
Quaternary of Northern England

D. Huddart Liverpool John Moores University, Liverpool, UK

and

N.F. Glasser University of Wales, Aberystwyth, UK

With contributions from

Jim Innes David Evans John Boardman Silvia Gonzalez Richard Chiverrell Wishart Mitchell Andy Plater Sarah Morriss
Cynthia Burek Stephan Harrison Richard Jones Graham Wilson

GCR Editor: G.S.P. Thomas

Published by the Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY, UK

First edition 2002

2002 Joint Nature Conservation Committee

Typeset in 10/12pt Garamond ITC by JNCC

Printed in Great Britain by CLE Print Limited on Huntsman Velvet 100 gsm.

ISBN 1 86107 490 5.

Apart from any fair dealing for the purposes of research or private study, or criticism or review, as permitted under the UK Copyright Designs and Patents Act, 1988, this publication may not be reproduced, stored, or transmitted, in any form or by any means, without the prior permission in writing of the publishers, or in the case of reprographic reproduction only in accordance with the terms of the licences issued by the Copyright Licensing Agency in the UK, or in accordance with the terms and licences issued by the appropriate Reproduction Rights Organization outside the UK. Enquiries concerning reproduction outside the terms stated here should be sent to the GCR Team, JNCC.

The publisher makes no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility or liability for any errors or omissions that may be made.

British Geological Survey Copyright protected materials

1. The copyright of materials derived from the British Geological Survey's work is vested in the Natural Environment Research Council (NERC). No part of these materials (geological maps, charts, plans, diagrams, graphs, cross-sections, figures, sketch maps, tables, photographs) may be reproduced or transmitted in any form or by any means, or stored in a retrieval system of any nature, without the written permission of the copyright holder, in advance.

2. To ensure that copyright infringements do not arise, permission has to be obtained from the copyright owner. In the case of BGS maps this includes both BGS and the Ordnance Survey. Most BGS geological maps make use of Ordnance Survey topography (Crown Copyright), and this is acknowledged on BGS maps. Reproduction of Ordnance Survey materials may be independently permitted by the licences issued by Ordnance Survey to many users. Users who do not have an Ordnance Survey licence to reproduce the topography must make their own arrangements with the Ordnance Survey, Copyright Branch, Romsey Road, Southampton SO9 4DH (Tel. 01703 792913).

3. Permission to reproduce BGS materials must be sought in writing from the Intellectual Property Rights Manager, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG (Tel. 0115 936 3331).

The National Grid is used on diagrams with the permission of the Controller of Her Majesty's Stationery Office, © Crown copyright licence no. GD 27254X/01/00.

A catalogue record for this book is available from the British Library.

Recommended example citations

Huddart, D. and Glasser, N.F. *et al.* (2002) *Quaternary of Northern England*, Geological Conservation Review Series, No. 25, Joint Nature Conservation Committee, Peterborough.

Glasser, N.F.. (2002) Harwood Dale Moor. In *Quaternary of Northern England*, Geological Conservation Review Series, No. 25, Joint Nature Conservation Committee, Peterborough, pp. 81–3.

