

Annual Report Summary

Period Covered by the Report: Jan 1, 2002 to Dec 31, 2002

Date of Report: Jan 24, 2003

Title: Resolution of sedimentation rates in impacted coastal environments using ^{137}Cs and ^{210}Pb markers: Dog River and Fowl River embayments.

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Research Category: SGER

Project Period: Jul 1, 2000 to Dec 31, 2003

Objective(s) of the Research Project:

This project seeks to determine sedimentation rates for multiple sites on Dog River and Fowl River using the technique of high-resolution gamma-ray spectrometry. The sampling sites have been chosen to allow different tributaries of Dog River to be compared regarding the degree to which development in western Mobile County has affected run-off sedimentation in the river.

Progress Summary/Accomplishments:

This year's activities have focused on the continuing gamma-ray analysis of sediment cores as well as grain-size analysis of the sediment from selected cores. The cores were previously extracted from six sites on Dog River and its tributaries. Four sites were in the main channel of the river: near its mouth (site DRA), upstream of the mouth (site DRB), at the mouth of Moores Creek (site DRC), and downstream of Luscher Park (site DRD). The two sites in tributaries were in Rabbit Creek (site DRE) and Hall's Mill Creek (site DRF). In Fowl River, cores were taken from three sites extending from upstream of the Fowl River Bridge (site FRA) to well upstream of the Bellingrath Estate (sites FRB and FRC). Finally, cores were extracted from two sites (CVA and CVB) in Converse Reservoir (Big Creek Lake) to provide a contrasting sediment environment to the two rivers. Duplicate archival cores were taken at each site. The cores were extruded and sliced into 2-cm samples (1-cm for the Converse Reservoir cores) and air-dried.

Gamma-ray analysis of the samples from the cores was performed using a high-purity germanium (HPGe) spectrometer system. Low-background radiation shielding is used with the spectrometer to minimize radiation from the surroundings to overwhelm the low-level radiation in each sample. Each sample was counted for 54000 seconds (about 15 hours). Cores from all six Dog River sites, one of the Fowl River sites, and one Converse Reservoir site have been analyzed for ^{137}Cs . The analysis of these eight cores has required measuring the ^{137}Cs gamma-ray emission from approximately 300 sample slices. One Converse Reservoir core and two cores from Fowl River remain to be analyzed.

An unnormalized yield of ^{137}Cs can be obtained for each core slice from the number of ^{137}Cs gamma-rays counted in a fixed time divided by the dry mass of each sample. A depth profile of the yield of ^{137}Cs then allows the 1954 horizon to be determined as the depth of the onset of ^{137}Cs . Such a depth profile is provided in Figure 1 for core DRE1. Preliminary results from the ^{137}Cs analysis are provided in Table 1. It can be readily seen that accumulation and sedimentation rates in Dog River are noticeably higher at the mouth of Moores Creek (DRC1) and in Hall's Mill Creek (DRF1), while Rabbit Creek (DRE1), which has seen less development

than the other two tributaries, is more similar to the main channel of the river (DRA1, DRB1, and DRD3) and to Fowl River (FRB1).

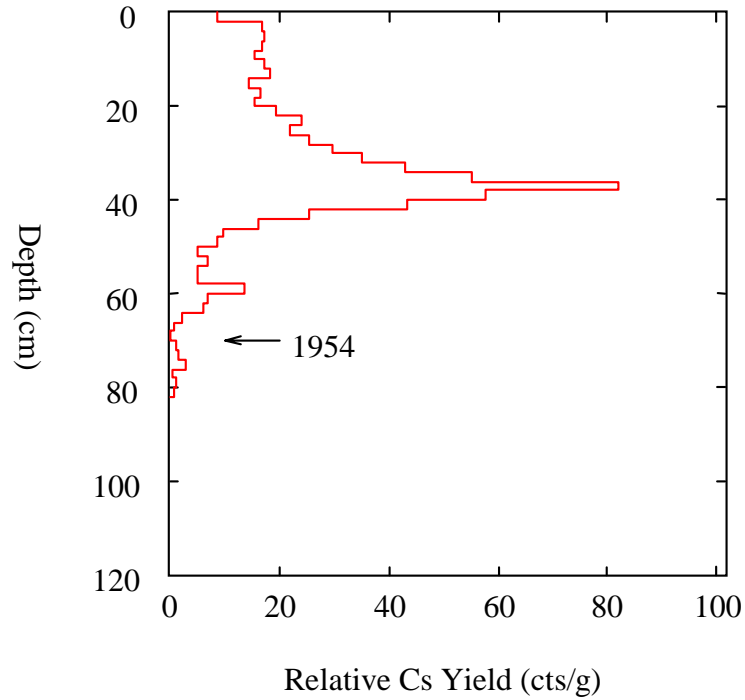


Figure 1: Cs Depth Profile for Core DRE1.

