly in terms of magnetic and Fe\(\text{d}\) properties reflecting a noticeable age difference and/or the differing climate existing in the range and the basin floor; (iii) fine-grained proximal sediments could be fluvially reworked moraines. Consequently, some insight into glacial activity and fan system processes has been gained. However, the role of glacial activity and origin of fine-grained sediments should become clearer once OSL and U-series dating of sediments has been completed.

I’d like to express my gratitude to the BSG for providing funding towards the flights and transport while in Greece.

References:


Research Grant Report:

Using terrestrial laser scanning to remotely detect beach surface moisture variations and its influence on aeolian geomorphology

Jo Nield, School of Geography, University of Southampton

Surface moisture is a key parameter in aeolian environments because it influences aeolian sediment transport, both by increasing the shear velocity threshold required to mobilise sediment, reducing surface sediment release and altering fetch length (e.g. Bauer and Davidson-Arnott, 2003; Davidson-Arnott et al., 2008). The high degree of spatial and temporal variability of surface moisture can confound traditional measurement techniques (such as soil moisture probes and gravimetric measurements (Wiggs et al., 2004; Yang and Davidson-Arnott, 2005)) that rely on ‘spot-based’ sampling. As such, synoptic remote sensing offers an attractive alternative. While remote sensing of surface brightness using video imagery enables surface moisture inference at a high resolution (Darke et al., 2009), it has a number of limitations including daylight dependent operation and inability to directly measure small changes in morphology. In contrast, terrestrial laser scanning (TLS) offers an alternative that could potentially be very powerful at capturing both the variation of surface moisture and beach morphology at high spatial and temporal resolution, and providing terrain information for sediment transport studies. Along with spatial orientation, TLS records an intensity signal for each return point, which is a function of surface properties and instrument position. The aim of this research project was therefore to investigate the ability of TLS to quantify changes in beach surface moisture, and the relationship between spatially varying surface moisture and topography. Funds from the BSG enabled the partial purchase of a Delta-T theta probe (ML2x) to aid in point-based beach surface moisture measurement and calibration, following the standard methods of Wiggs et al. (2004), Yang and Davidson-Arnott (2005) and Darke et al. (2009), for TLS method comparison.

Figure 1 Ynyslas on the 28th August, 2009. (a) Too windy for the TLS. (b) Example of the sand strips.

Figure 2 Beach surface and TLS measured surface moisture for the final scan undertaken at Ynyslas. Note the drier, rippled sand strip coloured red (A) and adhesion structures in moist interstrip area coloured blue (B).
An initial exploratory field visit was undertaken to East Head, where surface moisture in the intertidal zone was measured. Data collection was limited however, due to the act of a good samaritan, who kindly removed our field equipment from the beach and deposited it at the site office, during the few moments we were carrying the rest of our equipment to the site. A second trip to Ynyslas, Wales (site location: 52.53°N 4.06°W) was much more successful. Although the wind on the second day was too strong to operate the TLS (see Figure 1), we experienced perfect field conditions on the first day which enabled the collection of a time series of DEM and surface moisture measurements over a drying surface. An example of the results is shown in Figure 2. This enabled us to deduce interesting relationships between surface moisture patterns and bedform development, with clear distinctions between saltation behaviour on the rippled sand strips and moist interstrip area. Along with the development of adhesion structures in the moist areas, significant deposition occurred on the wet/dry boundary, leading to the formation of a protodune. Back in Southampton, a number of controlled experiments were used to calibrate the collected data. Details of these observations were presented at Windy Days (Nield and Squirrell, 2009), and in a paper submitted to Earth Surface Processes and Landforms (Nield et al., in review), which the reader is referred to for further experimental details. Along with successfully measuring the surface moisture and sedimentation patterns, the TLS eluded to saltation cloud characteristics which will be part of the focus of future research. The BSG is thanked for kindly supplying funds to facilitate the initiation of this research.

Acknowledgements:

Robert Squirrell assisted with all the field and calibration work, whilst a recipient of a School of Geography, University of Southampton Undergraduate Summer Bursary. Angela Harris is thanked for her invaluable help with the field work at Ynyslas, along with CCW and The National Trust who gave permission for us to experiment on their beaches (Ynyslas and East Head respectively).

