Younger Dryas Impact Study

Mentor: Dr. Malcolm LeCompte
MyAsia Reid (ECSU), Leroy Lucas (MVSU), Devina Hughes (MVSU)

Abstract—**The events precipitating the dramatic, millennial long climatic cooling known as the Younger Dryas, that occurred approximately 13,000 years ago remain a mystery. Recent evidence suggests an extraterrestrial impact on the Laurentide ice sheet may have provided the trigger for a massive influx of fresh glacial melt water theorized to have flooded the North Atlantic and shut down the Thermohaline circulation that moderates climate in the northern hemisphere. The apparent absence of an easily identified impact crater has focused the search for evidence of an impact on a search for extraterrestrial markers embedded in the Earth's sedimentary record.**

Association of an impact with coincident reduction in the numbers of megafauna species and human population of North America has suggested a strategy for the search for evidence of the impact. If an impact is responsible for initiating the onset of the Younger Dryas, the ultimate disappearance of megafauna species and the decline in human population, then the evidence should lie at the sedimentary boundary (YDB) separating the Younger Dryas from the preceding Bolling-Allerod at a depth corresponding to 12,900 years before present.

Some of these evidential markers (magnetic grains and spherules, charcoal, and glass-like carbon) were relatively easy to extract and identify while others (nano-diamonds and fullerenes) required great care, expensive instrumentation and considerable training. Fortunately, the vessels (carbon spherules) containing the more challenging markers were identified and extracted during the soil processing for magnetic spherules and charcoal. The research project also included an investigation of local paleo-lake depressions known to harbor impact markers and whose stratigraphy could have revealed a clearer understanding of the processes that shaped the coastal topography during the Younger Dryas. The research was carried out using a combination of Ground Penetrating RADAR (GPR) and sample coring to probe the subsurface deposits of selected depressions.

I. Introduction

About 12,900 years ago there was a mass extinction of mammals, and the Clovis culture due to an impact called the Younger Dryas. The Younger Dryas might have been an impact of a fragmented comet or asteroid that exploded in the atmosphere, ignited fires, and filled the atmosphere with soot and dust which resulted in the "nuclear winter" effect. The evidence lies in the 50 known Clovis sites which contain dark organic deposits, also known as "black mats" which mark the end of the Clovis era. The black mat contains charcoal, soot, carbon spherules, magnetic spherules, and many other elements that suggest an impact.

Assumptions have been made about the formation of the Carolina Bays. Most experts stereotypically point to fluvial, the rivers deposition of sand and dirt and Aeolian, wind depositions. However hydrological processes and pedigenesis would prove different results to the formation of the current surface. Pedigenisis is the process that modifies the grounds surface erosional depositions.

The purpose of the Younger Dryas impact team is to investigate the Carolina Bay's by the means of coring, using the Ground Penetrating Radar to survey then examine the bays stratigraphy; ultimately perform sedimentary geology processing for carbon and magnetic spherules.

Carbon spherules appear from the sources of burning vegetation which are described as the "floating fraction" in our experiment. However, magnetic spherules are founding elements that are not found on earth's surface which understood to be the "sinking fraction" This "sinking fraction" may hold the answer to our search for nano-diamonds. Nano diamonds are the possible correlation of an impact that suggests a different formation of the Carolina Bays.

In brief, soil processing is the method used to differentiate the soil's composition to further investigate the possible answers to the mass extinction during the Younger Dryas.

II. Procedure

A. Materials

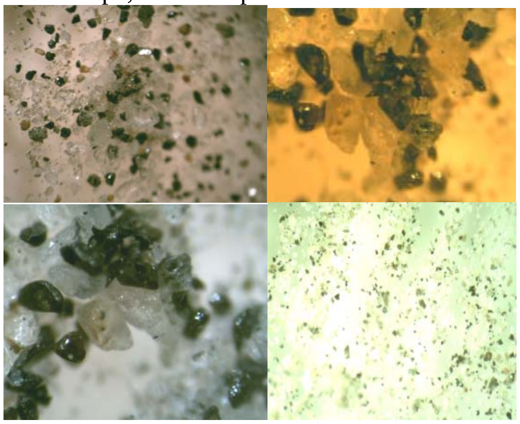
In order to make our soil processing successful, we have to have the right materials. (Fig. 1)

