Hydrometeorology and lacustrine sedimentary processes at Bear Lake, Devon Island, Nunavut

by

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A thesis submitted to the Department of Geography
in conformity with the requirements for
the degree of Master of Science

Queen's University
Kingston, Ontario, Canada
October, 2000

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Abstract

A lacustrine process study was undertaken at Bear Lake (75° 28’ N, 85° 13’ W), Devon Island, Nunavut from May 22 to August 19, 1999. Air temperature, precipitation, water temperature, mass accumulation rates (MARs), discharge and bottom currents were monitored in an attempt to spatially and temporally characterize lacustrine processes and the sedimentary response to environmental forcings.

Air temperature datasets reveal that the Bear Lake record is statistically significantly related to records from Resolute and Eureka. Bear Lake is warmer than both these stations, though it is likely that Bear Lake thermistors were improperly shielded from solar radiation, artificially elevating temperatures.

Precipitation at Bear Lake was dominated by an extreme storm event on June 29, when 50.8 mm of rain fell in 18 hours. The lacustrine effects of the precipitation on June 29 were magnified by its timing (early melt season). Runoff was derived from precipitation, but also had a strong snowmelt component. Turbidity currents were generated in front of all of the tributaries of Bear Lake, producing extremely high MARs in near-bottom sediment traps.

A deposit of sandy niveo-aeolian material quickly melted through the lake ice. MARs under the deposit generally decreased with depth; gradually becoming less concentrated as it spread out in deeper water. On short time scales, lacustrine deposits of aeolian material are of little paleoenvironmental use at Bear Lake, since the location of deposits changes interannually, and
their position is not predictable. However, they are potentially valuable indicators of changes over longer periods when considered in aggregate.

Turbidity currents were monitored in the late melt season at a sandur-proximal site. Underflow velocities were mostly low, but from July 23-25, high velocities (up to 21 cm/s) were associated with a large discharge event. At the same location, small near-bottom temperature anomalies were associated with diurnal discharge peaks. These are the first turbidity currents ever recorded in a High Arctic lake.

This project serves to improve the understanding of sedimentary processes in High Arctic glacial lakes, and to more confidently interpret the paleoenvironmental record. It is part of a larger research project at Bear Lake, which includes the analysis of sediment cores and a sub-bottom acoustic survey.
Acknowledgements

Dr. Robert Gilbert and Dr. Scott Lamoureux continuously provided thoughtful ideas, advice and support related to this project. Their love of lakes and the Arctic environment was infectious, and was always evident.

This research was possible thanks to the absolute efficiency and competence of the pilots, managers, labourers, and cooks of the Polar Continental Shelf Project, who make travels to Resolute and environs a joy.

Thanks to the Arctic Institute of North America Grant-in-Aid program, the Northern Scientific Training Program, and the Natural Sciences and Engineering Research Council of Canada, who provided financial support to this project. The staff and students at INSTAAR, in conjunction with the National Science Foundation, provided a superb forum for feedback and inspiration during the 30th Arctic Workshop.

Heather Nicholson unfailingly put up with three months of oatmeal and textured vegetable protein, not to mention a grumpy researcher with a terrible singing voice. Her help, advice and ideas ensured the work got done. Also, the help of Nicole Auty and Jackie Cockburn was invaluable.

Thanks to the grad students of geography and PEARL, whose scholarly enthusiasm is contagious, and who made Saturday morning hockey a cherished event. The editing skills of Chloë Stuart, Rich Butler and David Mazzucchi are particularly appreciated. Thanks also to Brandon Beierle, whose computing skills meant this thesis was not written on a ten-year-old
computer (the new one knows that there are two hyphens in “ten-year-old”, so I don’t have to).

Dave Tryon and Lloyd Rhymer from the Queen’s University Department of Civil Engineering were extremely helpful in allowing the use of their flume and current meter. Also from Civil Engineering, Dr. Ana da Silva provided advice on the various forms of the Chezy equation.

Guidance and elbow grease during the construction of sediment traps was greatly appreciated from Mark Publicover.

Finally, the support of my family is treasured. Their continuous encouragement and love were subtly expressed, but strongly felt. They also gave up their house to troops of Arctic researchers on numerous occasions. Thanks for not asking too many times “what kind of job can you get as a limnologist”? 
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<td>A</td>
<td>Submerged area of the outlet</td>
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<td>ASL</td>
<td>Above sea level</td>
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<td>C</td>
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<td>d2</td>
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<td>DIIC</td>
<td>Devon Island Ice Cap</td>
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<td>Fm.</td>
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<td>ka</td>
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<td>LGM</td>
<td>Last Glacial Maximum</td>
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<td>LOI</td>
<td>Loss on ignition</td>
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<td>Ls</td>
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<td>MAR</td>
<td>Mass accumulation rate</td>
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<td>MSC</td>
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