Glacial Geology
Lakes

Physical Limnology

Density stratification

water density f(temp, salinity, suspended sediment load)

Mixing

annual solar heating from on top, freeze in winter
Plus water most dense at 4° C (Fig 4-1),
during course of year top goes from being least dense (summer) to most dense (winter)
so overturning (Fig. 4-3)

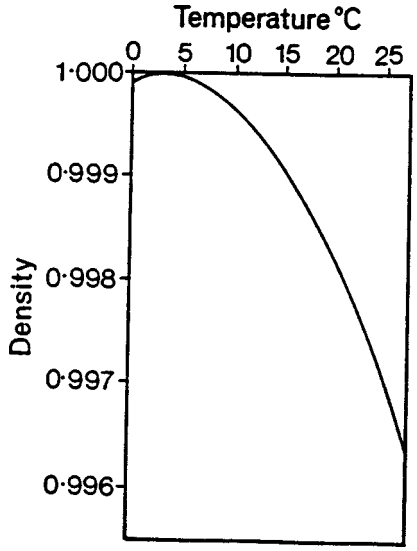


Fig 4-1 Relationship between density and temperature for pure water. After Ashley and others, 1985.

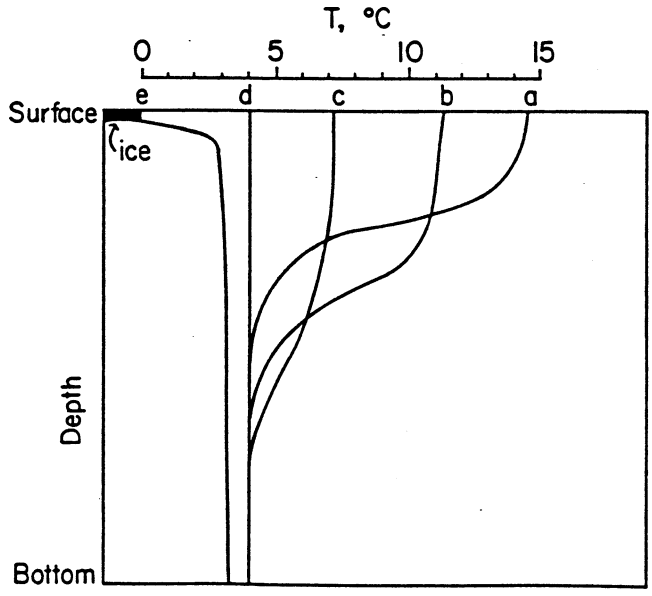


Fig. 4-3 Evolution of thermal structure in a hypothetical deep, temperate-region lake between mid summer a) and winter e). General circulation or "overturning", occurs in autumn and spring d). After Ashley and others, 1985.

Sediment Distribution

Point of entry

braided meltwater streams with large sediment loads (Fig 11.9, 4-29)
delta - coarse material drops out -source of some slumps

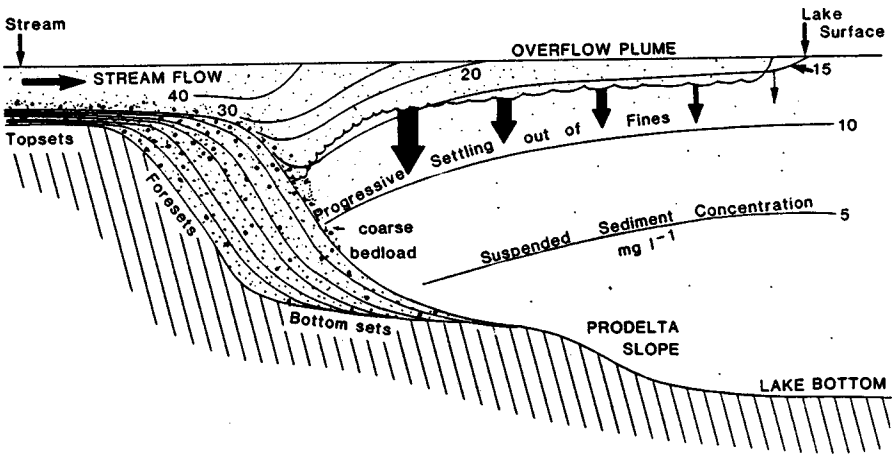


Fig 11-9 Typical sequences of sedimentation in glacial lakes. Note the gradation from glaci-fluvial deposits through deltaic units to the prodelta area and thence into deeper lake bottom sediments. There is usually a progressive decrease in grain size from the stream to center of the lake interrupted only by slumping on the delta slope.