References:


Lisa Mol

School of Geography and the Environment
University of Oxford

‘Ancient landscapes – Modern perspectives’. A very intriguing and wide-ranging theme which more than justified the journey to Australia. As a finishing doctoral student these international conferences present both a daunting challenge and a wonderful opportunity to put our own work out into the larger field as well as access to a large range of excellent research which we would normally not be in direct contact with.

I presented a poster in the Geoarchaeology section entitled ‘ERT, geomorphology and the deterioration of Rock Art in the Golden Gate Reserve, South Africa’, which was based on work I carried out in April of both 2008 and 2009 and forms the basis of my PhD thesis, which is due for submission later this year. My work aims to develop Electric Resistivity Tomography (ERT) further as a geomorphological tool, which furthers the understanding of the role of internal moisture in sandstone weathering and the subsequent surface weathering which threatens the future of San Rock Art in Southern Africa. Speaking to the conference attendees who were interested in my work was very helpful for my further research, as it provided me with an opportunity to exchange ideas with world-class geomorphologists from different backgrounds, ideas which have since been further developed and incorporated into articles that are now in preparation for submission.

The Geoarchaeology session itself showed the excellent range of interdisciplinary work. Wainwright’s keynote made the very interesting observation that to a certain degree humans could be as powerful land forming agents as for example rivers and glaciers and that landscape is a dynamic interaction between adaptation of human behaviour towards the environment, and environment development towards human influences. Even though this is a concept which has been discussed before, it showed the need for approaching Geoarchaeology from an equal geomorphological and archaeological background, rather than viewing geomorphology, and earth sciences in general, as a support method. The focus of the session then shifted towards regional studies, including Oguchi’s excellent presentation on salt crystallization in the Yoshimi Hyaku-Ana Site, Japan, which explained the usage of temperature and humidity loggers to correlate environmental factors with saline excretion from the rock face. André’s presentation on the deterioration of Angkor’s Ta Keo Temple raised equally interesting issues of differential weathering and investigations with diachronic photogrammetry. The main issues raised in this session were 1. how geomorphology can be a useful way of understanding the mutual human–environment interaction, 2. what traces people have left in the landscape and 3. how parts of this heritage could best be protected by understanding the environmental processes that are hastening their deterioration. All of these factors are resonant in my own research, but the wide range of topics contributed to a broader perspective on my research and made me aware of new angles and approaches which I had not previously considered.

Further sessions included a range of human–environment interaction sessions such as Geomorphosites and Geotourism which raised very interesting issues of tourist safety, accessibility of geomorphologically interesting sites, environmental protection and how all these factors either enhance or obstruct each other, and Geomorphological impact of armed conflicts, which discussed the impact of weapons on the wider environment. Kiernan’s presentation on the conflicts in Cambodia showed an often-overlooked side of geomorphology; the direct impact of weaponry on rock surface and their consequential acceler-
ated weathering rates. These represent only a small selection of the sessions held during the conference, all of which were of very high academic standard.

In addition to the sessions at the conference centre, field visits were offered to various sites in the vicinity of Melbourne. I participated in the Ocean Road tour, which visited research sites such as the Otway Coast (Gill, 1981), Port Campbell Coast (Shoemaker and Uhlherr, 1999) and the iconic Twelve Apostles.

I would like to take this opportunity to thank the BSG for their very generous contribution for attendance of Geomorphology 2009 in Melbourne.

REFERENCES


‘Synergies between river restoration and river management focusing on Natura 2000 and Ramsar sites’, European Centre for River Restoration

Lenka Anstead

The European Centre for River Restoration’s (ECRR) network seminar took place on 28 and 29 May 2009 in Lelystad, The Netherlands. My participation at this event was kindly supported by the fund from the British Society for Geomorphology. The seminar brought together some of the leading organizations and experts in river restoration in and outside of Europe. This meeting also celebrated the 10th anniversary of the European River Restoration Centre and 40 years of river restoration work by Bart Fokkens, director of Rijkswaterstaat – Centre for Water Management and the president and an active leader of ECRR.