Core	Accumulation Rate (cm yr ⁻¹)	Sedimentation Rate (g cm ⁻² yr ⁻¹)
DRA1	0.72 ± 0.04	0.58 ± 0.03
DRB1	1.13 ± 0.04	0.74 ± 0.03
DRC1	2.30 ± 0.04	1.15 ± 0.02
DRD3	1.16 ± 0.04	0.43 ± 0.02
DRE1	1.40 ± 0.04	0.50 ± 0.02
DRF1	1.94 ± 0.08	1.07 ± 0.03
FRB1	1.06 ± 0.04	0.36 ± 0.02
CVA1	0.26 ± 0.02	0.17 ± 0.02
CVB1	0.21 ± 0.02	0.27 ± 0.03

Table 1: Average Accumulation and Sedimentation Rates

Grain-size analysis has also been performed on cores DRC1, DRD3, DRE1, DRF1, and FRB1 following gamma-ray analysis. Since ¹³⁷Cs preferentially binds to clay in sediment, knowledge

of the clay content of the sediment will help in the more detailed interpretation of the ^{137}Cs depth profiles. Figure 2 presents a grain-size histogram from a typical slice. It can be readily seen that silt and clay are the primary constituents of this particular slice, and consequently it would be expected that this slice is representative of one in which ^{137}Cs is effectively bound.

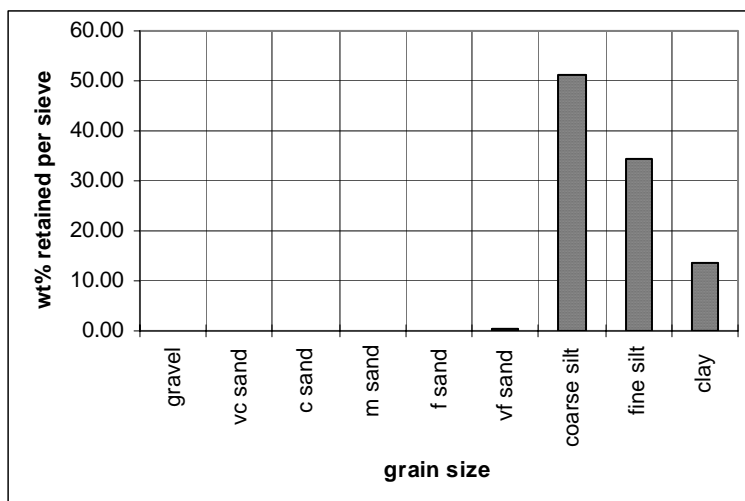


Figure 2: Grain Size Histogram, Core DRF1, sample interval 2-4 cm.

Publications/Presentations:

USA/USM Mini-conference on Undergraduate Research in the Mathematical Sciences, Mobile, AL, Apr 5, 2002, (invited lecture): "Use of Gamma-ray Spectroscopy for Radioactive Dating", J.M. Sanders.

USA Research Forum, Mobile, AL, Apr 9, 2002, poster presentation: "Gamma-ray analysis of sediment cores from Dog River and Fowl River, Mobile county, AL", J.M. Sanders, M.D. Williams, A.J.K. Pearce, D.W. Haywick, and M.L. Fearn.

Seventeenth International Conference on the Application of Accelerators in Research and Industry, Denton, TX, Nov 12-16, 2002: "Undergraduate Research Projects in Atomic Collisions and Gamma-ray Spectroscopy", J.M. Sanders, S.L. Varghese, D.W. Haywick, and M.L. Fearn. A paper, upon which this presentation was based, will be published in the peer-reviewed proceedings of this conference in 2003.

Some results from this work formed part of the following presentations:

Ninety-eighth Annual Meeting of the Association of American Geographers, March 19-23, 2002, Los Angeles, CA: "Estuarine Paleoecology: a Study of Weeks Bay, Alabama", Dr. Miriam Lee Fearn, Jennifer H. Hathorn, Chuck Stapleton, Dr. Douglas Haywick, and Dr. Justin M. Sanders.

Seventeenth International Diatom Symposium, August 25-31, 2002, Ottawa, Canada: "Estuarine Paleoecology: a study of Weeks Bay, Alabama," C.A. Stapleton, M.L. Fearn, D. Haywick, and J.M. Sanders.

Future Activities: Continuation and completion of the ^{137}Cs analysis and completion of ^{210}Pb analysis will be the major goals of the project. Correlation of the results of grain-size analysis with the ^{137}Cs analysis will also be performed.

Supplemental Keywords:

Relevant Web Sites: Web sites that reflect related research and publications associated with the principle investigators are:

<http://www.usouthal.edu/geography/haywick/weeksbay.htm>

<http://www.usouthal.edu/geography/fearn/research.htm>

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