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Introduction to the Special Issue on Glacial Geology and Geomorphology

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1. Introduction

This special issue of the Journal of Maps includes six maps originally presented as posters at the International Conference on Glacial Sedimentary Processes and Products held at the University of Wales, Aberystwyth on 22-27 August 2005. We would ike to take this opportunity to thank all those who helped with the organisation and management of the conference, as well as all those who helped to put together this Special Issue of the Journal of Maps. In particular we acknowledge the conference sponsors: the International Association of Sedimentologists (IAS), the International Commission of Snow and Ice (ICSI), the IUGG Commission for Cryospheric Sciences (CCS), the International Glaciological Society (IGS), the International Quaternary Association (INQUA), Antarctic Climate Evolution (ACE), the Scientific Commission on Antarctic Research (SCAR), the Quaternary Research Association (QRA) and the British Geological Survey (BGS). The meeting was dedicated to W.B. Harland (1917-2003) in recognition of his fundamental contributions to glacial geology.

The aim of the conference was to promote dialogue between researchers in the fields of contemporary glacial processes, glacial sedimentology and ice sheet modelling in order to advance these fields in an integrated way. Contributions were received from researchers working on all aspects of glacial sedimentary processes and products, including glaciomarine,

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glaciolacustrine and terrestrial settings, from Archaean times to the present day. Oral and poster presentations addressed a number of hot topics in glacial sedimentology, including debris entrainment and transport by contemporary glaciers, depositional processes at contemporary glaciers, the sedimentary record of past glacial systems and modelling studies of ice dynamics and glacial depositional systems.

As part of the conference a special poster session was held dedicated to glaciological maps. The maps included in this edition of the Journal of Maps represent the posters that were displayed at the conference and cover a range of contributions including glacier maps, as well as glacial geological and glacial geomorphological maps. The posters all demonstrate admirably how useful maps are to researchers in these fields and the importance of producing high-quality maps for glaciological research.

2. The Maps

The paper by Evans, Twigg and Shand reports on þórisjökull, which is a small (ca. 6 by 4 km) plateau icefield situated south west of the Langjökull Ice Cap in southwest Iceland. A detailed map (at 1:15,000) is presented showing the extent of the icefield and its outlet glaciers and whose form is portrayed with contours at 10 m intervals. The geomorphology and geology of the surrounding forefield has been mapped providing information on: moraines; eskers; flutes; meltwater channels; rock glaciers; and fault scarps, and surficial deposits including: alluvium; scree; glacilacustrine and glacifluvial deposits; till; blockfields and bedrock exposure. The map contains an abundance of information that records ice retreat from the Little Ice Age maximum. The motivation for this work, stems from the dual purpose of providing an historical archive of the glacier position and form (at the survey date of 1999) and in recording the landsystem typical of a glaciated upland plateau, which could be used in deciphering landform-sediment assemblages elsewhere in the world. The accompanying paper reports on the methodology of map production, which was by combination of digital aerial photography, GPS survey and fieldwork. Examples of aerial photographs displaying prominent landforms are included.

In the far North West corner of Scotland, Lukas and Lukas use their detailed mapping (from fieldwork and aerial photography) of glacial

geomorphology to reconstruct the extent and form of an upland icefield that existed during the Loch Lomond Stadial (equivalent to the Younger Dryas; ca. 12.7 - 11.5 ka BP). They report doing this by use of the landsystem approach, mentioned above in relation to Iceland. It could be interesting to compare the similarities and differences between the mountain icefields of Iceland and Scotland. The map covers an area of around 23 by 30 km, north of Loch Shin and includes similar landforms to those portrayed on the Iceland map, but also including glacially-transported boulders, boulder limits, trimlines, striae and a number of categories of ice moulded bedrock, and outwash terraces, and solifluction lobes. The authors point out that the area had only been scantily mapped prior to their work and that the new mapping has revealed a more extensive suite of landforms (especially hummocky moraine) than previously known. This has led to the reconstruction of an ice mass some six times larger than previously reported and ca. 211 km^2 in extent.

The contribution of Mitchell and Riley reports on drumlin distribution and patterns in the western Pennines and southern Vale of Eden of northern England, an area of around 650 km^2. The mapping was conducted by detailed fieldwork (onto base maps of 1:10,000 scale), and some 3,000 examples are presented, recorded by their outline at the break of slope, their long axes and summit point. This is an interesting and complex area because the drumlins are not of a simple lowland type merely running along a valley floor but cover both valley and upland areas and with drumlins high on interfluves at elevations up to 667 m. Also there is more than one population of drumlins, with superimposed forms discovered and mapped. In the accompanying paper the field methods are described and the pattern of palaeo ice flow interpreted. The authors reconstruct an ice divide and suggest this shifted through time as recorded by superimposed drumlins. A palaeo ice stream is identified flowing down the Wensleydale valley, and the Stainmore Gap is demonstrated to be a major route through which ice sourced in the west of England was able to breach the Pennine massif and flow eastwards. It is interesting to note that the actual mapping for this work was conducted in the 1970's and 1980's, and whilst the overall results have been reported in academic publications it has taken until now, and critically, the establishment of the Journal of Maps, for the detailed mapping to become published in all its glory.