The first day of the meeting was devoted to presentations on revitalization projects in major river basins in Europe. Keynote presentations concerned two major European Rivers: the River Rhine and the River Danube. Detlev Ingendahl from the State Authority for Nature, Environment and Customer Protection in Germany presented a project about the reintroduction of Atlantic salmon in the River Rhine catchment area and the geomorphological aspects of habitat restoration and free fish passage through engineering obstruction. Mircea Staras from the Danube Delta Institute in Romania talked about a large scale river restoration project (225 000 ha) in the Danube delta. The Danube delta biosphere reserve has international importance as it belongs to the largest wetlands in Europe. The UK was represented by Allan Frake from the Environment Agency reporting about the award winning conservation and rehabilitation project on the River Avon (known as STREAM – Strategic Restoration And Management). The project’s website: http://www.streamlife.org.uk/ provides a very attractive description of the project’s methods and results, with inspiring photographs.

Talks were followed by a poster session. I presented a poster on an ecological slope stabilization method known as willow spiling which is part of my PhD research at the University of East Anglia. Willow spiling is a soil bioengineering method based on weaving live willow canes around vertically driven live willow poles. Although the method dates back as far as 28 B.C, it is finding a new place in modern slope stabilization engineering as it has great potential for use in habitat enhancement and river restoration. We constructed two willow spiling projects on the River Stour, East Anglia, to observe the effectiveness of this method on riverbank stability on fast eroding sites. One of the aims is to show the effectiveness and limi-
tations of this method and promote its wider use as an alterative to hard engineering in situations where stabilization of riverbanks is necessary or habitat enhancement desirable. I received some useful feedback from conference participants.

The outcome of the day was a ‘Lelystad declaration’ which concluded the key points participants brought up during the discussions. It stated that river restoration should aim to restore complete ecosystems and ecosystem processes. There is general understanding of the importance of geomorphology in river restoration and according to the declaration: ‘Hydro-morphological processes remain the key factor in steering ecosystem processes and ecosystem quality’. One of the strategic objectives of the ECRR, which is also relevant to the wider scientific community, is to take the findings from research-oriented local river restoration activities and promote these for use in larger scale restoration projects.

The second day field trip was an exciting visit to the River IJssel, one of the three major distributary branches of the River Rhine. A bus drive through dry polders in Flevoland, recently used for agriculture and wind energy, was followed by a day-long boat trip to the River IJssel’s delta. First we sailed along the lake Ketelmeer which creates a boundary between Northeast polder and Eastern Flevoland. We went to see a Ketelmeer eye, a round shaped disposal site positioned in the middle of the lake, which stores heavily polluted sediments dredged from the lake in the past. The deposit is surrounded by 10 metre high dyke to prevent it from coming back to the lake. Natural colonisation of the site and the nearby shoreline is already attracting a number of different bird species. Next our boat sailed through a flexible weir system between Lake Ketelmeer and Zwarte Meer. The weir serves as flood protection for the region upstream of the weir against high waters coming from the lake caused by westerly winds. The weirs are made of three 8 m diameter (world’s largest!), inflatable rubber cushions which fill with water and air within one hour in the event of high water. After seeing this spectacular engineering project we went back to the eastern part of Lake Ketelmeer, to the mouth of the River IJssel. Here we could observe results of a nature development project carried out between 1997 and 2002. During this period a number of artificial river islands and quays with shallow waters were created to trap the sediment and support reed bed development. Today, this is a Natura 2000 site and an important habitat for many bird species. Approximately 5 km upstream from the IJssel mouth is the town of Kampen. A river bypass will be created here within the next few years to accommodate river flows of higher frequency and magnitude due to climate change, with the aim of protecting Kampen and a new planned development of 4000 houses from flooding. This strategy shows a changing trend in flood management which adds space to floodplains and rivers instead of deepening and straightening the channels and creating flood embankments. The last site we visited was the Vreugderijkerwaard floodplain. We could not see this, but a secondary channel was created here in 2002 to restore river and floodplain dynamics in this area. The river dunes which have naturally occurred here since the last ice age are very valuable for geomorphological and botanical researchers.

Both the seminar day and the field trip were a very valuable experience. I heard interesting views on my PhD project and collected ideas which could be implemented in the UK or in my own country – Slovakia. This event also further deepened my interest in river restoration as my career and I am grateful to BSG for the support they provided which allowed me to join this meeting.

