Fine-Grained Hyperpycnites and Coarser Grained Turbidites. A detailed Sedimentary Record of Glacial Retreat and Catastrophic Floods as Preserved in Pleistocene Pro-glacial Lake Sediments

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A well preserved record of Pleistocene glacial rhythmites and flood deposits from Flathead Lake, Montana, USA, form the basis for describing and interpreting the stratigraphic architecture, run-out distances, and hydrodynamic changes of fine-grained hyperpycnites and turbidites in a large lacustrine setting.

Our data set comprises a set of 19 Piston cores from Flathead Lake that cover an area of approximately 200 km^2 of the lakes 496 km^2 total area. The longest Pleistocene record is up to 9 m long and mainly composed of cm-scale rhythmites of silt and clay with a twofold grain size profile consisting of a thin basal upward coarsening portion and a thicker, upward fining upper part. We interpret the glacial rhythmites to be hyperpycnites, the deposits of hyperpycnal flows. The inversely-graded basal part of each rhythmite was deposited during the rising limb of the seasonal hydrograph in response to meltwater runoff. The normally-graded upper part of each rhythmite was deposited during the falling limb and seasonal minimum of the hydrograph following peak runoff. Thickness and grain size trends as well as sedimentary structures in the rhythmites reflect the spatial position (proximal/distal) to the glacial margin during overall glacial retreat.

Immediately overlying the Late Pleistocene rhythmite section is a unique, significantly coarser-grained dm-scale silt bed with a median grain size up to 50 µm. In contrast to the rhythmites, this silt bed has a sharp, locally erosional base and fines upward, lacking a coarsening upward lower portion. We interpret the coarse grained silt bed as a “classic” turbidite deposit representing a single, short lived catastrophic sedimentation event generated by a large glacial outburst flood. This event bed is present in cores from across the entire lake basin, suggesting a maximum run out distance of several 10s of kilometer along a lake floor, making it a potential analog for fine-grained turbidite deposition in ancient lacustrine basins or other intracratonic basins. Sedimentary structures in this fine-grained turbidite are mainly absent, but sharp erosional contacts are evidence for mainly bedload dominated sediment transport even in the most distal locations. Thickness and grain-size profiles are almost uniform from proximal to distal positions, suggesting similarly uniform rock properties over a large area for analogous deposits preserved in the rock record.