Item:

- 1.Super Magnets
- Hefty plastic bags
- Coffee Filters
- Large Buckets
- Small Bucket
- Microscope
- Vaseline
- Metal Chute
- Soil Samples

B. Soil Sampling

1. Chesapeake Bay, MD (Sample # 1)
The first sample to be processed was sample 1 of the four samples. This processing was a practice procedure. After processing the samples, we analyzed the samples under the microscope, and took pictures of the sediment found. (Fig. 2)



2. Miles Point MD (Samples # 1-4)
The second set of samples to be processed was four different layers of soil from a bank in Miles Point, Maryland. In this set of soil our goal was to see if it contained carbon spherules, magnetic spherules, and hopefully nano diamonds. There were a total of four collections of soil that needed to be processed. (Fig. 3)

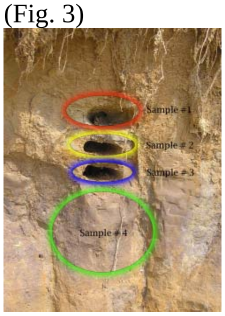


Fig. 3

The soil samples were weighed respectively, before a process was started. (Fig.4)

Sample	Total Mass (grams)	Depth in. (cm)	Magnetic Mass	Magnetic Fraction
1	263.5	22.5 (57.15)	<0.01	Trace*
1	185.5	24.5 (62.23)	<0.01	Trace*
1	258	26.5 (67.31)	0.01	.00004
1	467.5	27-37 (68.6-94)	0.03	.00006

*Trace- barely measurable.

The Magnetic Fraction was calculated by taking the Magnetic Mass divided by the total mass.

The first step to processing sticky or clay sediment is to add adequate water to each sediment sample to create a slurry and to put it aside for a few days (Fig. 5)

Fig.5

We are looking for Magnetic Microspherules, which are less than 150 mm (the size of the filter), so we use the magnet to catch them. The sediment was then poured into a filter, and then transferred into another bucket (Fig. 6)

Fig. 6

The magnet, tightly stretched in a hefty Ziploc bag, was then immersed in the mixture (Fig. 7). NOTE: The magnet should be moved slowly and gently, otherwise water action will dislodge the smallest grains.

Fig. 7

The magnetic fraction was then drawn from the magnet. (arrow) (Fig. 8) The bag, magnet, and grains were then immersed in a second container of clean water. Then the magnetic grains were released from the magnet into the water by withdrawing the magnet from the bag (Fig. 9)

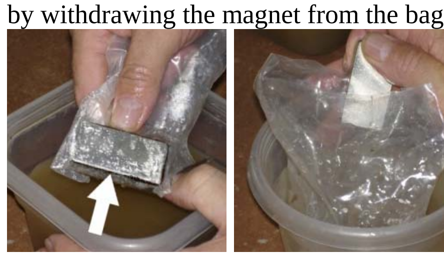


Fig. 8 & 9

The above steps were repeated until only minimal additional grains were extracted. Next, in order to separate excess dirt from the magnetic grains, the bag and magnet were used to retrieve the magnetic fraction from the second container (Fig. 10).

Fig. 10

After removing the magnet, the wet grains stuck to the bag and were transferred onto a small plate. (Fig. 11)

Fig. 11

After Drying, the magnetic fraction was weighed, catalogued, and analyzed.

C. Extraction of Magnetic Fractions

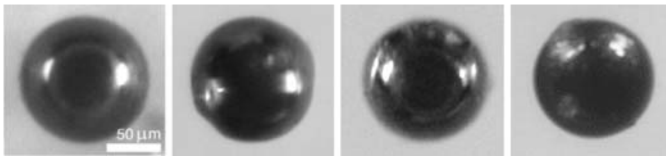


Fig. 12 Typical magnetic spherules

To find microspherules, the magnetic fraction was extracted as described above. To identify the maximum microspherules, we nearly always found it necessary to clean the magnetic fraction with water, as outlined in 1B) above.

One or more ~100-200 mg aliquots of the magnetic fraction were separated and weighed.