Stokes, Clark, Lian and Tulaczyk present a map of ribbed moraine superimposed on mega scale glacial lineations within a palaeo ice stream bed in Canada. They use this unusual arrangement to pose a question;

querying whether the superimposition of ribbed moraine is the signature of ice stream shut down by basal freeze-on. The nature of landform evidence for a small portion (20 by 20 km) of the bed of the Dubawnt Lake palaeo ice stream is shown on the map and illustrated with a satellite image and aerial photograph in the paper. The map displays glacial lineations, flutes, ribbed moraine and some abandoned shorelines of palaeo lakes. In addition to the map being available as a PDF file, those wanting to examine or use the mapped data are able to extract the actual mapping (as ESRI Shapefiles) from the PDF for use in their analysis software.

Ribbed moraine are the subject of a paper by Dunlop and Clark, whose wider aim is to map and describe the morphological characteristics of these subglacial landforms in order that models of their genesis can be better tested. The map they present is of the Lac Naococane region in central Québec, Canada, covering an area of 32,400 km^2 and some 12,000 ribbed moraine ridges. Mapping was achieved using satellite images, with each ridge being annotated by a line along its crest rather than by break of slope. The distribution and pattern of ribbed moraine are portrayed on a greyscale (DEM) representation of topography such that the relationship between landform pattern and topography can be visualised. The paper illustrates the ribbed moraine using satellite images, provides morphometric summaries of the scale of mapped features and points out that, contrary to established wisdom, in this area their occurrence is not preferentially related to topographic hollows. This paper also has the mapped data available (as ESRI Shapefiles) for extraction from the PDF.

The glacial geomorphology of the Kola Peninsula of Arctic Russia is reported in a map by Httestrand and Clark. The map, at a scale of 1:900,000, covers around 500 by 600 km and contains over 20,000 mapped landforms recording the activity of the last ice sheet to cover the area. Glacial lineations, end moraines, ribbed and hummocky moraine, eskers, glaciofluvial deposits, raised shorelines and a variety of meltwater channels are depicted and displayed on a greyscale image (DEM) of topography. Mapping was conducted using satellite images with key areas being checked and supplemented using aerial photography and by field work. Motivation for this work was to reconstruct the ice dynamics of the area. Some early findings are reported in the paper, relating to construction of the large and controversial Keiva moraine system, distribution of warm and cold-based ice and the finding of a possible palaeo ice stream.

The contributions in this special issue illustrate the wealth of evidence that exists in the landscape and that can be used to aid understanding of

glaciology and climate change. The examples collected here cover detailed maps of small areas produced by intensive fieldwork and at a scale of 1:10,000, through to a scale of 1:900,000 covering an extremely large area and with information primarily drawn from satellite images. It is clear that whilst fieldwork remains the optimum method for detailed and localised studies, Earth Observation technologies provide a means of acquiring systematic information over large and remote areas.

3. Conclusions

It is evident from recent research and publication activity in the realm of palaeo glaciology that there is a renaissance occurring in mapping and map production. Whilst some countries have maintained a strong mapping tradition (notably those in North America and Scandinavia) there has been a great decline in map output from researchers in the UK, where the focus over the last few decades has been on processes perhaps at the expense of landforms. We note that landforms are very much back on the agenda and expect that the contributions in this special issue will help to fuel this resurgence. We do not rehearse the reasons for producing and publishing maps but let the authors speak for themselves; it is clear from their accounts that they are not merely wishing to record information, but to use the information to solve scientific problems.

We take this opportunity to congratulate the Journal of Maps for its stance on enabling mapped data to be fully published, and hope that this special volume helps it on its way of becoming more firmly established as a mainstream journal. For too long the palaeo glaciology community has been inadequately served by many existing journals which, for reasons of cost or production difficulties, have not been able to let us publish the basic data on which our conclusions are based. As science is meant to be verifiable this was a great weakness. Imagine for example a Quaternary palynology paper in which the authors were not able to provide their tables and pollen diagrams, or a paper on dating chronology in which the details of the individual dates were not provided. With the existence of JoM palaeo glaciologists can now publish their basic data for others to scrutinise, further utilise or reject, and this should help the field greatly.