

## **Final Report Executive Summary**

**Period Covered by the Report:** Jan 1, 2002 to Dec 31, 2003

**Date of Report:** Mar 31, 2004

**EPA Agreement Number:** R827072-02

**Title:** Resolution of sedimentation rates in impacted coastal environments using  $^{137}\text{Cs}$  and  $^{210}\text{Pb}$  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.

### **Summary of Findings:**

Sedimentation rates have been determined from cores extracted from six sites on Dog River and its tributaries, from Fowl River, and from Converse Reservoir (Big Creek Lake). In Dog River, 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.

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). The analysis of the ten cores has required measuring the  $^{137}\text{Cs}$  gamma-ray emission from approximately 500 sample slices. An unnormalized yield of  $^{137}\text{Cs}$  can be obtained for each core slice from the number of  $^{137}\text{Cs}$  gamma-rays counted in a fixed time divided by the dry mass of each sample. A depth profile of the yield of  $^{137}\text{Cs}$  then allows the 1954 horizon to be determined as the depth of the onset of  $^{137}\text{Cs}$ . Results from the  $^{137}\text{Cs}$  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 and FRC1). The relatively high sedimentation rate at the mouth of Fowl River (FRA1) may be attributed to scouring in the vicinity of the coring site. Generally, for both Dog River and Fowl River,

accumulation rates in the undeveloped portions are slightly more than 1 cm/yr, while for the lake environment of Converse Reservoir, the accumulation is only 0.23 cm/yr.

Core	Accumulation Rate (cm yr <sup>-1</sup> )	Sedimentation Rate (g cm <sup>-2</sup> yr <sup>-1</sup> )
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
FRA1	2.02 ± 0.04	0.99 ± 0.03
FRB1	1.06 ± 0.04	0.37 ± 0.02
FRC1	1.06 ± 0.04	0.37 ± 0.03
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**

**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, invited talk: “Undergraduate Research Projects in Atomic Collisions and Gamma-ray Spectroscopy”, J.M. Sanders, S.L. Varghese, D.W. Haywick, and M.L. Fearn.

USA Research Forum, Mobile, AL, Apr 24, 2003, poster presentation: “Determination of Sedimentation Rates in Dog River and Fowl River, Mobile county, AL, using Gamma-ray Analysis”, J.M. Sanders, S.J. Oset, C.D. Gunn, D.W. Haywick, and M.L. Fearn.

2003 Annual Meeting of the Geological Society of America, Seattle, WA, Nov 3, 2003, poster presentation: “Sedimentation Rates in Marginal Marine Environments in Southern Alabama”, D.W. Haywick, M.L. Fearn, and J.M. Sanders.

J.M. Sanders, S.L. Varghese, D.W. Haywick, and M.L. Fearn, “Undergraduate Research Projects in Atomic Collisions and Gamma-ray Spectroscopy”, in J.L. Duggan and I.L. Morgan, eds., *Application of Accelerators in Research and Industry*, American Institute of Physics Conference Proceedings **680** (2003), 847-850.

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

Ninety-eighth Annual Meeting of the Association of American Geographers, Los Angeles, CA, March 19-23, 2002.: “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.

**Supplemental Keywords:** gulf coast, ecological effects

**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>

### **Acknowledgments and disclaimers**

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