To find spherules, we dusted the magnetic grains lightly across a microscope slide (Fig 14), being careful to avoid leaving dense clusters of grains, which made it difficult to distinguish the spherules. A white background makes it easier to locate the spherules.

Fig. 14

D. Extraction of Carbon Spherules, Glass-like Carbon, and Charcoal

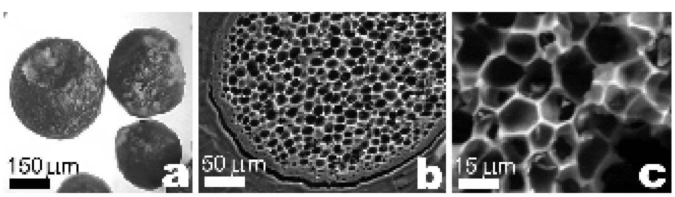


Fig. 15 Carbon spherules

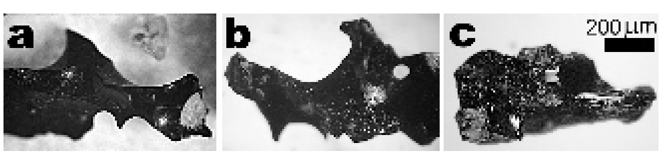


Fig. 16.Glass-like carbon

Carbon spherules have a low specific gravity, and water floatation was used to separate them. Ample water was used for dilution, and the slurry was agitated to free the floating fraction (arrows, Fig. 17).

Fig. 17

The floating fraction was captured with a filter (Fig 18).

Fig. 18

The floating fraction was placed onto a plate to dry (Fig 19).

Fig. 19

This was repeated until the entire floating fraction was removed.

Then, to recover the less buoyant fraction of carbon that did not float, the remaining slurry was rinsed and agitated repeatedly. This stratified the sediment and brought the remaining non-floating carbon fraction to the surface of the sediment sample, but beneath the water. Obvious carbon, which included charcoal and glass-like carbon, was separated manually.

III. Analysis of Indivisual Soil Samples

A. Impact Markers

The markers that were revealed our analysis of samples (particularly Sample 4, straddling the YDB at greater than 26.5 inches depth) extracted from Miles Point, on the Chesapeake Bay, near St. Michaels, MD included:

1. Scorched magnetite, pre-fossilized wood fragments (Fig. *20)*

Fig. 20

Magnetite impregnated and nearly fossilized wood fragments that appear to show some evidence of scorching to the point of becoming charcoal (Sample 3-1 SMCBMD is from layer 3)

2. Charcoal fragments (Fig. 21)

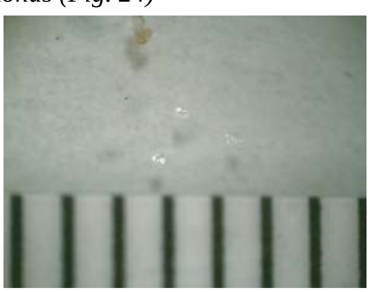
3. Glass-Like Carbon fragments (Fig. 22)

4. Carbon Spherules (Fig. 23)

Fig. 23 (close up)

Carbon Spherules (probably droplets of melted tree sap) in a variety of colors ranging from pearl to dark gray. (Sample 4 SMCBMD carbon spherule, dark gray with glass like carbon and perhaps a nano-diamond also in the photo.)

5. Nano-diamonds (Fig. 24)



Nano-diamonds presumably created in an environment of intense heat and pressure (Sample 1 SMCBMD diamond extract 2scale shows 3 such nano-diamonds with a millimeter scale)

1. The floating (or most buoyant since it didn't actually float) fraction was extracted by pouring the sample mixed in a bucket of water through a coffee filter into another bucket. From this fraction of the sample we extracted:
a. Carbon spherules
b. Charcoal
c. Glass-Like Carbon

Each of these were indicative of a very high temperature forest fire.

2. To discover the magnetite impregnated wood, a neodymium super magnetic (N=52) was used to extract any magnetic fraction from the sample. Instead of finding magnetic spherules, scorched wood was found (to the point of some fragments being charcoal) , impregnated with magnetite.
Scorched wood is also indicative of a forest fire, but impregnated with magnetite could be the result of the fossilization process of a extraterrestrial impact (trees near the Tunguska Siberia impact were impregnated with magnetite spherules.