Photographs by European Centre for River Restoration
Discussing the route of the field trip on the board of the Veerman van Kampen.

One end of inflatable weir system between Lake Ketelmeer and Zwarte Meer.

Sharing experience with a river restoration expert.
Postgraduate Research Report:
Water routing and sediment transport in a polythermal glacier: modelling and high resolution measurement

Richard Gravelle, Loughborough University

The responsiveness of fluvial suspended sediment fluxes to climate change makes them key indicators of relationships between glacier variations, climate and geomorphic change. However, uncertainties in the collection of suspended sediment concentration measurements significantly limit understanding of these relationships. Using Acoustic Doppler Current Profiling (ADCP) technology to measure both discharge and sediment concentrations, this study aims to understand the evolution of the subglacial drainage system in a polythermal glacier as both water and sediment sources vary over the glacial melt season.

In early July to late August 2009, I was able to travel to the Tarfala Valley in Northern Sweden to conduct intensive fieldwork in the proglacial area of Storglaciären with the help of a BSG Postgraduate Research Award. This fieldwork enabled me to successfully install ‘horizontal-looking’ SonTek Argonaut ADCPs in two outlet streams near the terminus of Storglaciären to record stream discharge and proxy suspended sediment concentration at high temporal resolutions. Pressure transducers and turbidity probes were also installed to allow calibration of the ADCPs, and provide independent measurements. Further calibration was carried out using depth-integrated suspended sediment samples and point velocity measurements collected with an electromagnetic current meter.

Figure 1: Gauging station configuration with ADCP (front), turbidity probe (rear) and pressure transducer (bottom) visible.

The data collected over this field season will provide the basis for an investigation of the influence of the seasonally-evolving glacier drainage system on water fluxes and sediment delivery to the proglacial area, using a linear reservoir model. The model will estimate the volume and rate of water movement through Storglaciären using the storage characteristics of different media (snow, firn and ice) to simulate glacial
drainage. Furthermore, a parameterized sediment entrainment and deposition model will represent sediment transport through the glacier. This modelling will allow seasonal subglacial drainage system evolution to be inferred as sediment availability changes and exhaustion of sediment sources occurs, and provide an assessment of how changing meltwater supplies and rates of throughflow influence sediment transfer in polythermal subglacial environments.

The money I received through the BSG Postgraduate Research Award funded my travel to Sweden and allowed me to stay at the Tarfala Research Station and collaborate with researchers from Stockholm University. In short, this generous award has been invaluable in enabling me to undertake the first part of my fieldwork programme and has provided me with an excellent foundation for the rest of my Ph.D. research project.

Figure 2: Setting up a data logger at a proglacial stream gauging site during the monitoring period. The glacier Storglaciären is visible in the background.
Geomorphological Discontinuities and Ecological Organisation: A Case Study of the River Drôme

Julia Anne Toone

Department of Geography, Loughborough University

River channel changes, and patterns of in-stream macroinvertebrate community organisation, are both well explored in alluvial channels. Less is known about the behaviour of mixed bedrock-alluvial rivers, and their patterns of macroinvertebrate community structure. In response to relatively recent, widespread acknowledgment that sustainable and holistic river channel management is best achieved by a strategy that accounts for large-scale controls on long-term channel behaviour, there is a clear need to identify how spatial and temporal variation in rates and patterns of channel adjustment constrain the long-term evolution of mixed bedrock-alluvial channels, and their in-stream macroinvertebrate ecology.

The River Drôme in south-eastern France is a fascinating example of river channel change in response to a complex history of natural and anthropogenic disturbances. Previous work has documented a long-term trajectory of channel degradation, but a reach linking the upper and lower sections of the river has not been explored and is of particular interest because of its striking mixed bedrock-alluvial morphology. Over five kilometres the channel is characterised by abrupt changes in style and substrate that naturally divide the reach into six geomorphologic zones. These indicate that long-term degradation is not a simple, linear evolution but a complex non-linear process. The distinct pattern of geomorphological zonation along this reach forms the central focus of this thesis, specifically in terms of its historical development, present-day macroinvertebrate community structure, and future evolution.

