Glacier science and environmental change

Edited by

Peter G. Knight
Contents

List of contributors xi

1 Glacier science and environmental change: introduction
   Peter G. Knight 1

Part 1  Glaciers and their coupling with hydraulic and sedimentary processes 2

2 Keynote introduction: Glaciers and their coupling with hydraulic and sedimentary processes
   Geoffrey S. Boulton 3

3 Haut Glacier d’Arolla, Switzerland: hydrological controls on basal sediment evacuation and glacial erosion
   Darrel A. Swift 23

4 A glimpse at meltwater effects associated with continental ice sheets
   John Shaw 25

5 The erosional origin of hummocky terrain, Alberta, Canada
   Mandy J. Munro-Stasiuk and Darren Sjogren 33

6 Tunnel channel character and evolution in central southern Ontario
   Tracy A. Brennand, Hazen A. J. Russell and David R. Sharpe 37

7 Glacial bedforms and the role of subglacial meltwater: Annandale, southern Scotland
   Tom Bradwell 39

8 Subglacial megafloods: outrageous hypothesis or just outrageous?
   Douglas I. Benn and David J. A. Evans 42

   Reply to Benn and Evans
   John Shaw and Mandy Munro-Stasiuk 46

9 Groundwater under ice sheets and glaciers
   Jan A. Piotrowski 50

10 Groundwater flow under the margin of the last Scandinavian ice sheet around the Eckernförde Bay, northwest Germany
   Silke Marczinek and Jan A. Piotrowski 60

11 Simulation of groundwater flow and subglacial hydrology, Late Pleistocene Lake Michigan Lobe, Laurentide Ice Sheet
   Chris Breemer 63

12 Modelling impact of glacier–permafrost interaction on subglacial water flow
   Paul M. Cutler 67

13 Pleistocene hydrogeology of the Atlantic continental shelf, New England
   Mark Person 68
14 Glacial chemical weathering, runoff composition and solute fluxes
   Martyn Tranter 71

15 Solute enhancement in the proglacial zone
   J. L. Wadham 75

16 Impact of mineral surface area on solute fluxes at Bench Glacier, Alaska
   Suzanne Prestrud Anderson 79

17 Phosphorus in glacial meltwaters
   Andy Hodson 81

18 Glacial landsystems
   David J. A. Evans 83

19 The subpolar glacier landsystem of the Canadian High Arctic
   Colm Ó Cofaigh 89

20 Plateau icefield landsystem
   Brice R. Rea 91

Part 2  Glaciers, oceans, atmosphere and climate 95

21 Keynote introduction: Glaciers, oceans, atmosphere and climate
   John T. Andrews 96

22 A multidisciplined approach to the reconstruction of the Late Weichselian deglaciation of Iceland
   Alun Hubbard 114

23 The cryosphere and climate change: perspectives on the Arctic's shrinking sea-ice cover
   Mark C. Serreze and Ignatius Rigor 120

24 The interaction of glaciers and oceans in the context of changing climate
   Gerard Bond 126

25 Northern Hemisphere glaciers responding to climate warming by increasing their sensitivity and their contribution
   to sea-level rise
   Mark Dyurgerov 133

26 Influence of ice streaming on the ocean–climate system: examining the impact of the M'Clintock Channel Ice Stream,
   Canadian Arctic Archipelago
   Chris R. Stokes and Chris D. Clark 135

27 Influence of ocean warming on glaciers and ice streams
   Eric Rignot 136

28 Glacial runoff from North America and its possible impact on oceans and climate
   C. F. Michael Lewis and James T. Teller 138

29 Impacts of climatic trends upon groundwater resources, aquifer–stream interactions and aquatic habitat in glacierized
   watersheds, Yukon Territory, Canada
   Sean W. Fleming 151

30 Ice sheets and marine sedimentation on high-latitude continental margins
   Julian A. Dowdeswell 153

31 Seismic geomorphology and Pleistocene ice limits off northwest Britain
   Martin S. Stoker, David Long, Joseph Bulat and Stephen Davison 160