Contents

Acknowledgements

Access to the countryside

Preface

1 Introduction to the Quaternary of northern England N.F. Glasser

Rationale for selection and conservation of Quaternary sites in northern England

Site selection guidelines

Structure of the volume

2 Late Cainozoic environmental change D. Huddart

Introduction

The definition of the base of the Quaternary Period

Divisions of the Quaternary Period

The oxygen isotope record

Ice cores and loess records

North Atlantic sediments

Sea-level change

The Quaternary record in Britain

3 Pre-Quaternary landscape development D. Huddart

Introduction

Tertiary sediments in northern England

Tertiary cover

Erosional history

Conclusion

4 The pre-Devensian glacial and interglacial record

Introduction D. Huddart

The Lower Quaternary

The Middle Quaternary

The Upper Quaternary

Thornsgill and Mosedale J. Boardman

Warren House Gill D. Huddart

Shippersea Bay D. Huddart

Scandal Beck W Mitchell Speeton D.J.A. Evans

Sewerby W.A. Evans

Kelsey Hill D.J.A. Evans

Harwood Dale Moor N.F. Glasser

5 The Devensian glacial record

Introduction D. Huddart and N.F. Glasser

Chelford N.F. Glasser

Four Ashes N.F. Glasser

Dimlington D.J.A. Evans

Aqualate Mere D. Huddart

Thurstaston NE Glasser, S. Gonzalez and D. Huddart

Sandy Bay D. Huddart

The Bradford Kames D. Huddart

Humbleton Hill and the Trows D. Huddart

Ludworth Intake N.F. Glasser

Newtondale and Hole of Horcum N.F. Glasser

Annaside and Gutterby Banks D. Huddart

St Bees D. Huddart

Holm St Cuthbert D. Huddart

Helvellyn J. Boardman

Roman Wall N.F. Glasser

Norber Erratics D. Huddart

Giggleswick Scar D. Huddart

6 The Late-glacial record of northern England

Introduction J. Innes

Low Wray Bay (Windermere) D. Huddart

Blelham Bog D. Huddart

Blea Tarn, Langdale D. Huddart

Tadcaster J. Innes

Gransmoor W.A. Evans

Kildale Hall J. Innes

Hawes Water R. Jones

Crose Mere N.F. Glasser

7 Periglacial landforms and slope deposits of northern England

Introduction N.E Glasser

Stiperstones N.E Glasser

Blackstone Edge N.F. Glasser

Brimham Rocks N.E Glasser

Burbage Brook N.F. Glasser

Wyns Tor N.F. Glasser

Bridestones N.E Glasser

Great Almscliff Crag N.F. Glasser

Cheviot Tors S. Harrison and N.F. Glasser

Ecton N.F. Glasser and C.V. Burek

Throstle Shaw J. Boardman

Sandbeds Fan J. Boardman

Grasmoor J. Boardman

Skiddaw J. Boardman

Cross Fell W. Mitchell and D. Huddart

Wasdale Screes D. Huddart

8 The Holocene (Flandrian) history and record of northern England

Introduction J Innes

Key for the stratigraphical symbols used in the pollen diagrams

Scaleby Moss D. Huddart

Valley Bog D. Huddart

Upper Teesdale D. Huddart

Neasham Fen D. Huddart

Mere Sands Wood R.C. Chiverrell

Martin Mere R. C. Chiverrell

Red Moss R.C. Chiverrell

Skipsea Bail Mere J Innes

Skipsea Withow J. Innes

The Bog, Roos J. Innes

Willow Garth J. Innes

Star Carr S. Gonzalez and D. Huddart

Old Mere, Hornsea N.F. Glasser

Fen Bogs R.C. Chiverrell

Gormire J. Innes and S. Morriss

Thorpe Bulmer J. Innes

Low Hauxley J. Innes

Featherbed Moss D. Huddart

Leash Fen G. Wilson

Lindow Moss S. Gonzalez and D. Huddart

Wybunbury Moss N.F. Glasser

Malham Tarn Moss D. Huddart

Bolton Fell Moss and Walton Moss D. Huddart

Hartlepool A. Plater

Holy Island A. Plater

Lytham D. Huddart

Downholland Moss D. Huddart

Formby Point S. Gonzalez and D. Huddart

Hightown S. Gonzalez and D. Huddart

Castlethorpe D.J.A. Evans

References

Glossary

Glossary of botanical names

Fossil index

General index

Acknowledgements

Work on this volume was initiated by the Nature Conservancy Council and was taken to completion by the Joint Nature Conservation Committee on behalf of the three conservation agencies, the Countryside Council for Wales (CCW), English Nature, and Scottish Natural Heritage (SNH).

The present authors were invited to prepare the text for this volume by JNCC in 1998. In this work, numerous peer reviewers and colleagues made helpful suggestions about drafts, or gave helpful advice, information or permission to use photographs or diagrams. In particular we thank all contributors to this volume for their site reports as well as Mike Hambrey for permission to use the photograph reproduced on the front cover of this volume.

We also owe grateful thanks to Geoff Thomas (University of Liverpool) who made a tremendous effort in editing and checking the whole text and who gave us invaluable advice throughout the project.

Thanks are also due to the JNCC GCR Publications Editorial and Production Team: Neil Ellis, Publications Manager and Anita Carter, Production Editor. The diagrams were produced by J S Publications of Newmarket by Drs Susanne White and Chris Pamplin.

Where the content of illustrations has been replicated or modified from the work of others appropriate acknowledgements are given in the captions. The National Grid is used on diagrams with the permission of the Controller of Her Majesty's Stationery Office, © Crown copyright licence no. GD 27254X/01/00. Photographs are accredited in the captions.

Neil Glasser acknowledges the advice and support of former colleagues at Liverpool John Moores University, where this work was initiated, as well as existing colleagues in the Institute of Geography and Earth Sciences at the University of Wales, Aberystwyth. He also acknowledges the support provided by Mary, who since the initiation of this volume has found time to give birth to no less than three children and complete a PhD thesis of her own.

David Huddart acknowledges the support, encouragement and advice from colleagues at The University of Reading and Trinity College, University of Dublin in the early years of his academic career, especially Peter Worsley, John Whittow, John Allen, David Drew and Frank Mitchell, who stimulated an early interest in the Quaternary of Northern England, especially in glacial sedimentology and environmental archaeology. Colleagues at Liverpool John Moores University are thanked for their encouragement in this project. The following Quaternary scientists are thanked for their valued collaboration over the years: The Merseyside County Archaeologist, Ron Cowell on the prehistoric trackway at Hightown, Gordon Roberts on the footprints at Formby, Adrian Neal (University of Wolverhampton) on the Quaternary evolution of the Formby area, Michael Tooley (University of Kingston) on sea level changes in Cumbria and South-West Lancashire,

Michael Hambrey and Matthew Bennett on glacial sediments and landforms. He also acknowledges the support of Silvia for not only giving him space and time for the writing of this volume but also for her collaboration on several of the sites.