The first part of this thesis documents decadal changes in channel morphology between 1948 and 2006 by using GIS to analyse eight series of high-altitude aerial photography. Field work in 2005 and 2006 was used to ground truth observations. Changes in longitudinal channel profile are derived from topographic surveys from 1928, 2003 and 2005. There have been modest overall amounts of channel constriction, narrowing and incision, but there is substantial spatial and temporal variability in these trends. The present-day configuration of wide alluvial, and narrow bedrock zones has developed in response to a particular sequence of natural and anthropogenic events, emphasising the importance of contingency and channel sensitivity to disturbance. The reach is located 200 m downstream from le Béoux, a tributary to the Drôme, and historical changes in this sub-catchment have been manifest in the long-term behaviour of the reach. A significant flood in 1978 is the likely catalyst of present-day zonation, which locked the reach into a geometry that has constrained subsequent channel adjustments. While zonation remained distinct as recently as 2006, there is evidence that the channel is now operating under different boundary conditions to those that produced and maintained zonation before 2001. It is clear that predictions of future changes in channel morphology require a long-term perspective of channel behaviour, patterns and connectivities through time.
The second part of this thesis characterises the present-day macroinvertebrate community of the study reach. Previous work in alluvial channels has considered how discontinuity in channel morphology influences spatial variation in patterns of macroinvertebrate organisation, but this has not been extended to mixed bedrock-alluvial channels. Relatively few studies have considered how spatial differences in channel behaviour (rather than simply channel character) may drive macroinvertebrate community organisation. Associations between channel morphology and macroinvertebrate community structure were tested by fieldwork carried out under low-flow conditions in 2006. Fifteen quantitative surber samples were collected at each of 10 sites along the reach. Local habitat characteristics, including particulate organic matter, bed sediment grain size (surface and subsurface), water quality (conductivity, temperature, pH) and flow velocity (benthic and mean) were also measured. Results indicate that the mass of particulate organic matter and the diversity of both surface and sub-surface grain size influence patterns of macroinvertebrate community structure along the reach. It is also apparent that zone-scale differences in flow and sediment regime, and differences in lateral and vertical channel dynamics are important. Variation in the frequency and intensity of bedload dispersal, which is a result of zone-scale variation in channel bed structure, is a dominant control on spatial patterns of macroinvertebrate community structure. These dynamics are the product of, and maintained by, the particular geography and history of the study reach, emphasising the ‘primacy of place’ and the importance of understanding how larger-scale morphological processes constrain smaller-scale patterns of macroinvertebrate biodiversity.

At present, there are plans to manage channel degradation, along the study reach and in downstream parts of the river Drôme, by restoring sediment supply to the channel. This will be achieved by the remobilisation of bedload in the Béoux sub-catchment and so it is likely that there will be future changes to the present-day morphology and macroinvertebrate community organisation in the study reach. Combining the findings of parts one and two, the third part of this thesis evaluates the likely impacts of this management strategy. It is suggested that if the channel is connected to its active floodplain, and receives a sufficient external supply of bedload, then the reach-scale dynamic of zonation is self-regulating. Successful management intervention relies upon an understanding of this behaviour. Compared to predominantly bedrock and predominantly alluvial sections of the reach, the mixed bedrock-alluvial mid-reach supports significantly more diverse macroinvertebrate communities and higher proportions of EPT taxa. These characteristics are a function of the morphological diversity of the mid-reach, which results from the particular configuration and the connectivity of the present-day zones. It is considered that if future bedload supply to the channel is not deficient or excessive to present-day flow and sediment regimes, then the present-day morphological diversity of the reach could be maintained. This would also maintain present-day patterns of macroinvertebrate community structure. It is, therefore, hypothesised that if the reintroduction of bedload from the Béoux secures the reach with a moderate volume and frequent supply of sediment, then this ‘drip feed’ would be a desirable management strategy.
Modelling catchment processes in pre-Alpine France
Katharine E. Welsh

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Changes in land management coupled with projected trends in climate could have significant impacts for the hydrology and sediment regimes within the pre-Alpine zone over the present century, particularly in terms of increased flooding and sedimentation. Previous attempts to discern the relative long-term contributions of climate and land use drivers on hydro-geomorphological from studies of palaeoarchives are hampered by the integrated and compounded nature of proxy signals. This research describes the testing, development and application of an established hydro-geomorphic numerical model (CAESAR) over different time scales (170-2000 years) to simulate at hourly time resolution, the changes in the hydrological and sediment regime of the Petit lac d’Annecy catchment in response to changes in system drivers. The cellular automata nature of CAESAR renders it an ideal tool for studying complex environments in a holistic manner, as it allows macro-scale emergent behaviour, such as the development of alluvial fans, from micro-scale physical process laws.