32 Modelling glacier response to climate change
   Shawn J. Marshall 163

33 Energy and mass fluxes over dry snow surfaces
   Richard Bintanja 174

34 Energy fluxes over Morteratschgletscher
   Lisette Klok 176
### Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>The environmental significance of deuterium excess in meteoric and non-meteoric Antarctic ice</td>
<td>R. Souchez and R. Lorrain</td>
</tr>
<tr>
<td>36</td>
<td>Deuterium excess in Antarctica: a review</td>
<td>G. Hoffmann and F. Vimeux</td>
</tr>
<tr>
<td></td>
<td><strong>Part 3  Changing glaciers and their role in earth surface evolution</strong></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Keynote introduction: Changing glaciers and their role in earth surface evolution</td>
<td>David Sugden</td>
</tr>
<tr>
<td>38</td>
<td>Reconstruction of paleo-ice sheets—reconstruction of their glacial geomorphological record</td>
<td>Johan Kleman, Clas Hättestrand, Arjen P. Stroeven, Krister N. Jansson, Hernán De Angelis and Ingmar Borgström</td>
</tr>
<tr>
<td>39</td>
<td>Reconstructing the pattern and style of deglaciation of Kola Peninsula, northeastern Fennoscandian Ice Sheet</td>
<td>Clas Hättestrand and Chris D. Clark</td>
</tr>
<tr>
<td>40</td>
<td>The Laurentide Ice Sheet: a review of history and processes</td>
<td>John T. Andrews</td>
</tr>
<tr>
<td>41</td>
<td>What can the ‘footprint’ of a palaeo-ice stream tell us? Interpreting the bed of the Dubawnt Lake Ice Stream, Northern Keewatin, Canada</td>
<td>Chris R. Stokes and Chris D. Clark</td>
</tr>
<tr>
<td>42</td>
<td>The Antarctic Ice Sheet</td>
<td>David G. Vaughan</td>
</tr>
<tr>
<td>43</td>
<td>Antarctic Ice Sheet reconstruction using cosmic-ray-produced nuclides</td>
<td>Greg Balco, Seth Cowdery, Claire Todd and John O. H. Stone</td>
</tr>
<tr>
<td>44</td>
<td>Current status and recent changes of the Greenland Ice Sheet</td>
<td>Niels Reeh</td>
</tr>
<tr>
<td>45</td>
<td>The impact of ice-sheet fluctuations and isostasy on sea-level change around Greenland</td>
<td>Kevin Fleming</td>
</tr>
<tr>
<td>46</td>
<td>The response of glaciers in South America to environmental change</td>
<td>Renji Naruse</td>
</tr>
<tr>
<td>47</td>
<td>Glacier mass-balance data for southern South America (30°S–56°S)</td>
<td>G. Casassa, A. Rivera and M. Schwikowski</td>
</tr>
<tr>
<td>48</td>
<td>Quantifying the significance of recent glacier recession in the Cordillera Blanca, Perú: a case study of hydrological impact and climatic control</td>
<td>Bryan G. Mark</td>
</tr>
<tr>
<td>49</td>
<td>Glacier variations in central Chile (32°S–41°S)</td>
<td>A. Rivera, C. Acuña and G. Casassa</td>
</tr>
<tr>
<td>50</td>
<td>Palaeoglaciology of the last British–Irish ice sheet: challenges and some recent developments</td>
<td>Chris D. Clark, Sarah L. Greenwood and David J. A. Evans</td>
</tr>
<tr>
<td>51</td>
<td>A regional glacial readvance in Ireland: self-promulgating theory, or science-based reality?</td>
<td>Robert T. Meehan</td>
</tr>
<tr>
<td>52</td>
<td>Average glacial conditions and the landscape of Snowdonia</td>
<td>Danny McCarroll</td>
</tr>
<tr>
<td>53</td>
<td>Mountain glaciers</td>
<td>Georg Kaser</td>
</tr>
<tr>
<td>54</td>
<td>The Little Ice Age glacial record at Franz Josef Glacier, New Zealand</td>
<td>Krista M. McKinzy</td>
</tr>
<tr>
<td>55</td>
<td>Changing glaciers in High Asia</td>
<td>Yao Tandong, Pu Jianchen and Liu Shiying</td>
</tr>
</tbody>
</table>
**Part 4  Glacier composition, mechanics and dynamics**

