Distribution and stratigraphy of fly ash deposits in the Emory and Clinch Rivers

Keith C. Seramur, Roy C. Sidle, Ellen A. Cowan and Aaron H. Pruitt
Geology Department, Appalachian State University, Boone, NC, 28608

Abstract

Fly ash from the December 2008 release filled the Emory River channel at the source area and deposited a bed of ash on the submerged river terrace to the east. A coring program was conducted to assess the distribution and characterize the stratigraphy of ash deposits in the Emory and Clinch Rivers. Box cores and Eckman dredge samples of surficial bottom sediment show that thin lenses of ash occur in isolated deposition settings throughout the study area.

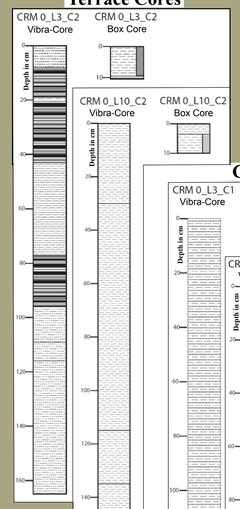
A cohesive organic mat caps the bed of ash extending across the submerged terrace east of the source area. Channel deposits upstream of the release at Emory River mile (ERM) 3.5 consist of a bed of laminated ash overlain by graded traction deposits and capped with a layer of pebble-sized pieces of coal. Total ash thickness at this location is about 30 cm and our cores terminated in a bed of loamy sand with coal and organics. These deposits likely represent the upstream extent of the channel fill from the release.

Channel deposits of ash extend downstream to the Clinch River with characteristics that change with distance from the source area. Immediately downstream of the sourc area (ERM 1.8) two beds of ash overlie a bed of gravely mud at a depth of 30-40 cm. At ERM1.2 depostis of an ash/sediment mixture are interbedded with three organic mat layers. A near-surface organic mat caps a thick ash/sediment mixture, which in turn, overlies a bed of laminated ash at ERM 1.0. The bed of ash/sediment mixture thins to <25 cm at the confluence with the Clinch River. Deposits on the submerged Emory River terrace downstream of the source area are relatively thin (~20cm) and are capped by or incorporated into an organic mat. In the Clinch River the ash is typically found in surface deposits mixed with sediment, ranging in depth from 15 cm thick at the mouth of the Emory River to ~10 cm in the lower Clinch River.

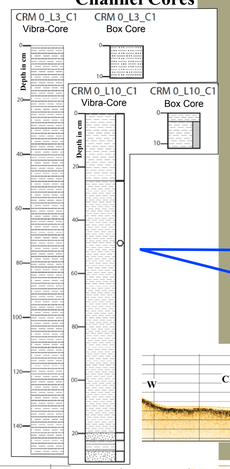
The organic mats associated with the ash deposits appear to be the result of the initial failure since they are not present upstream of the fly ash deposits and, with one exception, are not present in the older lake sediment. During the December 2008 release, a large seiche several meters in height is reported to have ripped across the submerged terrace east of the failure. This terrace is only 1-2 meters below the lake level and the seiche could have eroded organics from the terrace surface and surrounding shoreline. Flow in the Emory River was diverted across this terrace when the fly ash filled the former river channel west of the terrace. These organic mats are cohesive interwoven layers of foliage and woody debris and could protect the underlying ash deposits from erosion during future high flows in the river. The dispersed lenses of ash on the river bed and on submerged terraces are limited in volume, but could be easily transported downstream in future high flows.

Clinch River

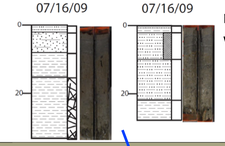
Terrace Cores

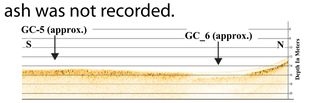


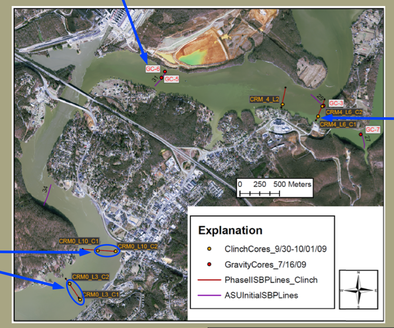
Channel Cores



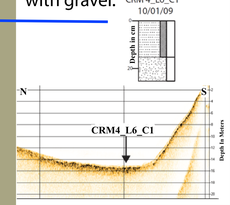
Eight cm of ash was recorded in core GC-6. Note that the profile shows a transparent seismic facies filling a channel incised into older deposits at core GC-6. The channel bottom is characterized by a diffuse medium amplitude seismic reflector at core GC-5 where ash was not recorded.