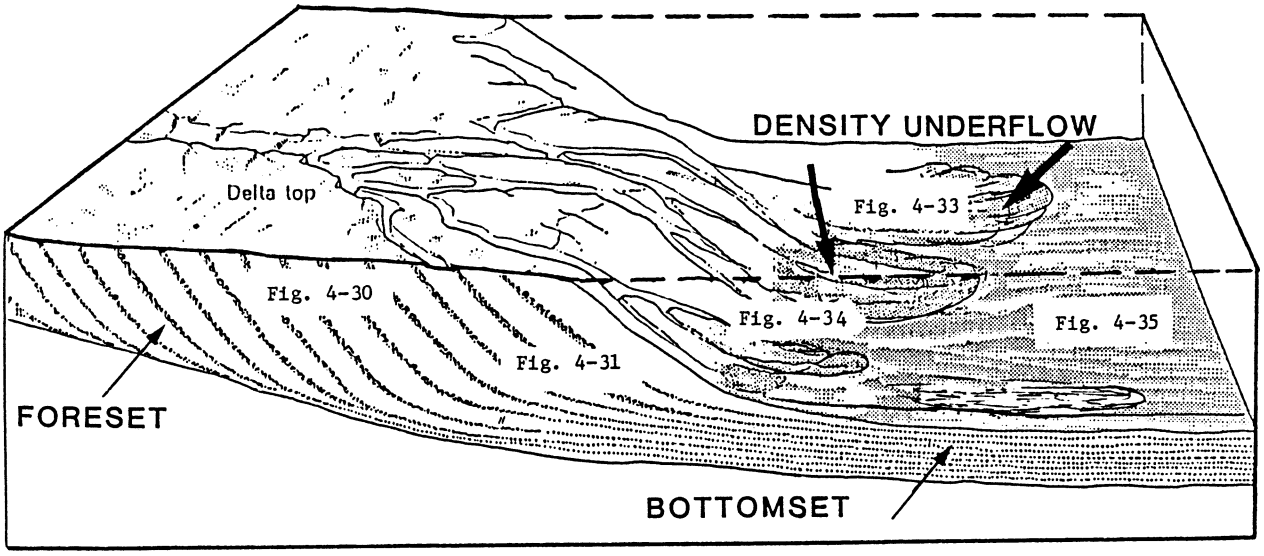


Fig. 4-29 Glacial lake delta. The location of Figures in Ashley and others (1985) indicated.

Overflow

density of water/sediment mix < lake density (fig. 4-7)
carries sediment over any bottom topography, wind impact
layers coat entire basin (fig 4-25A)

Interflow

density of water/sediment mix = lake density (fig. 4-7)
carries sediment over most bottom topography
layers coat entire basin (fig 4-25A)

Underflow

density of water/sediment mix > lake density (fig. 4-7)
carries sediment down controlled by bottom topography
sediment focuses into deep basins (Fig. 4-25B)
Gradation from source (grain flows) to away (suspension) (fig. 4-36)
study this figure carefully

Homopycnal

density all the same - equal dispersion in water
adds sediment to all locations, most near source

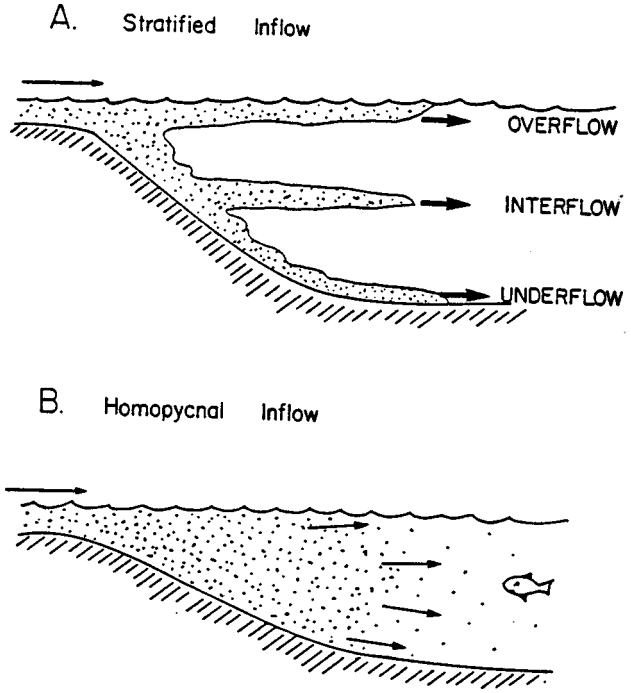


Fig. 4-7 Sketches illustrating principal types of inflow mixing patterns in glacier-fed lakes. Stippled pattern represents turbid inflowing river water whose density is different from all or part of the basin water in stratified inflow patterns A) but equal to the lake water in homopycnal inflow B). After Ashley and others, 1985.