3. To extract the nano-diamonds from the remaining sample, sample 1 was drained (the only one not discarded) down a chute coated with Vaseline. The surfaces of Diamonds are too smooth to become water-wet while the rest of the sample was wet. Oil and water don't mix, so any diamonds in the slurry (fraction plus water) flowing down the chute would get stuck in the Vaseline. Very hot water flowing down the chute into an empty bucket freed the nano-diamonds by dissolving the Vaseline. The last bucket contained only diamonds and some contaminants.
Nano-diamonds are among the primary products and markers directly indicative of an extraterrestrial impact.
Any fragment or marker light enough (markers 2-5) to float or be carried by the wind is typically found throughout the sediment layers and is not confined to that containing sample.

4. Only the largish fragments of scorched wood were confined to the sample 4 layer.

IV. Ground Penetrating Radar

A. What is the Ground Penetrating Radar?

The Ground Penetrating Radar Ground-penetrating radar (GPR) presents numerous advantages over conventional soil and sediment explorations methods such as pits, cores, and trenches. GPR provides high resolution and continuous profiles of the subsurface. GPR involves the transmission of high frequency electromagnetic energy into the ground and measurements of the time for this energy to travel to a subsurface discontinuity and reflect back to the surface.

B. Location

1) Fayetteville, North Carolina

Ground Penetrating Radar (GPR) was used to reveal buried features within the interior of the ancient Kimball Bay located in Fayetteville, North Carolina. The Ground Penetrating Radar Transects was taken through high grass across the cemetery, on the rim of the Carolina Bay where the locations (Fig. 21) images were recorded. (Fig. 22)

The Kimbel Bay was chosen, because it is one of the known bays to have impact markers extracted of the sediment. The GPR showed its stratigraphy, but the results were inconclusive.

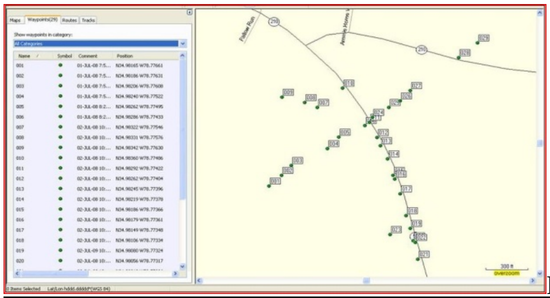


Fig 21

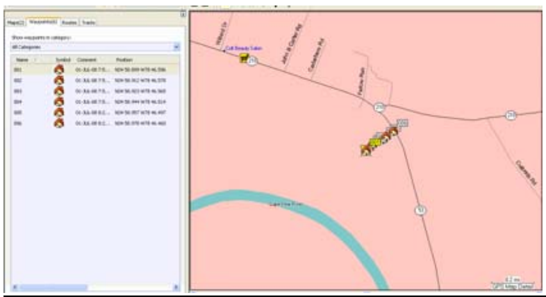
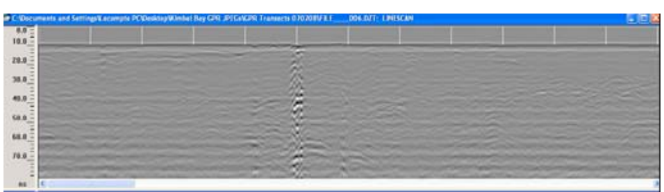
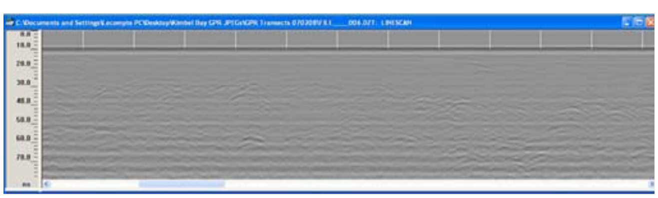
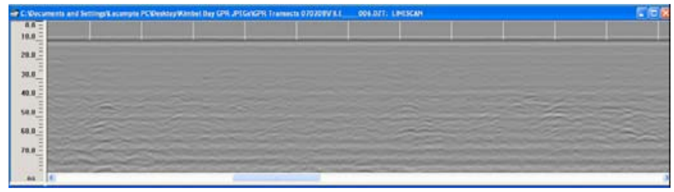