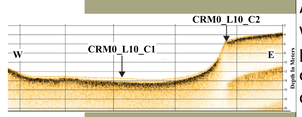


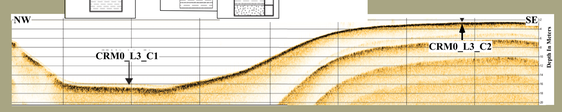




Two vibra-cores in the Clinch River channel only recovered 15 cm of ash over sandy mud with gravel.



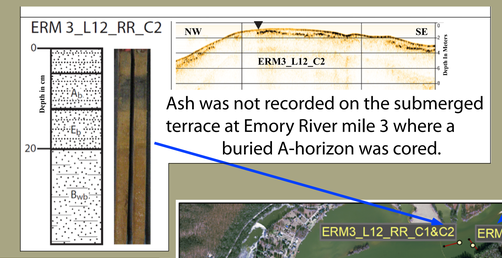




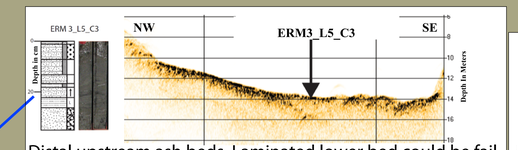
Ash occurs as an unconsolidated ash/sediment mixture with laminations and inclusions of pure ash in surficial deposits of the lower Clinch River. Vibra-coring does not recover the upper strata, but cored through two beds of an organic mat on the terrace at CRM0_L3_C2. The upper organic mat is interpreted to be associated with the recent release, but the lower organic mat is an older deposit.

Lenses of ash occur in isolated settings throughtout the river in box cores and Eckman dredge samples.

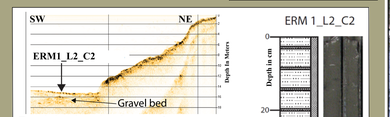
Emory River



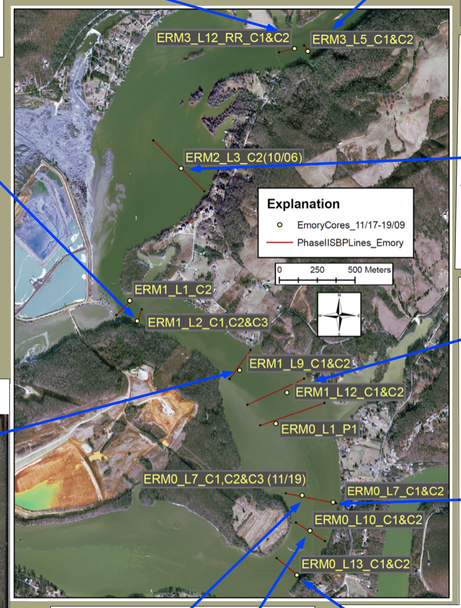
Ash was not recorded on the submerged terrace at Emory River mile 3 where a buried A-horizon was cored.

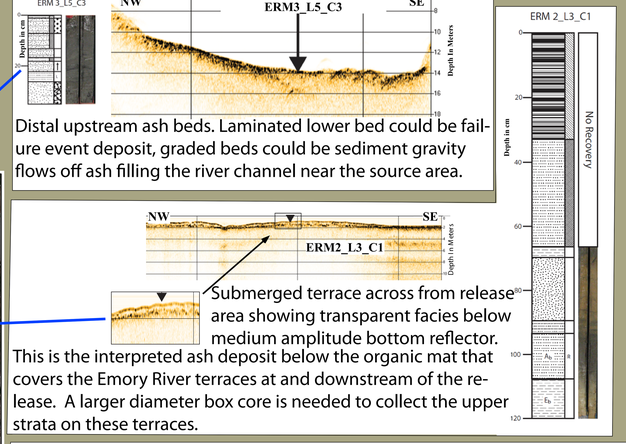


Distal upstream ash beds. Laminated lower bed could be failure event deposit, graded beds could be sediment gravity flows off ash filling the river channel near the source area.