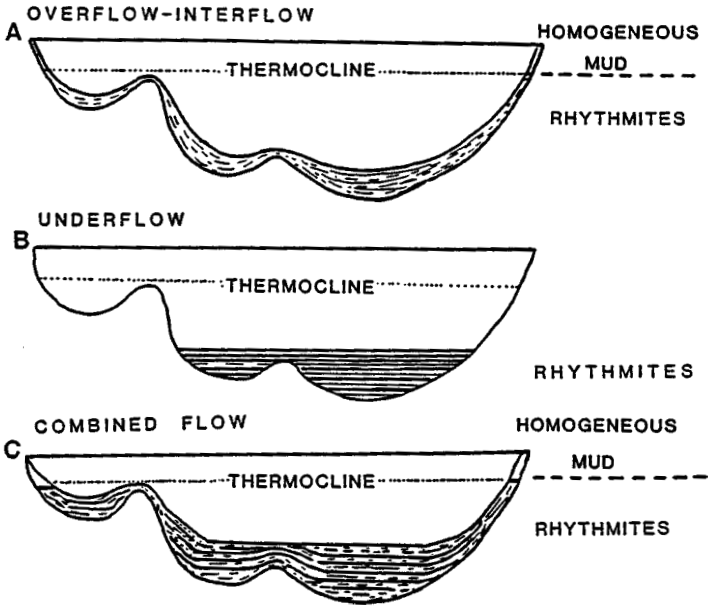


Fig. 4-25 Sediment disperal in narrow glacier-fed lakes dominated by overglow-interflow. A) Dispersal mechanisms and proximal-distal trend in deposit thickness. B) Sketch map depicting the areal distribution of sediments from one-melt season. After Ashley and others, 1985.

Classification

Varves vs. rhythmites

cycle deposition vs. annual
entire lake basin vs. local to source

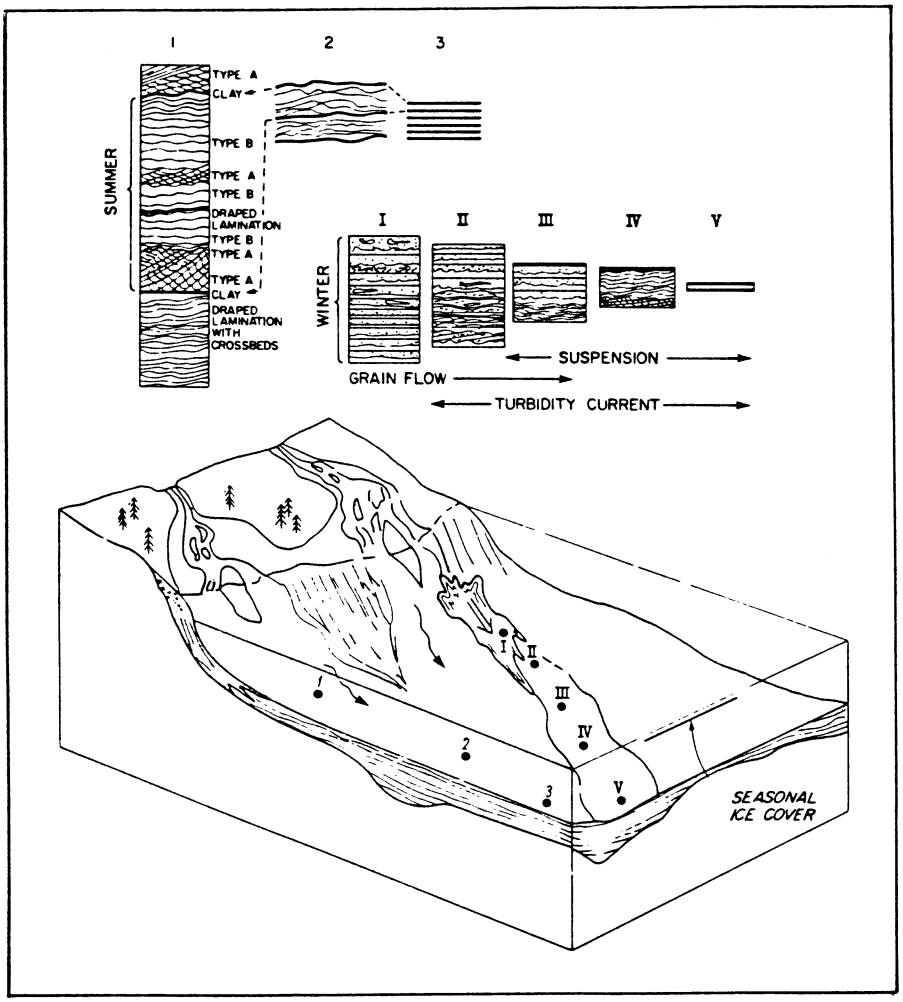


Fig. 4-36 Rhythmites in a glacier-fed lake. 1 to 3 show lateral facies variation (After Ashley 1975). I to V show sand lithofacies within a winter clay layer that result from slumping (after Shaw 1977).

