MODERN SEDIMENTATION OF MENDENHALL LAKE, JUNEAU, ALASKA, USA

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INTRODUCTION

This investigation focuses upon examining the relative roles of sevral controls on sedimentation in Mendenhall Lake, near Juneau, Alaska. Here, I report the results of my examination of the sedimentology of material shed into the lake from both the Mendenhall Glacier and inflowing tributaries. By calculating settling velocities for the material sampled from the lake bottom, it is possible to better understand the processes of deposition and sedimentation at work in the Mendenhall Glacial system.

Sedimentation in an ice-contact lake is complex, and in order to determine the patterns of sedimentation, all factors which that might sedimentation must be taken into account.

The dominant control on sediment distribution is proximity to the ice-front. However, other factors can be nearly as influential. For instance, continuously incoming subglacial water usually disturbs the thermal stratification caused by surface heating that is typical of non-glacial lakes (Ashley, 1985). Settling velocities are controlled by a number of variables including grain-size, shape, and density, which strongly influence depositional patterns in a lacustrine environment. Katabatic winds can create strong surface waves and disruption of thermal stratification, contributing to reworking along the shorelines and influencing the deposition of suspended sediment in the direction of prevailing wind patterns (Drewry, 1986). The position and size of tributaries into the lake must be taken into consideration because they may cause disruptions in current direction and sediment concentration. The location(s) of the medial moraine and subglacial channels influence deposition of material in subaqueous fans, which in turn affects patterns of sediment distribution by tending to deposit large quantities of coarse material directly at the ice-front in a fan-shaped landform (Menzies, 1995). In addition, the density difference between the incoming subglacial water and the lake water causes turbulence and hinders mixing; as a result, a typical thermocline might not develop. Differences in density also may produce underflows, interflows, and overflows, which greatly affect the settling out of suspended sediment (Menzies, 1995). The bathymetry of a pro-glacial lake, shaped in part by basins and moraines, can affect deposition of sediment through over-deepening and uneven sedimentation (Benn and Evans, 1998).

METHODS

Field Methods:

In order to determine patterns of sediment distribution in Mendenhall Lake, sediments from the lake bottom were collected using a grab sampler at strategic locations. A Global Positioning Systems (GPS) receiver was used to locate sample stations. GPS also was used to map the modern ice-front and lake shoreline. At varying depths throught out the water column at each station, water samples were collected to determine the concentration of suspended sediment. Temperature and salinity also were measured (using a YSI meter) at each sample collection point. Samples of the underlying bedrock and transported glacial debris were collected for the purpose of comparing the mineralogy of lake bottom and suspended sediment samples to that of the source material. Portions of the shoreline were traversed, and physical geologic features that might influence glaciolacustrine processes occurring were noted.

Laboratory Methods:

Lake-bottom sediment samples were analyzed with a Laser Particle Analyser for grain size. The statistical parameters of interest are the percentages of sand, silt, and clay, mean and modal grain sizes, and standard deviation of the grain size distribution. Both bottom and suspended sediment samples were analyzed with a Phillips 1710 X-Ray Diffraction Unit (XRD) in order to determine sediment mineralogy. Sample mineralogy, in turn, was used to estimate particle density. The samples were sieved to grains smaller than 2 mm, crushed with a mortar and pestle, and mounted on a glass slide. The XRD also was used to determine the mineralogy of the bedrock samples. GPS locations and corresponding data were

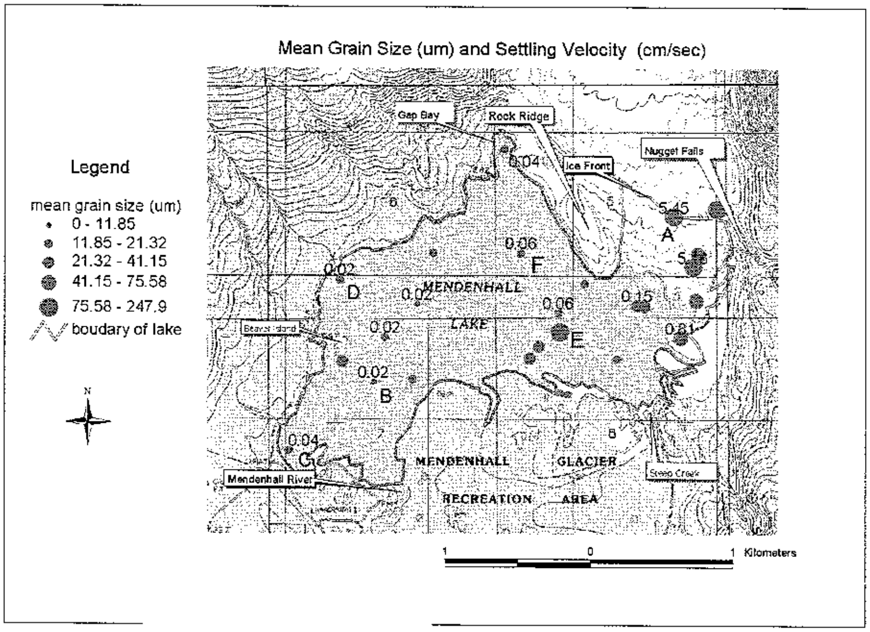

Figure 1: Mean grain size and settling velocity

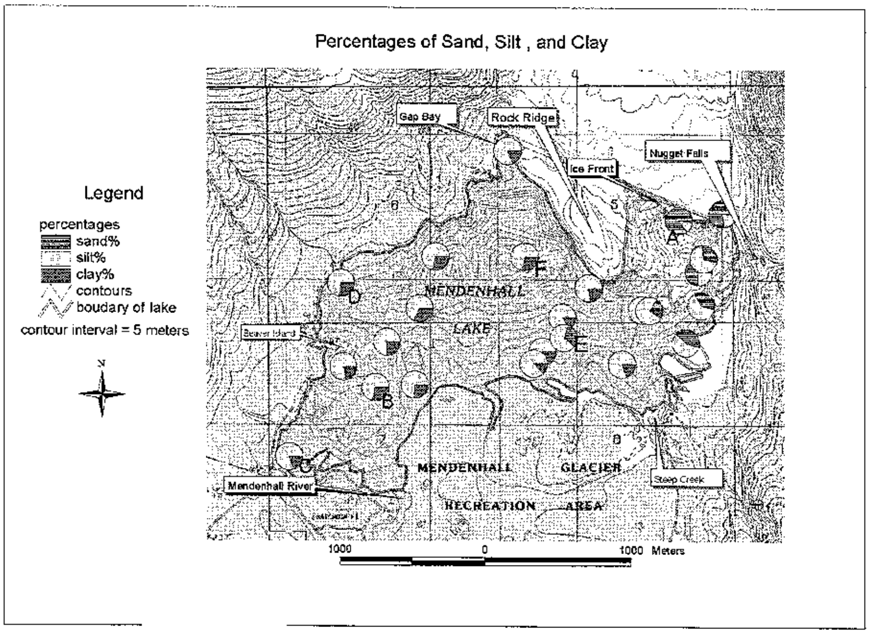

Figure 2: Percentages of sand, silt, and clay

RESULTS AND DISCUSSIONS

Settling velocity is affected by a number of variables. Stokes' Law generalizes a relationship for settling velocities. However, the law assumes that the settling particles are spherical grains. Wadell's sedimentation formula attempts to take non-spherical grains into account. Using Wadell's formula, the settling velocities ranged from 5.45 to 0.02 cm/sec for various localities throughout the lake (see figure 1). Average values were used for the density of water and the viscosity of water because, as calculated in