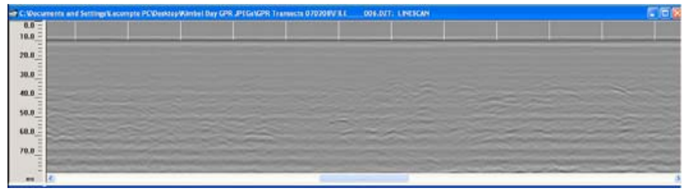
Fig 22

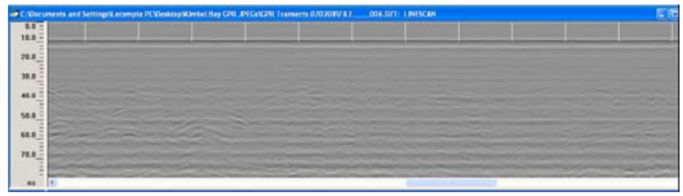
Below are GPR images of transects 1-8 (Fig. 23)

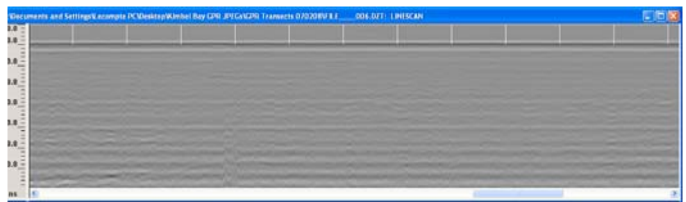


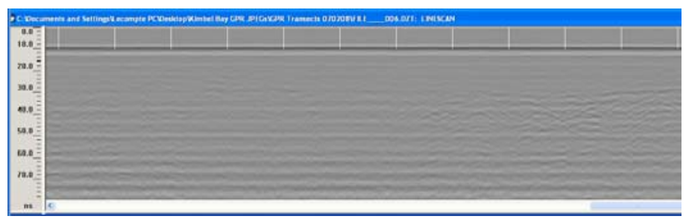


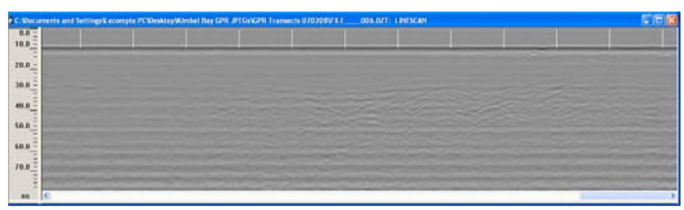












V. Coring

A. *Kimball Bay, North Carolina*

The purpose of coring was to get the full vertical sedimentary profile of 126 inches underground. We know the markers came out of the Kimbel Bay, so we collected soil samples to process in our future work. We were also going to analyze the GPR stratigraphy of the Kimbel Bay, but due to a flat tire, it'll be completed in our future work also.

VI. Conclusion

The hypothesis that the Younger Dryas (YD) was triggered by an (extraterrestrial) ET impact appears to be confirmed by our results. Our research revealed a number of constituents that support the comet impact hypotheses from soil samples extracted from the bank of the Chesapeake Bay at Miles Point, MD. Most of these constituents, including charcoal, glass-like carbon, carbon spherules (possibly melted tree sap), and scorched wood fragments suggest major forest fires preceded the YD cooling. The carbon spherules were discovered in all the samples, while the rest of the markers were concentrated in samples 3 and 4.

Magnetite discovered embedded in the scorched wood fragments may have been a direct result of the impact or normal mineralization due to the process of fossilization. Magnetite spherules were found embedded in downed trees at the site of the Tunguska, Siberia impact in 1908. The Tunguska event that happened in 1908 burned over 2,150 square kilometers (830 square miles) of trees.