Ice-Contact

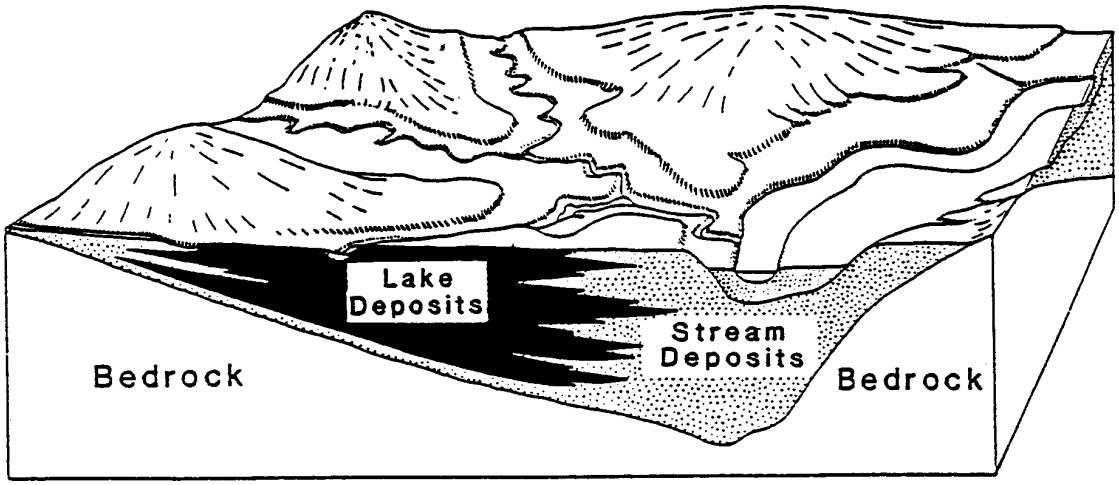
debris flows from large debris along ice front
turbidites
ice-rafted debris

Pro-glacial

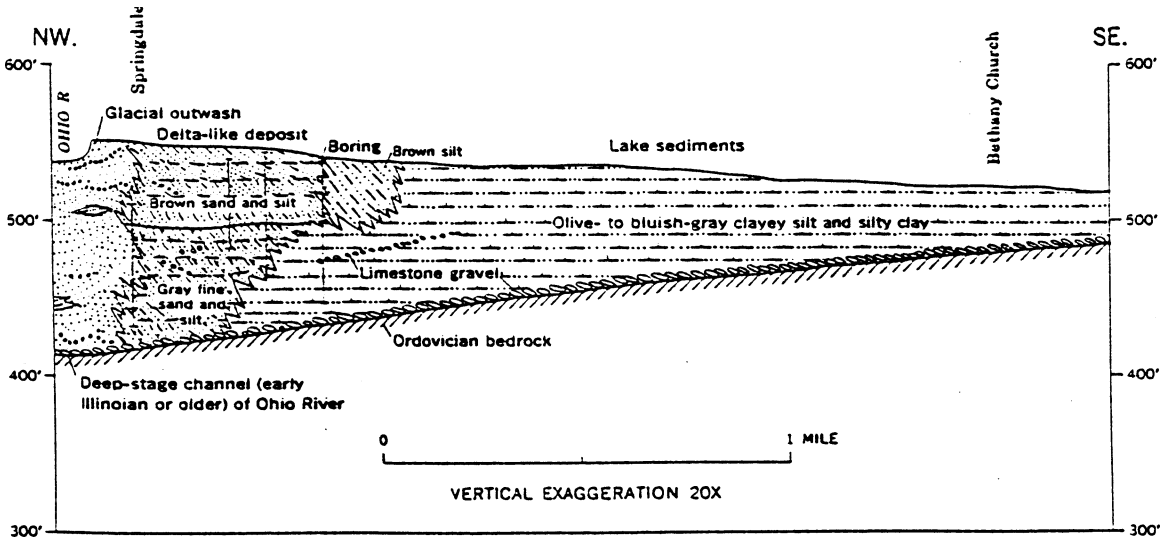
second or further lake in sequence
coarse removed
lots of fines more likely similar throughout

Outwash dammed

Coarse toward main valley - finer away
multiple generations
subsequent stream downcutting



Block diagram showing relationship of lake deposits to valley train (stream) depsosits. Width of block about 10 mi, depth about 200 ft.



Cross section showing facies change from coarse outwash to fine lake sediments.