Lateglacial and Younger Dryas glaciation in the Romanian Carpathians (Ref IAP2-18-110)

Durham University, Department of Geography
In partnership with University of St. Andrews, Department of Geography

Supervisory Team
- Prof. Dave Evans, Durham University
- Prof. Doug Benn, University of St. Andrews
- Dr. Stewart Jamieson, Durham University
- Prof. Dave Roberts, Durham University

Key Words
- Glaciation, Romanian Carpathians, Glacial Geomorphology, Numerical Modelling, Cosmogenic Nuclide Dating.

Overview

Figure 1. Ridges of unknown origin (termed Discrete Debris Assemblages or DDAs) in the Bila Valley floor, Rodna Mountains, Eastern Carpathians. No previous research apart from observational description has been performed at this location.

Under contemporary climate change, a key issue is to understand how small ice bodies, such as mountain cirque and valley glaciers, respond to it. However, as modern examples are either found at high altitudes or polar areas, few analogues exist for transitional topoclimatic conditions offered by mid-altitude mountain ranges in temperate-continental climates. Therefore, an investigation of the ancient sedimentary footprint of glaciers nourished by such settings may provide an insight into future mountain glacier behaviour under oscillating atmospheric circulation.

Such environments are recorded in the mountain landscapes of the Romanian Carpathians, where various Discrete Debris Assemblages (DDAs; Fig. 1) are interspersed across cirque and valley floors. Their subducted, irregular and occasionally over-printed profiles, particularly in the upper cirque reaches, remain unexplored in terms of origin and climatic significance; These could either relate to the oscillating glacier snouts during the Lateglacial (19-14.4 ka BP) and Younger Dryas (12.9-11.7 ka BP) climatic fluctuations or postglacial hillslope and periglacial processes pertaining to increased continentality. Most previous work in the Romanian Carpathians was centred on 1) the identification of the terminal moraines marking the Last Glacial Maximum (20 ka BP) extents, 2) the derivation of climatic influences from cirque geomorphometry; or 3) localised cosmogenic nuclide dating in the highest mountain ranges for general geochronological frameworks. As a consequence, there is much scope for both proposing and testing potential interpretations and importance of these landforms with respect to Quaternary glacial dynamics.

This project aims to fill this gap by employing an integrated methodology, involving geomorphological mapping, cosmogenic nuclide dating and numerical modelling performed in selective areas of the Romanian Carpathians. While mapping will be undertaken to spatially analyse the depositional patterns of these landforms to help identify the origin, $^{10}$Be cosmogenic nuclide dating will constrain their timing with respect
to the Lateglacial - Younger Dryas Quaternary timeframe. Finally, a time-transgressive 2-dimensional numerical model, spatially and temporally-constrained through the previous two methods, will reconstruct the extent and timing of the chosen palaeoglaciars; This is done to both refine landform interpretations and pose additional insights about glacial landsystems, ice dynamics and palaeoclimate in mid-altitude, temperate-continental mountain environments.

**Methodology**

This project will involve the following methodology: First, a geomorphological and sedimentological (where possible) investigation of the DDAs in selected cirques and valleys in the Romanian Carpathians. The locations can pertain to either the same mountain range or different ones, as long as the choice is justified for comparison purposes (e.g. climate/topographic gradients between E-W or N-S locations). This exercise will be primarily conducted through fieldwork GPS recording of landforms of interest and their subsequent digitisation in a Geographical Information System. Landform patterns will be conceptualised and compiled into a glacial landsystem model (Evans, 2003). Second, a $^{10}$Be cosmogenic nuclide dating programme aimed at the cirque and valley extents most likely associated with the Lateglacial and Younger Dryas Quaternary climate events. Sampling will be systematically targeted towards dateable materials (e.g. exposed bedrock, erratic boulders within/near potential moraine ridges) from the valley bottoms towards the upper cirque floors to enable the construction of a robust geochronological framework. Finally, a 2-dimensional numerical model, will be used to test controls and patterns of the growth and decay of the ice cover on the mountain landscape topography. This will reproduce the glacier extent, thickness, speed and volume through the chosen Quaternary timescale. A comparison of the ice fronts extents and timing with the mapped and dated field evidence will be employed to thus test the reliability of the other two techniques.

**Timeline**

**Year 1:**
Develop an understanding of previous research in the region; develop and apply a GIS methodology for mapping from satellite and air photos and conduct mapping. Conduct a season of fieldwork.

**Year 2:**
Process cosmogenic samples and begin producing landsystem maps; receive training on modelling and set up modelling experiments. Conduct a second season of fieldwork.

**Year 3:**
Carry out modelling experiments and analyse results; produce final landsystems maps; develop writing skills; draft publications; present outcomes to IAPETUS2 and at international conference; draft thesis.

**Final 6 months**
Produce synthesis of glacial history of the region based on mapping, field, chronological and modelling evidence. Complete write-up.

**Training & Skills**

Techniques of geomorphic mapping, GIS analysis, and numerical modelling will form the core of this project. Applicants must be numerate with some previous experience of GIS and quaternary research being particularly beneficial. Specific training in all aspects of work will be delivered in Durham and at British Antarctic Survey, and via internationally recognised ‘summer schools’ including the Karthaus School for ice sheets and climate.

The student will be supported in broader skills training via the award-winning Career and Research Development (CAROD) group at Durham (thesis writing, writing for publication, presentation skills, enterprise skills etc.) and will benefit from cross-enterprise skills etc.), and will benefit from cross-disciplinary training provided as part of IAPETUS2. The training is designed to ensure that the student becomes a well-rounded scientist who is comfortable working independently and in teams.

**References & Further Reading**


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**Further Information**

Further information can be obtained by contacting:

David J A Evans (d.j.a.evans@durham.ac.uk)

Stewart S R Jamieson (Stewart.Jamieson@durham.ac.uk)