THE HOLOCENE RECORD OF HILLSLOPE EROSION IN VERMONT: FIVE YEARS OF CHASING PALEO-STORMS AND THE EFFECTS OF CLEAR CUTTING

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For the past five years, my students and I have been trenching alluvial fans and coring frozen ponds to learn more about the post-glacial behavior of hillslopes in the mountainous terrain of New England. From these deposits, we infer the timing and magnitude of historic and pre-historic (Holocene) hillslope erosion.

Six well-dated, overlapping gyttja-rich sediment cores from the center and sides of Ritterbush Pond in the Green Mountains include 52 layers of sand and silt. On the basis of texture and stable carbon isotopic measurements, we interpret these inorganic layers as terrestrially-derived, episodic sedimentation events triggered by hillslope erosion in the steeply sloping, 2.2 km^2 watershed. The thickness of these layers suggests hydrologic events at least equal in size to, and probably much larger than, any storm or flood recorded during nearly 300 years of written regional history.

Layer thickness and frequency, and by inference storm size and recurrence, change through the Holocene. The largest events occurred 2620, 6840, and 9440 calibrated ^{14}C years before present (cal ^{14}C yBP). The most frequent hydrologic events occurred in three periods: 1750 to 2620, 6330 to 6840, and >8600 cal ^{14}C yBP. The recurrence interval of layer deposition during stormy periods averages 130±100 years, whereas the recurrence interval during less stormy periods is longer, 270±170 years. The Ritterbush Pond event record illustrates the potential of inorganic lacustrine sediment to serve as detailed proxy record for estimating paleoflood frequency and deciphering climate change.

Trenching of five small (<2500 m^2) alluvial fans demonstrates that these landforms preserve a detailed and datable record of deposition from which we have estimated aggradation rates and inferred changes in hillslope denudation over the past 8,000 ^{14}C years. In every fan, a well-preserved paleosol is buried by 0.5 to 4 m of historic sediment indicating that colonial land clearance and agricultural practices increased hillslope erosion by up to an order of magnitude over background rates; such a dramatic increase in sedimentation during historic time is not present in the Ritterbush Pond sediment cores.

Within the resolution of our 24 AMS ^{14}C ages, periods of increased inorganic sediment deposition in the pond are coincident with periods of sediment deposition on the alluvial fans. Both archives appear to reflect climatic forcing of hillslope erosion during both the early (>6000 ^{14}C y BP) and late (<2500 ^{14}C y BP) Holocene. The middle Holocene appears to be a time of greater hillslope stability and lower sediment yield with less terrestrial sediment delivered to the pond and reduced rates of fan sedimentation.