Bedded ash deposits over a gravel bed downstream of the source area. Upper 40 cm is unconsolidated (soupy) and susceptible to erosion and transport. Lower ash bed has a very stiff consistency. Uncertain if gravel bed represented by subsurface reflector on seismic profile is base of ash deposits.

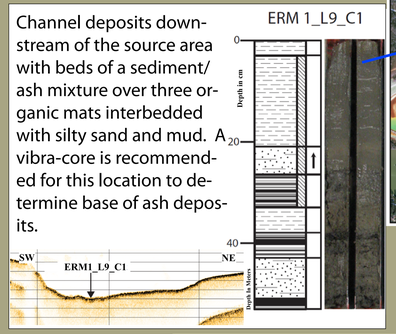


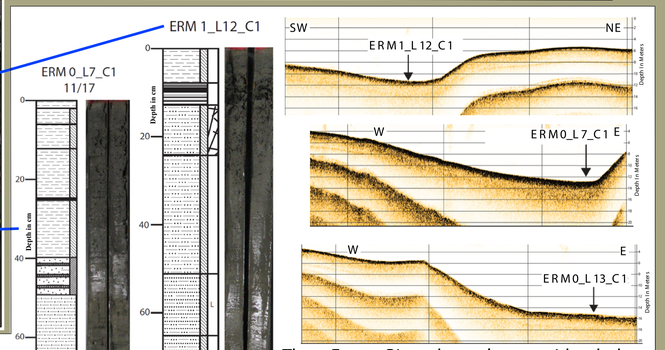


Submerged terrace across from release area showing transparent facies below medium amplitude bottom reflector.

This is the interpreted ash deposit below the organic mat that covers the Emory River terraces at and downstream of the release. A larger diameter box core is needed to collect the upper strata on these terraces.

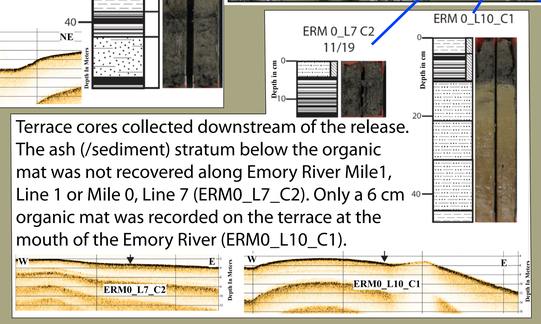
Channel deposits downstream of the source area with beds of a sediment/ash mixture over three organic mats interbedded with silty sand and mud. A vibra-core is recommended for this location to determine base of ash deposits.





Three Emory River channel cores with ash deposits thinning with distance from the source. An organic mat was cored in the upper portion of core ERM1_L12_C1. Base of ash deposits could be indicated by laminated ash bed in cores ERM0_L7_C1 and in top of ERM0_L13_C1. This bed of laminated sediment is similar to the base of the ash deposits north of the source area described in core ERM3_L5_C3.

Terrace cores collected downstream of the release. The ash (/sediment) stratum below the organic mat was not recovered along Emory River Mile1, Line 1 or Mile 0, Line 7 (ERM0_L7_C2). Only a 6 cm organic mat was recorded on the terrace at the mouth of the Emory River (ERM0_L10_C1).



Summary

1. Continuous ash deposits extend 1 mile upstream and 3.5 miles downstream of the source area.
2. A significant volume of organic material was introduced into the Emory River as a result of the release. This organic detritus is deposited as mats interbedded with and capping the ash deposits.
3. Discontinuous lenses of ash extend several miles upstream of the release and downstream into the Tennessee River.
4. Sediment gravity cores in combination with box cores are effective at collecting the stratigraphic record of ash deposits less than 80 cm thick in the Emory River channel and throughout the Clinch River.
5. Vibra-cores, sediment gravity cores and box cores are necessary to assess thicker ash deposits in areas proximal to the release.
6. Coring ash deposits on submerged terraces of the Emory River have not been successful. A larger diameter coring device such as a Kasten box core will be required to sample these strata.