Access to the countryside

This volume is not intended for use as a field guide. The description or mention of any site should not be taken as an indication that access to a site is open. Most sites described are in private ownership, and their inclusion herein is solely for the purpose of justifying their conservation. Their description or appearance on a map in this work should not be construed as an invitation to visit. Prior consent for visits should always be obtained from the landowner and/or occupier.

Information on conservation matters, including site ownership, relating to Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs) in particular counties or districts may be obtained from the relevant country conservation agency headquarters listed below:

Countryside Council for Wales, Plas Penrhos, Ffordd Penrhos, Bangor, Gwynedd LL57 2LQ.

English Nature, Northminster House, Peterborough PE1 1UA.

Scottish Natural Heritage, 12 Hope Terrace, Edinburgh EH9 2AS.

This rendition of a digital elevation model (DEM) illustrates an extensive suite of drumlins recording former ice flow patterns around the Kendal and Sedbergh area. Classical drumlins are clearest in the mid-west portion of the image (around Kendal) and record ice flowing towards the south-west. In the south-east corner, smaller drumlins, and of more varied morphology, record southwards flow from Cam Fell. In the north-east, drumlins and subglacially-moulded transverse ridges indicate converging flow eastwards leading into the trunk valley of Wensleydale. It is unlikely that these flows were contemporaneous, but rather that they demonstrate snapshots of flow configuration as the ice cover over the region gradually thinned, leading to greater topographic control on flow pattern. Image provided by C.D. Clark (University of Sheffield), and is a simulated solar shading of an Ordnance Survey, 50 m DEM. Illumination is from the north-west, and the east–west dimension of the image is c. 30 km. For further details of methods see Clark (1997) and for drumlin patterns see Mitchell, (1991b).

Preface

There is such a diversity of rocks, minerals, fossils and landforms packed into the piece of the Earth's crust we call 'Britain' that it is difficult not to be impressed by the long, complex history of geological change to which they are testimony. But if we are to improve our understanding of the nature of the geological forces that have shaped our islands, further unravel their history and learn more of the history of life on Earth, we must ensure that the most scientifically important of Britain's geological and geomorphological localities are conserved for future generations to study, research and enjoy. Moreover, as an educational field resource and as training grounds for new generations of geologists and geomorphologists, it is essential that such sites continue to remain available for study. The first step in achieving this goal is to identify the key sites, both at national and local levels.

The GCR, launched in 1977, is a world-first in the systematic selection and documentation of a country's best Earth science sites. No other country has attempted such a comprehensive and systematic review of its Earth science sites on anything near the same scale. After over two decades of site evaluation and documentation, we now have an inventory of over 3000 GCR sites, selected for 100 categories covering the entire range of the geological and geomorphological features of Britain.

This volume, detailing the Quaternary of Northern England GCR sites, is the 25th to be published in the intended 42-volume GCR series. It contains not only descriptions of key localities that will be conserved for their contribution to our understanding of the events during this time, but also excellent summaries of their key morphological, sedimentological and palaeoecological features and the palaeoclimatic significance that can be attached to them. This volume also serves to highlight the scientific research that has been undertaken on these sites. It will be invaluable as an essential reference

book to those engaged in the study of Quaternary science and will provide a stimulus for further investigation. It will also be helpful to teachers and lecturers and for those people who, in one way or another, have a vested interest in the GCR sites: owners, occupiers, planners, those concerned with the practicalities of site conservation and indeed the local people for whom such sites are an environmental asset. The conservation value of the sites is mostly based on a specialist understanding of the stratigraphical, palaeontological and sedimentological features present and is therefore, of a technical nature. The account of each site in this book ends, however, with a brief summary of the geological interest, framed in less technical language, in order to help the non-specialist. The first chapter of the volume, used in conjunction with the glossary, is also aimed at a less specialized audience. This volume is not intended to be a field guide to the sites, nor does it cover the practical problems of their ongoing conservation. Its remit is to put on record the scientific justification for conserving the sites.

This volume deals with the state of knowledge of the sites available at the time of writing, in 1998–2002, and must be seen in this context. Quaternary Science, like any other science, is an ever-developing discipline. As new discoveries are made, existing models and paradigms are subject to continual testing and modification as new data come to light. Increased or hitherto unrecognized significance may emerge in new sites, and it is possible that further sites worthy of conservation will be identified in future years. Indeed, during the writing of this volume, a small number of sites were identified by the authors as potential GCR sites that should be considered for conservation in order to more fully represent the Quaternary history of northern England. These sites are described in this volume and are being investigated for formal addition to the GCR.

There is still much to learn about Quaternary environmental change and the sites described in this volume are as important today as they have ever been in increasing our knowledge and understanding of this, the most recent of the geological time periods. This account clearly demonstrates the value of these sites for research, and their important place in Britain's scientific and natural heritage. This, after all, is the *raison d'être* of the GCR Series of publications.

N.V. Ellis GCR Publications Manager May 2002

[References](#)