Samples of the Miles Point scorched wood fragments have been forwarded to Dr. Barry Rock at the University of New Hampshire for further testing to determine whether or not the wood fragments are pre-fossilized.

Microscopic examination revealed traces of nano-diamonds in soil samples 3 and 4, which are direct evidence of an ET impact.

Taken together these markers suggest that a significant environmental calamity occurred 12,900 years ago with many of the expected characteristic side effects characteristic of an ET Impact.

VII. Future Work

We have collected many more soil samples than we can analyze within an 8-week period. Remaining for future researchers to analyze are all the soil core samples that we have collected from Kimbel Bay. We would also like to process and analyze the stratigraphic soil samples that we collected from Eure Farm, Cross Neck Road, Hertford, NC. There also remain four GPR transects done at Kimbel Bay that have yet to be examined. A short list of future work to be accomplished is as follows:

- Continue analysis of GPR data from Kimbel Bay.
- Processing and analyzing stratigraphic soil samples collected at Eure Farm, Cross Neck Road, Hertford, NC.
- Processing and analyzing stratigraphic soil core samples collected at Kimbel Bay.
- Collection and analysis of stratigrahic soil samples from at or near Miles Point, MD.
- More GPR surveys of Carolina Bays.

VIII. Acknowledgment

The Younger Dryas Team thanks Dr. Linda Hayden for making the URE Program in Ocean and Marine Science Possible, Dr. LeCompte for being a great mentor, and pushing us along the way, David Kimbel for allowing us to use our equipment on their property, George Howard for video tapping us during our GPR and Coring Process, Allen West for sharing his research about the impact that had taken place, and allowing us to use his studies to create a research project. Bob Langenburg for letting us use his camera to take wonderful pictures to document our research, Suntzu, our mentors dog who traveled with us, and the audience who attended our presentation.

References

[1] Curtis, Erin. “Clovis in the Southeast Conference 2005”. Mammoth Trumpet. Vol. 21. No.2, pp. 1-3 12. 2006.

[2] Ellis, C., A.C. Goodyear, D.F. Morse, and K.B. Tankersley. “Archaeology of the Pleistocene-Holocene Transition in Eastern North America. “ Quaternary International, Vol.49/50 pp.151-166. INQUA/ Elsevier Science Ltd. 1998

[3] Firestone, R.B., A. West, J.P. Kennett, L. Becker and others. “Evidence for an Extraterrestrial Impact 12,900 Years Ago that Contributed to the Megafaunal Extinctions and the Younger Dryas Cooling.” Proceeding National Academy Sciences. Vol. 104 No. 41, pp. 16016-16021. 2007.

[4] Forman, Steve. “Luminescence Dating of Quaternary Sediments, New Methods for Dating Archaeology Components.” Mammoth Trumpet, Vol. 18 No. 3, pp. 10-13. 2003.

[5] Goodyear, A.C. “Evidence of Pre-Clovis Sites in the Eastern United States” PaleoAmerican Origins: Beyond Clovis, pp.103-112. Re-edited 2005.

[6] Goodyear, A.C. “Recognizing the Redstone Fluted Point in the South Carolina PaleoIndian Point Database.” Current Research in the Pleistocene, Vol. 23, 100-103. 2006.

[7] Goodyear, A.C. “The Early Holocene Occupation of the Southeastern United States: A Geoarchaeological Summary.” Ice Age Peoples of North America. Re-edited 1999.

[8] Kawamura, K., Ozawa, S., and Endo, H. “Volume expansin of glass-like carbon upon high temperature heat treatment.” Elsevier, Vol. 41 No.1 pp. 191-194. 2003.

[9] Largent, Floyd. “The Clovis Comet, Part I: Evidence For a Cosmic Collision 12,900 Years Ago.” Mammoth Trumpet, Vol. 23 No.1, pp. 1-4. 2008.

[10] Marshall, Eliot. “PreClovis Sites Fight for Acceptance.” Science Vol. 291, pp. 1730-1732. 2001.

[11] Szuch, Ryan Paul. 2004. “Application of Ground Penetrating Radar to Map Stratigraphy of a Drained Carolina Bay and Aid its Wetland Restoration.” Soil Sci. Raleigh. 2004