The hourly drivers of the model, precipitation, temperature and forest cover, have been derived a combination of instrumental data, documentary records and lake sediment records. The outputs of the model have been compared to field-based catchment geomorphology, empirical evidence and over longer-scales, against proxy records of detrital sediment in the catchment. Model developments included improving hillslope process representation which have been rigorously tested and compared with field evidence and known process rates. Additionally, a ‘snow mass balance model’ has been developed to imitate the effect of snow melt and snow store in the catchment.

Results from model runs over a few centuries show that in general the relationship between forest cover and total sediment discharge is nonlinear. Multiple-scenarios were modelled in order to quantify changes in the system. Forest cover scenarios suggest that flood peaks under forest cover above 60% (similar to current levels) may be too low to access overbank sediments in low, wide morphological settings. This is likely to result in channel incision occurring over decadal-centennial timescales accompanied by increased sediment discharge. In narrow, well coupled sub-catchments, an increase in forest cover from ~20% to ~40% over a 2000 year timescale shows a 37% decrease in sediment discharge, whereas a further increase of 20% (i.e. 40% to 60%) shows a decrease of only 17%. The results tentatively suggest that there may be threshold levels of forest cover.

Fig 1 Hillslope processes in the catchment headwaters.
Different climate scenarios show the effects of increasing precipitation on catchment geomorphology. For example, a 33% increase in precipitation over a 500 year timescale can drive gully incision by up to 50% (8m deep to 12m deep), with a significant increase in the extent of slope failure zones and up to 2m of fan head incision.

Two thousand year long model runs in five different morphological settings were simulated, the results suggest that intrinsic system behaviour such as storage-release, hillslope-channel coupling and supply-capacity relationships may well exert larger controls on sediment discharge patterns over this timescale than climate or land use drivers. The combined results from all five sub-catchments were compared to lake sediment proxy records and overall behaviour and temporal patterns compare well with the sediment accumulation rates and sediment proxies.

Hypothetical scenarios to investigate the geomorphic implications of a snow-free pre-alpine region over the last 2000 years show that there would be around 1.4 times more sediment discharge, with the annual hydrological regime radically altered with increased flooding throughout the year, particularly in winter months and a lack of a sustained discharge peak in the ‘melt’ months. This has implications for the projected environmental changes over the coming decades. The simulated effects of increased precipitation, reduced forest cover and snow-free conditions, in combination, point to increased amounts of coarse sediment discharge within the channels. Broad estimations show that a 20% reduction in forest cover or snow-free conditions can result in an additional 1m of sediment moving through the system and accumulating in the lake with potentially large impacts on flooding, in-channel fauna, benthic-dwelling lake fauna, aquatic macrophytes and water quality and water availability for storage and local power generation. Overall, CAESAR can be considered a robust tool for future predictive simulation modelling of hydro-geomorphic changes.

Fig 2 The Petit lac d’Annecy, southeast France.
## Diary Events

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<tr>
<th>Date &amp; Location</th>
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| 22nd-23rd April 2010 | All at Sea! Synergies between past & present coastal processes & ecology | Dr D.B. Ryves, Professor N.J. Anderson & Dr P.J. Wood  
http://www.lboro.ac.uk/departments/gy/allatsea/ |
| 31st August—2 September 2010 | BSG Annual Conference @ the RGS/IBG Annual Conference—London. | Prof Bob Allison, Dr David Robinson |
| 20th-27th July | (XXVIII) INQUA Congress will be held in Bern, Switzerland | http://www.inqua2011.ch/  
http://www.inqua.tcd.ie/ |