56  Keynote introduction: Glacier composition, mechanics and dynamics  
   T. H. Jacka  
57  Manifestations of ice microphysical processes at the scale of whole ice sheets  
   K. M. Cuffey  
58  Ice flow at low deviatoric stress: Siple Dome, West Antarctica  
   Erin C. Pettit  
59  Physical deformation modes of ice in glaciers and ice sheets  
   Paul Duval and Maurine Montagnat  
60  Superplastic flow of ice relevant to glacier and ice-sheet mechanics  
   David L. Goldsby  
61  Anisotropy and flow of ice  
   Throstur Thorsteinsson  
62  Ductile crevassing  
   Antoine Prolong  
63  Environmental conditions, ice facies and glacier behaviour  
   Wendy Lawson  
64  The behaviour of glaciers on frozen beds: modern and Pleistocene examples  
   Richard I. Waller and Julian B. Murton  
65  Mechanical behaviour and structure of the debris-rich basal ice layer  
   Sean Fitzsimons  
66  High-resolution time series of basal motion at an Arctic glacier margin  
   David Chandler  
67  On the relationships between field data and numerical models of ice-mass motion  
   Bryn Hubbard  
68  Measurements and modelling of diurnal flow variations in a temperate valley glacier  
   Shin Sugiyama  
69  Using field data to constrain ice-flow models: a study of a small alpine glacier  
   Alun Hubbard  
70  Fast glacier flow and ice streaming  
   Slawek Tulaczyk  
71  Regional basal-thermal budget: implications for ice streaming along the Siple Coast, West Antarctica  
   Byron R. Parizek

**Part 5  The practice of glaciology**

72  Keynote introduction: The practice of glaciology  
   Richard B. Alley and Sridhar Anandakrishnan  
73  Remote sensing in glaciology  
   Jonathan Bamber  
74  Interferometric synthetic aperture radar (InSAR) study of the northeast Greenland Ice Stream  
   Ian Joughin  
75  An overview of subglacial bedforms in Ireland, mapped from digital elevation data  
   Mike J. Smith, Paul Dunlop and Chris D. Clark  
76  Borehole-based subglacial instrumentation  
   Urs H. Fischer and Bryn P. Hubbard  
77  Instrumenting thick, active, clast-rich till  
   W. D. Harrison and M. Truffer
78 Ice-core chronology
Claus U. Hammer

79 The 420,000-yr climate record from the Vostok ice core
Jean Robert Petit

80 Numerical modelling of polar ice sheets through time
Philippe Huybrechts

81 Ice-flow models
Anthony J. Payne and Andreas Vieli

82 Estimating basal properties of glaciers from surface measurements
G. Hilmar Gudmundsson

83 Measuring and modelling the mass balance of glaciers for global change
Roger J. Braithwaite

84 Integrated perception of glacier changes: a challenge of historical dimensions
Wilfried Haeberli

85 The Global Land-ice Measurements from Space (GLIMS) project
A. Kääb

86 Historical glacier fluctuations
Frank Paul and Max Maisch

87 Interpreting glacial sediments
Doug Benn

88 Moraine sediment characteristics as indicators of former basal ice layers
William George Adam

89 Using cosmogenic isotopes to interpret the landscape record of glaciation: nunataks in Newfoundland?
J. C. Gosse, T. Bell, J. T. Gray, J. Klein, G. Yang and R. Finkel

90 Characteristic cosmogenic nuclide concentrations in relict surfaces of formerly glaciated regions
Arjen P. Stroeven, Jon Harbor, Derek Fabel, Johan Kleman, Clas Hätteland, David Elmore and David Fink

91 Laboratory experiments in glaciology
Neal R. Iverson

92 Laboratory observations of ice formation and debris entrainment by freezing turbid supercooled water
Peter G. Knight and Debbie Knight

References

Index

Colour plate section falls between pp. 274 and 275.